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Theory of inquiry learning arrangements. Research, reflection, and implementation

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Research, Reflection, and Implementation

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This is a place from which to see the unexplored,
to come together as we reach the peak,
to think of things as if they could be otherwise.

Maxine Greene, *Variations on a Blue Guitar*

CONTENTS

Preface

Directive instruction in institutionalized learning settings is still prevalent, as well as the disposition towards heteronomy that is widely observable in contemporary society and media culture. Fostering a self-determined, inquisitive mind is, therefore, highly desirable and should be given priority. The authors of *Theory of Inquiry Learning Arrangements. Research, Reflection, and Implementation*, consequently, regard the constructs of self-determination and Inquiry Learning as promising concepts. The Theory of Inquiry Learning Arrangements (TILA) concretizes these concepts according to the precepts of a critical multiplism. The effectivity of TILA is scrutinized via the personalized concepts AuRELIA (Authentic Reflective Exploratory Learning and Interaction Arrangements) and CrEEd (Criteria-based Explorations in Education). These concepts are presented in detail, empirically investigated, and underpinned with practical examples.

In Part I of this volume (Chapters 1–4), the theoretical framework of TILA as well as its corollary pragmatic concepts AuRELIA and CrEEd are presented in detail. Further, a summary of research which has been carried out in order to evaluate Inquiry Learning based on TILA, AuRELIA, and CrEEd is given. In the concluding chapter of Part I, the theoretical considerations are rounded off with a review of a project of scale development. The Criteria of Inquiry Learning Inventory (CILI) is introduced to the interested reader and offered to practitioners and researches as a useful tool to evaluate their own endeavors at self-determined Inquiry Learning Arrangements according to the discussed theory.

Part II represents a collection of empirical studies based on CrEEd and AuRELIA. Chapter 5 discusses the application of the CrEEd concept in the context of education of student teachers of English. This qualitative study gives insight into how the Criteria and Principles of Inquiry Learning unfolded in the participants' points of view. Chapter 6 also reflects on the benefits and challenges of CrEEd in a qualitative-empirical way, and with a focus on its application in student teacher training in English as a Foreign Language (EFL). The authors of Chapter 7 reflect on the relevance of Principles of Inquiry Learning in the course of a CrEEd arrangement within a university tutorial for student

teachers. The results of their qualitative analysis allow the establishment of action inducing conclusions, which are also presented in this chapter. Chapter 8 describes a quantitative study employing the AuRELIA concept. It explores the application of a self-determined Inquiry Learning arrangement in the field of mathematics didactics and shows the effectiveness of the concept with regard to the special self-efficacy of student teachers concerning the realization of inquiry-based learning arrangements. Chapter 9 returns to a qualitative approach and discusses the results of a case study of the *Autonomous Weeks* where student teachers experienced self-determined Inquiry Learning within a period of two weeks in the course of their teacher training. The final chapter of Part II presents a quasi-experimental study about the impact of AuRELIA in the field of teaching physics. Significant results are presented, suggesting that AuRELIA is an appropriate teaching concept for lower secondary school, triggering intrinsic motivation, involvement with educational content in physics, and perceived self-determination of girls aged 11–14 years.

In Part III of this volume, four authors discuss TILA in relationship to other theories or concepts. Chapter 11 addresses approaches like critical multiplism and viability check. In Chapter 12, a cultural-historical perspective is outlined by discussing compatibilities between the theory of expansive learning and TILA, as well as potentials of reciprocal support on various levels. In Chapter 13, TILA is critically compared with inquiry-based science education. Closing Part III of this book, Chapter 14 introduces a novel conceptual framework for Musical Inquiry Learning, which is theoretically affiliated with TILA.

Part IV contains a short reflective paper (Chapter 15) written by the developer of TILA, CrEEd, and AuRELIA. The paper comprises a set of commentaries on the various empirical and theoretical contributions presented in Part II and Part III, as well as further implications for the implementation of TILA and its corollary concepts. Further, this closing chapter intends to recall the very mission of this book by emphasizing its dedication to self-determination and acknowledging all its supporters.

It is worth mentioning that the Chapters 3–14 of this volume went through a double blind peer review process. Chapters 1 and 2 represent revised reprints of peer reviewed original articles.

If *Theory of Inquiry Learning Arrangements. Research, Reflection, and Implementation* at least at one point or another has the effect that institutionalized learning settings once more turn into a personally meaningful, authentic, and autonomous experience for learners, as well as for educators, the major objective of its editors and authors will have been achieved.

Johannes Reitinger
Christina Haberfellner
Eric Brewster
Martin Kramer

Part I

Introducing the Theory of Inquiry Learning Arrangements

1 An Overview of the Theory of Inquiry Learning Arrangements (TILA)

Johannes Reitinger
Christina Haberfellner
Gudrun Keplinger

TILA according to Reitinger (2013) represents a general theory of Inquiry Learning Arrangements, which has already been published in German research literature. The theory refers to self-determined inquiry in autonomy-oriented learning arrangements at schools or at university colleges of teacher education and is now, after a phase of empirical research, ready for international and interdisciplinary discussion. The article at hand[1] elucidates the theoretical framework of TILA, which consists of three frame constructs (definitional frame construct, action-orchestrating frame construct, organizational frame construct). It also reveals the theory's connection to Self-Determination Theory (SDT), Dewey's educational principles, constructivism and neuroscience.

Keywords: inquiry learning, criteria, principles, theoretical constitution

1 Introduction

In Europe, Inquiry Learning has been implemented into higher education and teacher training in recent years by means of various concepts, projects and prototypes (Aulls & Shore, 2007; Roters, Schneider, Koch-Priewe, Thiele, & Wildt, 2009; Beer & Humer, 2011). Research which accompanied these implementation endeavors has helped to enhance the theoretical frameworks which form the basis of Inquiry Learning. Despite the structural and contentual diversity of these current approaches, all of them have substantially contributed to the specification of what Inquiry Learning means over the past years (Littleton, Scanlon, & Sharples, 2011).

1 This article represents a revised and supplemented version of a paper published in the Online Journal R&E Source: Reitinger, J., Haberfellner, C., & Keplinger, G. (2015). The Theory of Inquiry Learning Arrangements (TILA). R&E-Source. *Open Online Journal for Research and Education, 4*(2), 78–90.

The framework of self-determined Inquiry Learning which is introduced in this article also provides an example of such evidence-based development of theory (Reitinger, 2013). By outlining the Theory of Inquiry Learning Arrangements (TILA), Reitinger made an attempt to conflate the earlier roots of Inquiry Learning coined by Dewey(1933) with recent findings from motivational psychology (Ryan, & Deci, 2004; Reeve, 2004) as well as arguments derived from the German *Bildungstheorie* (scholarly debate of the issue of *Bildung*; cf. Benner, 2011; Klafki, 1999).

2 Self-determined Inquiry Learning

Advocates of the German Bildungstheorie state that the main purpose of education is to encourage human beings to act in a self-determined and responsible manner (Klafki, 1999). Hence, learners should be allowed to contribute to their own learning processes by autonomously putting forward their demands, proposing hypotheses, promoting their own ideas and suggesting strategies for action. Moreover, teachers and coaches reveal their own competence to act in a self-determined manner by reflecting and questioning their own dispositions, intentions and routines in order to escape the dictate of untrue and inhibitory presuppositions. According to modern motivational psychology (Ryan & Deci, 2004), neuroscience (Roth, 2009), and Dewey's theory of inquiry (1938), self-determined action is inherently anchored in every human being's mind. Autonomy-supportive Inquiry Learning in particular seems to be part of human nature, as Messner (2009, p. 22) argues. Depending on the stage in one's cognitive development, this holds particularly true for different forms of complexity, i.e., sensory tangible discovery, systematic exploration, and methodological scientific activity (Moegling, 2010, p. 100).

Reitinger (2014) succeeded in defining six criteria of self-determined Inquiry Learning by reflecting and conflating these transdisciplinary approaches. A basic description of these criteria will be given in the following section.

2.1 Criteria of Inquiry Learning – the Theory's Definitional Frame Construct

Based on the theoretical frame described in this treatise, Inquiry Learning is characterized by six criteria. In other words, it is argued that an endeavor can be classified as Inquiry Learning if the following criteria are met.

(1) General Discovery Interest. Inquiry Learning is triggered off by some general interest. This curiosity which facilitates Inquiry Learning is rooted in the innate cognitive-emotional structure of every individual (Kashdan et al., 2009, pp. 987–988). Therefore, it may emerge directly by itself or may also be provoked and sustained by interesting conversations, experiments, different media, contradictory contents, or extraordinary learning environments.

(2) Method Affirmation. Inquiry Learning cannot be ordered or forced to happen, as this would be contradictory to the authenticity of the autonomous learning pro-

cess. Approval of the individualized self-determined learning approach is, therefore, a crucial constituent of the disposition of the participating learners and a decisive determinant in the learning process. According to Seyfried (2002), this agreement concerning the applied method between learners and teachers can be reached by collaborative and demand-oriented negotiation.

(3) Experience-based Hypothesizing. Inquiry Learning includes the acts of hypothesizing and making assumptions. Learners do not only pose questions, they also make suppositions concerning probable answers. These presumptions are then argued critically, based on personal experiences, reflected, and eventually verified or falsified as a result of the reflection of the output of the explorations. In this process, the learning experience can be integrated into the learning continuum and linked with personal preknowledge and individual subjective concepts. Therefore, it is likely to become more memorable (Reitinger, 2013).

(4) Authentic Exploration. Exploratory actions in self-determined Inquiry Learning Arrangements are marked by autonomy, authenticity, and collaboration (Reeve, 2004). Hence, the discovery of suitable ways in which explorations can take place is controlled by the learners themselves and supported externally by coaches or teachers who cater for the learners' individual needs and who act primarily on demand (Seyfried, 2002).

(5) Critical Discourse. Reflecting on Inquiry Learning experiences includes more than presenting and discussing the results. Therefore, participants discuss their performance in the whole learning process as well as personal meaningful contexts which may have been examined (Reich, 2010, pp. 60–63). Hence, Critical Discourse represents an opportunity to check the viability of drafted inquiry perspectives as well as already found answers to open and personally relevant questions (Patry 2001, p. 74; 2014). Critical Discourse also plays an important role in a more rationalistic context. According to Patry (2008), not just pure evidence but arguments represent the core of scientific rationality (p. 136). He claims that arguments include not only evidence but also theoretical premises, paradigmatic orientations, and moral judgements. In the sense of Dewey (1938; cit. by Phillips & Burbules, 2000, p. 31), arguments are rather warranted assertions than propositions of truth. In reference to Inquiry Learning, Critical Discourse may serve as a room for the collaborative generation of such "warranted assertibility" (Patry, 2008; Dewey, 1941).

(6) Conclusion-based Transfer. Demonstrating one's competence (Elliot, McGregor, & Thrash, 2004, p. 361) by transferring the findings and discoveries (i.e., through publication, application) rounds off the phase of exploration and denotes personal value regarding the Inquiry Learning process which has just been undergone. Moreover, passing on, applying and transferring the acquired knowledge seems to be a logical and meaningful, and, therefore, also indispensable, action in all kinds of authentic researching and exploring processes.

However, these criteria are not understood as dichotomous attributes of Inquiry Learning Arrangements that have to be fully possessed. Instead, they are of a continual nature and can evolve to various degrees. That is to say, the higher the number of criteria met and the more fully the evolvement, the more intensive the Inquiry Learning process.

In sum, these six criteria represent the *Definitional Frame Construct* of Inquiry Learning and enhance the understanding of the process concerning several aspects: (a) reference to these criteria helps to provide a more precise definition of Inquiry Learning, (b) the criteria create a link between the theoretical framework of Inquiry Learning and actions (practice of learning), (c) a differentiation of the term Inquiry Learning by means of clearly defined criteria eases the access for empirical work in the field, and (d) the criteria provide an orientation for practitioners when outlining, performing, and reflecting Inquiry Learning arrangements.

Recapitulating the previously mentioned references and criteria, we define Inquiry Learning as a process of self-determined quests for discovering new contexts of knowledge and gaining insight which the inquiring learner lacked before. Thereby, Inquiry Learning evolves simultaneously into both an autonomous and structured process. This series of events encompasses various activities, ranging from holistic discovery to systematic explorations in which scientific research methodology is applied. Inquiry Learning is underpinned by two dispositions which foster the act of questioning, namely General Discovery Interest, and Method Affirmation. Additionally, four inquiry-related fields of action are characteristic of self-determined Inquiry Learning. These domains are Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, and Conclusion-based Transfer. Inquiry Learning Arrangements, therefore, are educational settings characterized by collaborative endeavors of Inquiry Learning in which these criteria unfold.

Due to the characteristics of reflective inquiry (Lyons 2010), openness, situational relevance, authenticity, self-determination, and social-reversible communication (Textor 2007, p. 38; Tausch & Tausch 1998, p. 118) among the participants (learners, teachers) in a constructivist sense, i.e. checking viability instead of directive instructing (Patry, 2001; 2014), TILA also describes a research and theory-affine approach of Inquiry Learning. In other words, Inquiry Learning according to TILA has the potential to support learners when integrating research and theory into their individual explorations (Seyfried & Reitinger 2013), which may lead to a desirable advancement of subjective theories (Gastager, Patry, & Gollackner 2015).

2.2 Principles of Inquiry Learning – The Theory's Action-Orchestrating Frame Construct

In addition to the six criteria that represent the *Definitional Frame Construct* of the theory TILA, Reitinger (2014) has ascertained six pedagogical principles of Inquiry Learning through literature review.

(1) Trust. The first principle underpins the importance of establishing rapport between learners and teachers, henceforth, referred to as inquiry coaches. Seyfried (2010, p. 33) points out that aiming to create trustworthiness serves as an indispensable basis for Inquiry Learning, if not for successful learning in general.

(2) Self-determination. Autonomy, competence-orientation, and social relatedness have been identified as crucial factors in generating intrinsic motivation (Ryan & Deci, 2004, pp. 7–8). Therefore, inquiry coaches should be fully aware of these basic needs when organizing inquiry-oriented lessons.

(3) Safety. By being present and providing guidance, the inquiry coach facilitates autonomous, collective, and safe explorations. Supplementary, methodological, material-based, and media-oriented support is given if needed or demanded by the learners (concern-orientation; cf. Seyfried, 2002).

(4) Clearness. The theoretical basis for the principle of clearness, here delineated as a construct which is claimed to support motivation, knowledge acquisition, and memorization, is provided by the fields of learning theory, didactics, constructivism, and neuroscience (Markowitsch, 2002; Roth, 2009; Reitinger, 2013, p. 53). The relevance of this principle may not seem entirely obvious in the context of Inquiry Learning Arrangements, however, as one of the oldest educational principles altogether, with no less a person than Comenius referring to it, clearness can be considered a principle of utmost importance for any kind of learning.

(5) Structuring. Connell and Wellborn (1991; cit. by Reeve, 2004, p. 194) point out that "… autonomy support and structure exist as two independent contextual variables that can be complementary and mutually supportive." Therefore, autonomy and structure are not perceived as antagonisms. Reitinger (2013, p. 61) argues that both variables play an important role within Inquiry Learning Arrangements, providing that structure is not devised by showing linear predetermination but by granting criteria-orientation and contextual guidance, and conceding responsibility for learning.

(6) Personalization. Inquiry learning involves the careful consideration of different motivations, interests, and personal capacities. The Inquiry Learning process is grounded in individualized participation. This personalization stems from activity which is considered relevant by the learner and can be organized independently. According to Schratz, Schwarz, and Westfall-Greiter (2011, pp. 25–30), personalization can be seen as the learners' individual perceptions which consequently lead to unique outcomes. Nevertheless, in the course of Inquiry Learning, the learners' activity is also embedded in a social context. Activity is discussed collaboratively and, therefore, a form of interaction that constructs social knowledge and performs cognitive development (process of internalization; Wygotsky, 1997). The consideration of this social dimension is not contradictory to a personalized and concern-oriented learning endeavour.

In general, pedagogical principles are expected to exert a beneficial effect on the learning process in order to gain recognition within the reflective organization (preparation, performance and reflection) of learning arrangements (Wiater, 2001). The relevance of the six theory-based principles of Inquiry Learning listed above has already been empirically confirmed among various groups of teacher trainees in the context of inquiry lesson organization (Reitinger, 2012; 2013, pp. 164–168).

In the context of the theoretical framework of self-determined Inquiry Learning, these six principles characterize the *Action-orchestrating Frame Construct*. In order to approach the organization of Inquiry Learning lessons on a meta-level, these principles may serve as points of orientation. As the reflective consideration of these principles has shown to be conducive to the learning process, it is, thus, recommended to guide the coaches' orchestration of Inquiry Learning arrangements.

2.3 Dimensions of Realizing Inquiry Learning – The Theory's Organizational Frame Construct

The Theory of Inquiry Learning Arrangements (TILA) combines the criteria and principles defined above. Additionally, it integrates a model to describe the organization of Inquiry Learning Arrangements. This model, published under the acronym OPeRA-Model (Outline-Performance-Reflection-Analysis-Model; Reitinger, 2013, pp. 73–78), represents the *Organizational Frame Construct* of the theory by subdividing the process of organization of Inquiry Learning arrangements into four phases:

(1) Outline. As it is hardly possible to predict the actual procedure and outcome within a widely open educational setting, the preparation and planning of an Inquiry Learning Arrangement is an open action, just like the setting itself. The preparation is rather an outlining process than one of planning. Therefore, the authors suggest using the term outline instead of the term planning when talking about the preparation of Inquiry Learning.

(2) Performance. This term delineates the actual procedures in a learning setting. The more learners are allowed to work in a self-determined manner, the more the suppositions which were contemplated while outlining the setting may vary from the actual performance.

(3) Reflection. Reflection describes the process of careful and serious consideration of the practical experiences one had during the outlining and performance process.

(4) Analysis. The three interacting phases of outline, performance, and reflection are sheltered by a meta-reflective construct called analysis. This term emphasizes that, besides the permanent reflection on outlined and performed education, a process of meta-regulation based on scientific criteria exerts supportive effect. This analytical work may include activities such as collecting and reflecting on qualitative feedback from students, involving relevant scientific literature on the organization of individual learning arrangements, asking colleagues to sit in on classes in order to take observation

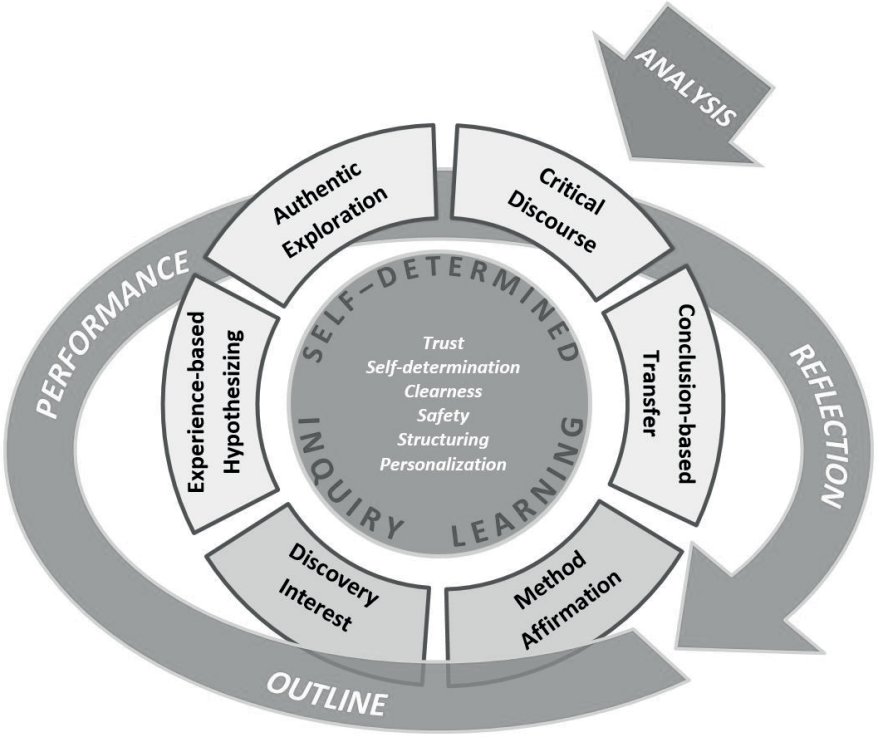
notes according to some theory-based criteria, conducting or participating in action research projects (Altrichter & Posch, 2006), or working together with other researchers to evolve collaborate innovation, etc. (cf. Corno & Randi, 1997; Naashia, 2014, p. 49). Such meta-reflective actions wield influence upon educational endeavor in the form of regulative effects, namely quasi-direct influence on actions and progressive effects, i.e., evidence based advancement of individual and general concepts.

The four-dimensional theoretical constitution of the organizational model defines essential and distinct conditions of self-determined learning settings which are generally marked with a high degree of unpredictability. Out of this, OPeRA facilitates the deduction of specific action-related devices which support the organization of highly open collaborative learning processes (action-supportive deductions; for a detailed report cf. Reitinger, 2013, pp. 75–78).

2.4 MODELING A THEORY OF INQUIRY LEARNING ARRANGEMENTS

A conflation of the three frame constructs which have been described so far, i.e., the *Definitional Frame Construct*, the *Action-orchestrating Frame Construct*, and the *Organizational Frame Construct*, constitutes the framework of TILA. Figure 1 provides a visualization of the TILA model.

FIGURE 1. *TILA – Theory of Inquiry Learning Arrangements (Reitinger, 2013)*



The interrelated constructs of TILA combine the theoretical background and practical application of self-determined Inquiry Learning Arrangements and make those better accessible to both educational theorists as well as reflective practitioners by suggesting reasoned, educationally relevant, and empirically accessible variables. The open characteristic as well as the orientation toward criteria and principles rather than defined didactic models define TILA as an approach accessible for multiple methods on various levels, e.g., methods of instruction, methods of empirical accessibility, and approaches of applied theories (Patry, 2013, pp. 50–53).

The visualization of the differences between self-determined Inquiry Learning and conventional inquiry-based learning approaches is achieved by (a) the interpretation of autonomy and structure as two independent variables, (b) the orientation toward learners' concerns, and (c) the non-linear interrelation of the criteria of Inquiry Learning, whereby the criteria are understood as indicators, not as procedural steps (cf. Reitinger, 2013, pp. 17–19, 71–81).

Hence, in view of all that has been mentioned so far, a theory-based development of practical concepts which are broadly applicable to primary, secondary, and tertiary education and further research seem to be next logical steps. The following contributions within the book at hand will deal with these intentions.

3 Discussion and Paths to Further Implementation

The treatise at hand pursues the goal of introducing a self-determination-oriented approach of Inquiry Learning by revealing its pivotal theoretical groundings and explaining its three frame constructs. Concerning future endeavors, two major paths seem to be plausible and necessary in order to make self-determined Inquiry Learning which is theoretically based on TILA, a subject matter of both international scientific discourse as well as educational practice.

The first path is to motivate more researchers to consider self-determined Inquiry Learning according to the introduced theoretical approach, an inventory which measures participants' ratings for post-interventional investigation of Inquiry Learning arrangements might be useful. Such an inventory could be used to measure the degree to which the defined criteria occur en bloc. Recent research has been conducted (Reitinger, 2015) which aims to develop and test (according to Classical Test Theory; DeMars, 2010; Devellis, 2011) such an inventory. The result obtained from this project (Criteria of Inquiry Learning Inventory; CILI) is presented within the book at hand (see Chapter 4).

As a second path to achieve effective implementation in educational practice, it will be necessary to make TILA also known among the non-German-speaking scientific community. This article represents an initial to do so.

In general, however, any ambition will be frustrated unless we succeed in fostering a participation-oriented attitude among educators. In believing that humans are inher-

ently autonomy-oriented and in trying to encourage each and every one in his or her individual development in a professional, reflective and dignified way, the paradigm of the curious, self-determined, and inquiry-oriented human being may guide us into a promising future.

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2 Inquiry Learning According to the AuRELIA Concept

Johannes Reitinger
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This treatise[1] introduces the inquiry-oriented learning concept AuRELIA (Authentic Reflective Exploratory and Interaction Arrangement). This concept is compatible with TILA and has been proven to be effective in secondary and tertiary education. Further, a summary of research which was carried out in order to evaluate Inquiry Learning based on AuRELIA with regard to the constructs *self-efficacy*, *inquiry habit of mind* and *motivation* is given. Up to now, mainly German publications on this concept have been available. This English article aims to open up AuRELIA, as well as corresponding research findings collected in recent years, to international discourse and application.

Keywords: inquiry learning arrangements, concept, authenticity, interaction

1 Inquiry Learning According to the AuRELIA Concept

The practical implementation of TILA requires autonomy-oriented and structured concepts which offer orientation for all participants in an Inquiry Learning Arrangement. A paradigmatic prototype of this guiding concept is AuRELIA (Authentic Reflective Exploratory Learning and Interaction Arrangement; Reitinger, 2013a, pp. 84–115; 2013b, pp. 18–27). The structure of AuRELIA comprises seven steps and suggests a linear array of specific phases of action which can be performed in a flexible order. The seven steps are:

(1) Emergence. The main objective of this phase is to arouse interest by involving all learners in the process of selecting their preferred content and learning style.

1 This article represents a revised and supplemented version of a paper published in the Online Journal R&E Source: Reitinger, J., Haberfellner, C., & Keplinger, G. (2015). The Theory of Inquiry Learning Arrangements (TILA). *R&E-Source. Open Online Journal for Research and Education, 4*(2), 78–90.

(2) Speculation. In this phase, participants make an attempt to specify their topics of interest. They formulate hypotheses drawing on pre-existing knowledge and following their individual cognitive pattern.

(3) Conception. The learners' and coaches' primary focus in this phase is on collaboratively outlining a suitable study design for the phase of investigation.

(4) Investigation. Learners perform what they have developed in the phase of conception. Activities include collecting information and data, carrying out explorations, and conducting experiments.

(5) Discovery. In the phase of discovery, learners organize the information they have gathered, they examine and process data, and test (or reconstruct) hypotheses.

(6) Critical Phase. This phase includes the discussion of results, reflection on experiences which learners had in the antecedent phases, updating knowledge, checking viability of outlined inquiry paths (Patry 2001; 2014), and evaluating the relevance of contexts which have gained significance for the participant in the Inquiry Learning process.

(7) Transfer. The phase of transfer is marked by procedures which finish off the Inquiry Learning process. These include the application of insights and knowledge, the publication of findings and results, or the initiation of some general or professional discourse in which ideas are made available for a wider audience.

AuRELIA takes into account the Criteria of Inquiry Learning (see Table 1).

table 1. *The Relation between AuRELIA and the Criteria of Inquiry Learning*

AuRELIA phases / **Criterion**	Emergence	Speculation	Conception	Investigation	Discovery	Critical Phase	Transfer
Discovery Interest	*	**					
Method Affirmation							
Experience-based Hypothesizing							
Authentic Exploration							
Critical Discourse							
Conclusion-based Transfer							

*) Dark gray fields mark AuRELIA-phases in which the respective criterion of Inquiry Learning primarily emerges.
**) Light gray fields relate the core phases of AuRELIA to the six Criteria of Inquiry Learning.

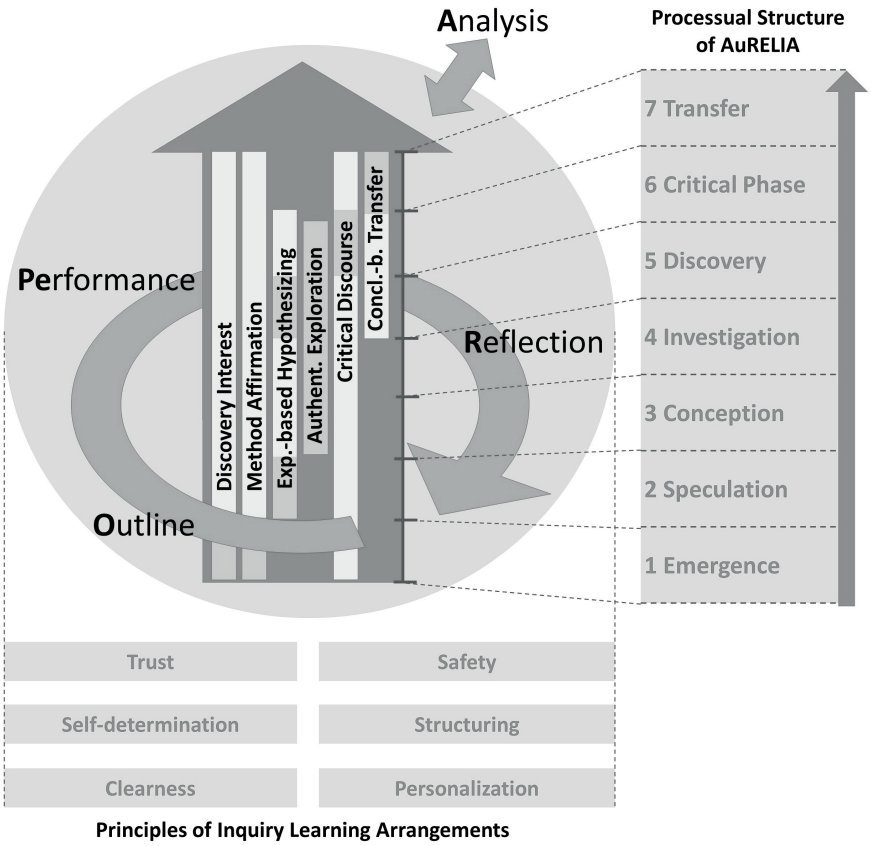
The AuRELIA concept refers to specific steps of reflective thinking and acting, namely, emotional reaction, location and definition, suggestion of possible solutions, development by reasoning and experimenting, rejection or acceptance, application, according to Dewey's Theory of Inquiry (1933; cf. Reich, 2008, p. 189), as well as the scientific-knowledge building process, i.e., thematic access, identifying hypotheses by consulting foreknowledge, designing an investigation, performance, evaluation, review, estimation of results, according to Demuth, Gräsel, Parchmann, and Ralle (2008). Table 2 gives an overview.

TABLE 2. *Theoretical Derivation of AuRELIA*

The Concept of Learning According to Dewey (1933; cf. also Reich, 2008)	**The Structure of the Inquiry Learning Process According to AuRELIA (Reitinger, 2011)**	**The Process of Knowledge Acquisition in the Natural Sciences (Demuth, Gräsel, Parchmann, & Ralle, 2008; cited after Parchmann, 2009)**
	a) ***Emergence:*** developing a personally relevant discovery interest and reaching consensus concerning the Inquiry Learning process.	*a) topic-based lead-in + information*
a) emotional response: involvement of the learners (concern) due to personally relevant context		
b) connection: establishing a connection to foreknowledge; raising awareness concerning cognitive patterns and explanatory models	*b)* ***Speculation:*** developing personally relevant questions further by connecting them to foreknowledge and cognitive models and patterns; making assumptions and formulating individual hypotheses	*b) framing questions and constructing hypotheses + applying foreknowledge*
c) hypothesis, investigation, experimentation: giving room to independent questioning and acting of the learners	*c)* ***Conception:*** collaborative planning of the exploration	*c) planning of the experimental design*
	d) ***Investigation:*** applying the conception	*d) carrying out the investigations*
d) solutions: finding solutions, here seen as procedures which help to find answers and to solve problems	*e)* ***Discovery:*** presentation of the obtained data and findings; testing of assumptions	*e) analysis and validation* *f) testing of the hypotheses by reference to the results*
	f) ***Critical Phase:*** reflecting the result; reflecting the processes; bringing to mind and developing personally relevant meanings	*g) evaluation and classification*
e) applications, practices, transfer: aiming at sustainability; impartation and application including personal attitudes	*g)* ***Transfer:*** applying; publishing (opening up the discourse to the public)	

When reflecting on the structure of AuRELIA and linking it with TILA, two shared characteristics can be identified. Firstly, AuRELIA is asserted to be a theory- and evidence-based concept. Secondly, it is shown as a self-determined concept with affiliations to authenticity, reflectivity, trustfulness, and participant-orientation. This is demonstrated in Figure 1.

FIGURE 1. *Linking the AuRELIA Concept with the Theoretical Approach TILA*



Additionally, it is marked by a high level of unpredictability concerning the performance within the various phases. Some recommendations on how this unpredictability can be met are, e.g., including the learners' wishes, demands, and concerns in the process of selecting the contents for inquiry learning settings, offering innovative learning environments, handing over responsibility to the learners, practicing continuous reflection, and having an extensive personal repertoire of internalized education techniques and micro methods available in order to react flexibly in unexpected situations (see Hauer (2014) and Reitinger (2013a; 2013b; 2013c) in order to gain further insight into the practice of AuRELIA).

2 Results of Research

Effectiveness and acceptance of AuRELIA have been the subjects of recent German publications describing the results of empirical studies which focused on Inquiry Learning (e.g., Hauer, 2014). In the following chapters a detailed description of three studies will be given which up to now has only been available in German (Reitinger, 2012, 2014, pp. 199–201; 205–207; 295–320). The presentation of the outlines of these studies aims to acquaint the English-speaking professional scientific community with the key findings from some of the latest research projects.

2.1 Outline of Study 1: Effectiveness of AuRELIA in Science Lessons in Enhancing Self-Efficacy and Extending Personal Understanding and Knowledge of Inquiry Actions

Study description and hypotheses: A quasi-experimental replication study (in German: Reitinger, 2012, pp. 125–129), which was carried out in heterogeneous lower secondary classes among pupils aged between 10 and 14 (see Table 3), investigated several dimensions of effectiveness of self-determined Inquiry Learning according to the concept AuRELIA.

Table 3. *Replication Study Design – Efficacy of AuRELIA*

Sample		**Design**			
Cohort 1 (C1)	Treatment Class (TC_C1); 13 Sts; 6th Grade	NR	O_1	X	O_2
	Control Class (CC_C1); 14 Sts; 6th Grade	NR	O_1		O_2
Replicated Cohort 2 (C2)	Treatment Class (TC_C2); 23 Sts; 7th Grade	NR	O_1	X	O_2
	Control Class (CC_C2; 20 Sts; 7th Grade	NR	O_1		O_2

The following hypotheses, referring to students (Sts) in heterogeneous lower secondary classes, were put forward:

H1: Inquiry Learning Arrangements according to the AuRELIA concept (Treatment X) enhance the general self-efficacy (Schwarzer, & Jerusalem, 1995).

H2: Inquiry learning Arrangements according to the AuRELIA concept (Treatment X) enhance the special self-efficacy concerning inquiry actions (Reitinger, 2012, p. 121).

H3: Inquiry learning Arrangements according to the AuRELIA concept (Treatment X) extend the personal understanding and knowledge of inquiry actions (ibid.).

Results: In this setting with a special focus on science lessons, the stated hypotheses were proven to be true. The statistical testing of the hypotheses was realized by means of six Mixed-Between-Within-Subjects Analyses of Variance (class * measure point; Mixed ANOVA; Field, 2009, pp. 506–538), differentiated by cohort and dependent variable (see Table 4).

TABLE 4. *Replication Study Design – Effectiveness of AuRELIA*

		General Self-Efficacy		***Special Self-Efficacy* concerning Inquiry Actions**		**Personal Understanding and Knowledge of Inquiry Actions**	
		O_1	**O_2**	**O_1**	**O_2**	**O_1**	**O_2**
C1	**TC_C1**	30.15 →	34.38	12.08 →	14.23	0.92 →	2,08
	CC_C1	28.36 →	29.07	11.86 →	12.29	1.21 →	1.29
	Sign. Test	Interaction Effect: $F(1/25) = 5.834$, $p < 0.05$, $\eta^2 = 0.189$ Main Effect: $F(1/25) = 11.538$, $p < 0.05$, $\eta^2 = 0.316$		Interaction Effect: $F(1/25) = 4.772$, $p < 0.05$, $\eta^2 = 0.160$ Main Effect: $F(1/25) = 10.691$, $p < 0.05$, $\eta^2 = 0.300$		Interaction Effect: $F(1/25) = 8.728$, $p < 0.05$, $\eta^2 = 0.259$ Main Effect: $F(1/25) = 11.184$, $p < 0.05$, $\eta^2 = 0.209$	
C2	**TC_C2**	28.71 →	30.14	10.71 →	12.48	1,67 →	3.86
	CC_C2	27.44 →	26.83	11.06 →	10.89	1.72 →	1.67
	Sign. Text	Interaction Effect and Main Effect: ns Betw.-Subj. Effect: $F(1/37) = 4.159$, $p < 0.05$, $\eta^2 = 0.101$		Interaction Effect: $F(1/37) = 8.994$, $p < 0.05$, $\eta^2 = 0.196$ Main Effect: $F(1/37) = 6.153$, $p < 0.05$, $\eta^2 = 0.143$		Interaction Effect: $F(1/25) = 6.153$, $p < 0.05$, $\eta^2 = 0.448$ Main Effect: $F(1/25) = 6.153$, $p < 0.05$, $\eta^2 = 0.423$	

The significant outcomes of the analytical testing, considering the absolute mean differences between pretest and posttest measure points (O_1-O_2), led to the conclusion that AuRELIA was effective in both cohorts. In addition, a Multivariate Analysis of Variance (MANOVA) was carried out in order to compare the differences between all mean scores of the pretest (O_1). Obtaining no significant result, the means at the time of O_1 can be interpreted in both cohorts as comparable, which adds to the validity of the study. In a final step, three Mixed MANOVAs including all three dependent variables were calculated to identify global interaction effects (class * measure point; per cohort samples and per total sample). The significant results of all three calculations (C_1: $F(1/25) = 10.604$, $p < 0.05$, $\eta^2 = 0.298$; C_2: $F(1/37) = 18.882$, $p < 0.05$, $\eta^2 = 0.338$; total sample: $F(1/64) = 27.662$, $p < 0.05$, $\eta^2 = 0.302$) suggest the effectiveness of the treatment with regard to the tested dependent variables.

In addition to the testing of the three hypotheses, students' attitudes concerning Inquiry Learning according to AuRELIA were ascertained by use of a post-interventional scale. The four rating dimensions measured by the scale were opinions on (a) the *inquiry mode* of the learning activity, (b) the *differentiated mode* of the learning ac-

tivity, (c) the *self-determined choice of inquiry questions*, and (d) the *experienced freedom* within the inquiry process. The participants' reactions to the AuRELIA-lessons in the four dimensions were measured by use of a four-part scale, from 1 ("hat mir gar nicht gefallen"[2]) to 4 ("hat mir sehr gefallen"[3]). The means of the treatment class of C1 could all be found in the upper positive half of the scale, showing the values (a) $M = 3.69$ ($SD = 0.63$), (b) $M = 3.65$ ($SD = 0.47$), (c) $M = 3.62$ ($SD = 0.87$), and (d) $M = 3.85$ ($SD = 0.56$). The analysis of treatment class of C2 reveals similarly positive ratings with the means (a) $M = 3.45$ ($SD = 0.47$), (b) $M = 3.19$ ($SD = 0.87$), (c) $M = 3.86$ ($SD = 0.36$), and (d) $M = 3.71$ ($SD = 0.64$).

2.2 OUTLINE OF STUDY 2: EFFECTIVENESS OF AURELIA IN TEACHER EDUCATION IN THE DEVELOPMENT OF AN INQUIRY HABIT OF MIND

Study description and hypothesis: In a two-week blocked study phase which had been outlined according to criteria and principles of the Theory of Inquiry Learning as well as the seven phases of AuRELIA, 19 Austrian teacher trainees at a teacher training college individually and autonomously delved into various topic areas, all of which were represented in the curricula for teacher training. The students could choose their fields of exploration freely and independently. Two accompanying inquiry coaches neither set operationalized learning objectives, nor predetermined specific material to work with. They took the role of a professional learning companion who was available on demand.

According to Reitinger (2014, pp. 205–207; publication in German), the research interest in the accompanying study focused on the influence of the treatment on the habit of inquiry (Deluty, 2010). This construct describes a research-affirming attitude which is based on open-mindedness and reflectivity (Dewey, 1938). Thus, an inquiry habit of mind finds expression in the appreciation of deep understanding under the premise of diversity of perspectives (Earl, & Katz, 2002). It manifests itself in the posing of profession-relevant questions, in choosing reflective and inquiry-oriented approaches, and in consulting theoretical frameworks and scientific methodologies in the context of professional activity and problem-solving.

The study hypothesis, referring to first-year teachers trainees who voluntarily participated in the project, reads as follows:

H: Inquiry Learning according to the concept AuRELIA enhances the *inquiry habit of mind* of participating teacher trainees.

The hypothesis was examined by conducting a one-group repeated-measuring design, including five phases of data pooling (five measuring points: O1, O2, O3, O4, and O5) at intervals of one week. The treatment phase (the two-week blocked AuRELIA study

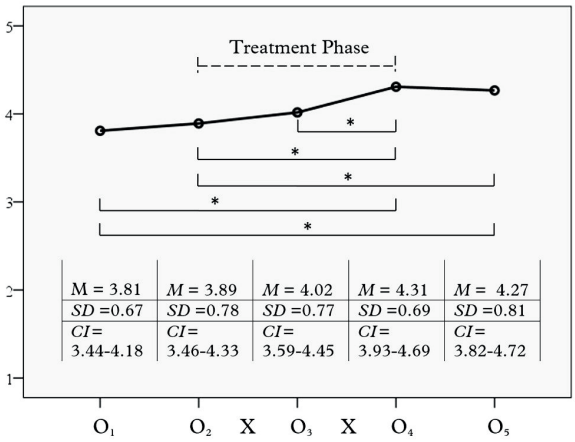
2 "did not like at all"

3 "liked a lot"

phase) took place between measuring points O2 and O4. The time spans between O1 and O2 as well as O4 and O5 were defined as reference phases (research design: see x-axis caption of graph in Figure 2).

Results: The construct inquiry habit of mind was made quantifiable in the questionnaire by use of eight items and a five-part scale which covered degrees of agreement, from 1 ("stimme gar nicht zu"[4]) to 5 ("stimme voll zu"[5]). Details are given in Reitinger (2014, p. 206). Figure 2 shows the results of the repeated-measure survey.

FIGURE 2. *Development of Inquiry Habit of Mind – Repeated Measures*



A One-factor Repeated-measure Analysis of Variance (ANOVA) reveals a highly significant main effect ($F(1/4 = 8.504$; $p < 0{,}001$; $\eta^2 = 0.378$). Alpha-error corrected paired comparisons (Bonferroni Correction; Field 2009, p. 373) indicate multiple significant contrasts (O1–O4; O1–O5; O2–O4; O2–O5; O3–O4), indicating effectiveness of the treatment.

2.3 OUTLINE OF STUDY 3: EFFECTIVENESS OF AURELIA IN TEACHER EDUCATION IN PERCEPTION OF COMPETENCE, EFFORT, AND ATTRIBUTION OF VALUE

Study description, research questions, and hypothesis: The scholarly interest of this study (reference publication in German: Reitinger, 2014, pp. 199–201) focused on how educators rated the relevance of experiences gained in Inquiry Learning Arrangements according to the concept of AuRELIA with regard to *motivation*. For this purpose, a rating scale was used which included three dimensions of motivation, namely (a) *perceived competence*, (b) *effort*, and (c) *attribution of value*. Items to measure the three dimensions were derived from the Intrinsic Motivation Inventory (IMI: Ryan, 1982, p. 450;

4 "I strongly disagree."
5 "I fully agree."

McAuley, Duncan, & Tammen, 1989) and were used in their original English form. Data was collected from two groups of educators who demonstrated different degrees of professional practice concerning Inquiry Learning Arrangements. Group 1 (G1; $N = 27$) comprised second-year teachers trainees of an Austrian teacher training college. All 27 students participated in Inquiry Learning according to the concept of AuRELIA within the framework of a seminar entitled "New Learning Cultures". Group 2 (G2; $N = 18$) was composed of Austrian primary and lower secondary school teachers. The theoretical structure of AuRELIA was presented to the 18 teachers in an in-service training course which also took place at an Austrian teacher training college. Following this, they outlined and accompanied Inquiry Learning according to AuRELIA at school with their primary (aged 6 to 10) and lower secondary (aged 10 to 14) school pupils. The research questions and the examined hypothesis were:

Q1: To what extent do student teachers experience a) *competence*, b) *effort*, and c) *attribution of value* when participating in teacher training seminars based on AuRELIA?

Q2: To what extent do primary and lower secondary teachers experience a) *competence*, b) *effort*, and c) *attribution of value* when organizing (outlining, performing, reflecting) AuRELIA learning settings for their pupils at school?

H: There is a difference in how a) *competence*, b) *effort*, and c) *attribution of value* are rated depending on whether a person participates in or organizes AuRELIA.

Results: As mentioned earlier, the dimensions a) *competence*, b) *effort*, and c) *attribution of value* were measured by means of item arrays taken from the Intrinsic Motivation Inventory (IMI). The seven-part scales of the IMI range from 1 ("not at all true") to 7 ("absolutely true"). The results showed high ratings of all three dimensions of *motivation*. The calculated means as well as the confidence intervals (CI), all situated in the positive half of the scale, indicate high affirmation of the dimensions of *motivation* in the investigated contexts of experience (participating and organizing Inquiry Learning according to the concept AuRELIA). This is shown in Table 5 ($M < 4$).

TABLE 5. *Comparison of Ratings of a) Competence, b) Effort, and c) Attribution of Value*

	G1; Participating Students			**G2; Organizing Teachers**		
	M	*SD*	*CI*	***M***	*SD*	*CI*
Competence	**5.42**	0.84	5.09-5.75	**5.89**	0.72	5.53-6.25
Effort	**4.67**	1.09	4.23-5.10	**6.17**	0.79	5.78-6.56
Value	**5.62**	0.91	5.26-5.99	**6.42**	0.70	6.07-6.76

A comparison of Group 1 (G1; participating students) and Group 2 (G2; organizing teachers) revealed the fact that all three average ratings of G2 (organizing teachers) are higher than the means of G1. Three alpha-error corrected *t*-tests (independent *t*-tests;

inferential statistical tests for comparison of two groups) showed that these differences are significant in the dimensions *effort* and *attribution of value* (*competence*: $t(43) = -1.953$, ns, $r = 0.285$; *effort*: $t(43) = -5.018$, $p < 0.017$, $r = 0.608$; *attribution of value*: $t(43) = -3.137$, $p < 0.017$, $r = 0.432$; p adjusted according to Bonferroni Correction). The high effect sizes calculated according to Field's r (2009, p. 332) indicate practical relevance of the discovered differences. Non-parametric tests (Mann-Withney-U-Test; consulted due to missing normal distributions within the dimensional scores) arrive at the same conclusion (*competence*: ns; *effort*: $p < 0.017$; *value*: $p < 0.017$). Hence, hypothesis H could be proven true for the dimensions *effort* and *attribution of value*.

3 Discussion and Paths to Further Implementation

The three studies outlined in this article provide conclusive evidence of *effectiveness* of the concept AuRELIA. In these quasi-experimental research endeavors, the concept's positive influence on *self-efficacy*, *motivation*, and *inquiry habit of mind* has been conclusively demonstrated. These outcomes underpin the relevance of TILA, despite the limitations of research. Especially the results of the empirical studies which focus on *self-efficacy* and *motivation* clearly illustrate the legitimacy of the action-orchestrating frame construct represented in the principles of Inquiry Learning (e.g., trust and self-determination). The result concerning teacher trainees' development of an *inquiry habit of mind* when participating in AuRELIA relates to the area of (meta)reflection of (prospective) inquiry coaches. AuRELIA, therefore, appears to be suitable to fundamentally support the development of student teachers' dispositions, and the evidence suggests that engaging with the concept will help them to assume the role of inquiry coaches in their later professional life.

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3 Criteria-based Explorations in Education: Introduction to the CrEEd Concept

Johannes Reitinger

The introduction of CrEEd (Criteria-based Explorations in Education) at hand describes the pivotal characteristics of this concept of self-determined Inquiry Learning. Thereby, it clarifies the theoretical reference to the *Theory of Inquiry Learning Arrangements* (TILA). Further, a review of research on CrEEd is given. The contribution closes with a prospect of opportunities for appropriate application and empirical accessibility.

Keywords: inquiry learning arrangements, concept, meta-intentional action

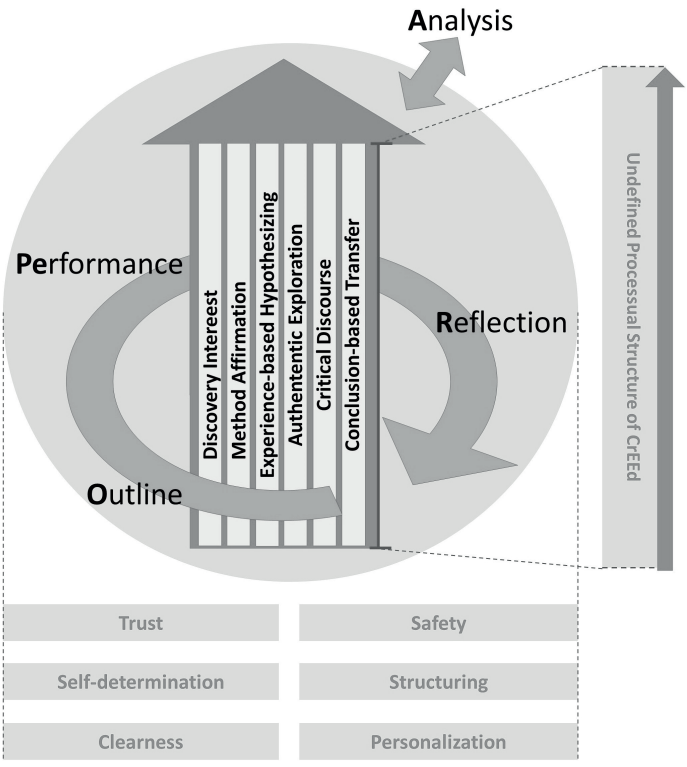
1 The Theoretical Foundation of CrEEd

Criteria-based Explorations in Education (CrEEd) (Reitinger, 2013a, pp. 116–131) is neither a specific educational methodology nor an explicitly phased approach to inquiry lessons. Rather, CrEEd can be interpreted as an experimental practice-oriented approach following a meta-intention derived from the Theory of Inquiry Learning Arrangements (TILA). This meta-intention is addressed to teachers, so-called inquiry coaches, and amounts to the best possible unfolding of the Criteria of Inquiry Learning within a learning arrangement. Thereby, CrEEd does not predetermine any kind of methodology or specific strategy to achieve this goal. Through these means, CrEEd facilitates the involvement of an unconfined range of methods and media in the sense of unbounded self-determination (Ryan & Deci, 2004) and critical multiplism (Patry, 2013), not just on the part of the learners but also the teachers. This characteristic makes CrEEd an experimental approach and enables organizational, contentual, methodological, and social openness for all participants (Peschel, 2003). However, CrEEd by no means is an arbitrary concept because decisions of the inquiry coach as well as of the learners are not taken in a haphazard manner. They are consequently oriented towards the six criteria

of the Theory of Inquiry Learning Arrangements (TILA; Reitinger, 2013a), which are theoretically reasoned by referring to Self-Determination Theory (Ryan & Deci, 2004), constructivism (Reich, 2010; Patry, 2014), *Bildungstheorie* (scholarly discussion of the issue of *Bildung*; cf. Klafki, 1999; Benner, 2011), neuroscience (Roth, 1997, 2003), and Dewey's (1933, 1938) everlasting pragmatic arguments. These six criteria (General Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, and Conclusion-based Transfer) represent the *Definitional Frame Construct* of TILA (see Chapter 1).

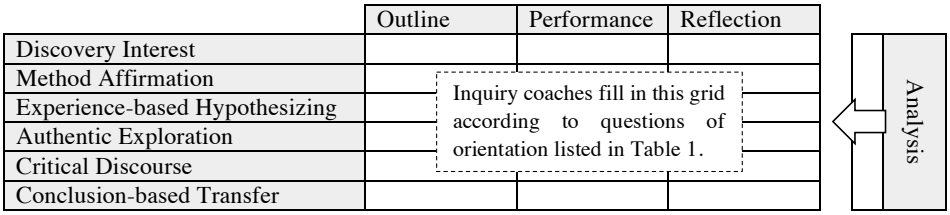
The CrEEd concept further interprets the range of possible degrees of occurrence of the Criteria of Inquiry Learning as a spectrum. It is particularly not understood dichotomously, in the sense of 'existing or not'. Hence, according to CrEEd, and even according to TILA, Inquiry Learning is not a question of a special educational phenomenon or methodology. Rather, it is a question of the evolvement of its criteria (Reitinger, 2013b, 2015b). The more the Criteria of Inquiry Learning unfold, the more Inquiry Learning occurs. The connection of CrEEd to the Criteria of Inquiry Learning is fundamental (see Figure 1).

FIGURE 1. *Linking the CrEEd Concept with the Theoretical Approach TILA*



Mention might also be made of two other relevant connections of CrEEd to further frame constructs of TILA. First, it seems to be worthwhile to consider the Principles of Inquiry Learning (*Action-orchestrating Frame Construct* of TILA) when outlining, performing, or reflecting Inquiry Learning Arrangements. Research confirms this thesis and delivers initial evidence that Trust, Self-determination, Clearness, Safety, Structuring, and Personalization are indeed supportive parameters for Inquiry Learning endeavors (Reitinger, 2012, p. 123–125, 2013a, pp. 164–168). Second, the application of the OPeRA Model (*Organizational Frame Construct* of TILA; Oyrer, Ressl, & Reitinger, 2012; Reitinger, 2013b, pp. 13–18) helps to structure a thoughtful and differentiated pursuit (see Figure 2) by structuring the Organization of Inquiry Learning into four feasible Dimensions (Outline, Performance, Reflection, and Analysis; see also Chapter 1).

FIGURE 2. *Differentiated Grid for the Organization of Criteria-based Inquiry Learning According to the OPeRA Model (Reitinger, 2013b, p. 29)*



The questions of orientation listed in Table 1 (see next page) may help the inquiry coach to organize Inquiry Learning, when referring to the differentiated grid introduced above (see Figure 2).

Nevertheless, it is difficult to predetermine to what extent the Criteria of Inquiry Learning actually unfold. This is because the intention to support the evolvement of the Criteria of Inquiry Learning or the application of the differentiated grid for the Organization of CrEEd are necessary but not sufficient conditions for success concerning this endeavor. In view of this fact, the wholehearted post-interventional, critical reflection, and analysis of the arrangement according to the OPeRA Model gains in importance because it is an essential manner to analyze to what extent the meta-intention of CrEEd could actually be realized (see Chapter 4) and, therefore, an instrument to collect important information for a thoughtful outline of future Inquiry Learning.

It remains to be added that CrEEd still possesses opportunities to check the viability of chosen exploratory paths by being widely open and unpredictable. Thoughtful and well-coached explorations as well as the steady recognition of the criterion Critical Discourse during the arrangement may dissociate CrEEd from arbitrariness and help to ensure *warranted assertibility* (Patry, 2008) about particular matters of inquiry.

TABLE 1. *The organization of CrEEd according to the OPeRA Model – Questions of orientation (Reitinger, 2015c)*

Criteria	Outline (process before performance)	Performance	Reflection (process after performance)	
General Discovery Interest	*How can I activate hidden interest concerning some relevant content?*	*What actually happened during the Self-determined Inquiry Learning Arrangement that could be associated with the criteria "general discovery interest"?*	*Was I able to help learners feel intrinsically motivated? Or: Was I able to raise my learners' intrinsic motivation?*	Analysis
Method Affirmation	*What if the learners do not want to explore in a self-determined way?*	*What actually happened during the Inquiry Learning Arrangement that could be associated with the criteria "methodic consensus"?*	*Did the learners agree with my suggestion to work in an exploratory way?*	
Experience-based Hypothesizing	*How can I motivate the learners to form questions and make suggestions/ assumptions concerning possible answers?*	*What happened during the Inquiry Learning Arrangement that could be associated with the criteria "experience-based hypothesizing"?*	*How do I feel about the questions and hypotheses of the learners?*	
Authentic Exploration	*How can I support learners to work on several tasks? Do they feel free to ask me if they need my expertise?*	*What actually happened during the Inquiry Learning Arrangement that could be associated with the criteria "authentic exploration"?*	*How do I perceive learners actions after the explorations? Do I assess those as autonomous and authentic?*	
Conclusion-based Transfer	*Which parts of my lesson could make learners wish they could apply or communicate their results?*	*What actually happened during the Inquiry Learning Arrangement that could be associated with the criteria "Perceived transfer need"?*	*Is there a real demand for applying and communicating the discoveries and results?*	
Critical Discourse	*How can I provoke thinking about the result on the learners' side, the process or the effect of the process on themselves?*	*What actually happened during the Inquiry Learning Arrangement that could be associated with the criteria "Critical Discourse"?*	*How do I interpret the reflective feedback of my learners? If there was no time for differentiated feedback, what could I do the next time?*	

2 Results of Research

In the following sections, a review of studies in regard to CrEEd will be given which up to now have only been available in German (Reitinger, 2013a, 2013b, 2015a, 2015b; Hollick & Reitinger, 2013). Outlining the key findings from some of the latest research endeavors, the ensuing descriptions aim to make recent evidence accessible for the English-speaking scientific community with regard to CrEEd.

2.1 OUTLINE OF STUDY 1: INVESTIGATION OF VARIOUS DIMENSIONS OF EFFICACY OF INQUIRY LEARNING ACCORDING TO THE CREED CONCEPT

Study description, research questions, and hypothesis: A quantitative study by Reitinger (2013a, pp. 165–180; 2013b) focused on the following research interest with a view to student teachers' organization of Inquiry Learning according to CrEEd within lessons at school (primary education, secondary education, religious education, special needs education):

Q1: How do student teachers experience the motivational dimensions perceived competence, effort, and value when organizing, e.g. outlining, performing, and reflecting, inquiry learning according to CrEEd at school?

Q2: To what extent are the Principles of Inquiry Learning (see Table 1) relevant for student teachers within the organization of CrEEd arrangements at school?

Q3: To what extent do student teachers assess Inquiry Learning concepts as generally effective?

Q4: To what extent do student teachers feel generally competent in arranging Inquiry Learning concepts?

Further, the following hypothesis was stated:

H: Regarding the estimations concerning the general potency of Inquiry Learning concepts (Q3), as well as the degree of a person's general competence in arranging Inquiry Learning concepts (Q4), there are no significant differences between estimations of student teachers from various school-related contexts (primary education, secondary education, religious education, special needs education).

The sample recruited for the investigation comprised 379 student teachers from an Austrian university college (second term of teacher education). CrEEd was introduced to them in the context of a lecture dealing with basic educational contents. After the introduction of CrEEd, the students were tasked to organize CrEEd at training schools in the context of their practical trainings. Therefore, they used the OPeRA-Portfolio (Reitinger, 2015c). This portfolio represents a form-based tool that helps to structure the organization of CrEEd according to the differentiated grid introduced above in Figure 2. All students' estimations pertinent to the investigation were ascertained with a focus on this practice-related experience.

Results: To answer Q1, three standardized scales of the Intrinsic Motivation Inventory (IMI; Ryan, 1982; MacAuley, Duncan & Tammen, 1987) were applied. The scales measuring the dimensions perceived competence, effort, and value consist of multiple retrospective items for post-interventional application, e.g., "I think I was pretty good at this activity.", "I put a lot of effort into this activity.", "I believe this activity was of some value to me.", and are assigned to a seven-fold array of possible ratings (1 = "not at all true" to 7 = "very true"). The descriptive analysis of the responses deliver mean values

of $M = 5.88$ ($SD = 0.86$) for perceived competence, $M = 6.10$ ($SD = 0.95$) for effort, and $M = 6.12$ ($SD = 0.95$) for value. These results indicate high efficacy of the treatment in terms of the investigated dimensions (cf. Reitinger, 2013b).

The relevance of the Principles of Inquiry Learning (Q2) was ascertained by six clusters of questions (4 questions per cluster), written in German. Each cluster refers to one specific principle, i.e., Trust, Self-determination, Clearness, Safety, Structuring, and Personalization (see also Chapter 1). Each question of the set of clusters represents a possible reconsideration that might be important for the inquiry coach in the course of the organization of Inquiry Learning, e.g., "Wie halte ich für das selbstbestimmte Handeln die dazu nötige Motivation aufrecht?"[1] . Each question was rated by the students according to a five-fold array ("Während der Organisation des forschenden Lernens war diese Frage für mich … 1 = …gar nicht bedeutend to 5 = …sehr bedeutend"[2]). The averaged responses per principle show high relevance of the six principles and underpin the importance of their consideration within the outline, the performance, and the reflection of Criteria-based Inquiry Learning (see Table 2; cf. Reitinger, 2013a, pp. 165–167).

TABLE 2. *The relevance of the Principles of Inquiry Learning in the course of the organization of CrEEd*

Principle of Inquiry Learning	*M*	*SD*	Internal Consistency Alpha (α)
Trust	4.08	0.71	0.83
Self-determination	4.45	0.48	0.65
Clearness	4.40	0.53	0.70
Safety	4.29	0.57	0.68
Structuring	4.10	0.56	0.62
Personalization	4.31	0.57	0.71

However, the results do not implicate that the six principles are sufficient. This might be a question for further research (cf. Oyrer & Reitinger, 2015).

Further, the investigated group of 379 students expressed that they appreciate the potency of inquiry learning in general (Q3). An array of four German-language trait items, e.g., "Forschendes Lernen schätze ich als ein im positiven Sinne wirksames Unterrichtskonzept ein."[3] , responded by declaring the degree of approval (1 = "stimmt gar nicht" to 5 = "stimmt genau"[4]), reveal a mean value of $M = 4.49$ ($SD = 0.66$).

1 Footnotes 1–6: author's translation
"How can I sustain the pupils' motivation which is necessary for their self-determined acting?"

2 "During the organization of Inquiry Learning this question was … 1 = …not at all significant / 5 = …very significant."

3 "I rate Inquiry Learning as a positively effective educational concept."

4 1 = "not at all true" / 5 = "very true"

A similar outcome can be denoted concerning Q4. The degree of a person's general competence in arranging inquiry learning concepts was also explored by using an array of four German-language items. In contrast to the construct of perceived competence investigated in the course of Q1 by using a post-interventional, retrospective scale of the IMI, the four items referring to the general competence are formulated also as traits (e.g. "Forschendes Lernen zu organisieren ist eine Herausforderung, die ich mir mit Zuversicht zutraue."[5]; 1 = "stimmt gar nicht" to 5 = "stimmt genau"[6]). The averaged score delivers a mean value of $M = 4.39$ ($SD = 0.70$).

The outcome of inferential statistics (one-way between-groups analysis of variance; Pallant, 2011, p. 250) applied to investigate the question about possible differences between students of various types of educational studies (primary education, secondary education, religion education, special needs education) concerning Q3 and Q4 shows no group-specific significances (dimension * type of educational studies; $F(1/3) = 0{,}825$; ns). Therefore, the hypothesis H, expressed as a null hypothesis, is confirmed (cf. Reitinger, 2013a, p. 180).

2.2 OUTLINE OF STUDY 2: THE RELEVANCE OF PRINCIPLES OF INQUIRY LEARNING IN THE CONTEXT OF INFORMAL LEARNING

Study description and results: A qualitative pilot study realized by Hollick and Reitinger (2013) revealed that student teachers perceive the organization (outline, performance, and reflection) of criteria-based learning arrangements as an encouraging experience supportive of their personal development of competences. This enhancement of competences occurs inter alia within informal learning processes. In this context, informal learning is understood as a kind of self-organized learning (Kirchhof 2007, p. 34) beyond curricular derived and directive instructed learning processes. Informal learning is rather unconscious or tacit (Molzberger 2007, p. 87) and arises from various occasions in practice-oriented everyday situations (cf. Hollick, 2011).

Further, the study brought to light some domains of supported competences that strongly correspond with the *Principles of Inquiry Learning*. These domains of competences are (a) structuring of inquiry learning processes, (b) trust in one's own pedagogical actions as well as trust in actions of learners, (c) diversity of perspectives concerning possibilities of one's own pedagogical actions, (d) supportive communication between teachers and learners, (e) open-mindedness, and (f) competencies to reflect personal learning processes.

Considered methodologically, this qualitative research included an inductive formation of categories according to the processual model of Mayring (2007, p. 74) and a contentual structuring by a between-case analysis according to Kuckartz (2012, pp. 93–98).

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5 The organization of Inquiry Learning is a challenge I manage with confidence.

6 1 = not at all true / 5 = very true.

Its outcomes as well as the interpretation of the categories lead to the conclusion that for the 21 participants of the study, the Principles of Inquiry Learning, especially the principles of structuring and trust, play an important action-orchestrating role while operating self-determined in inquiry learning arrangements.

2.3 Outline of Study 3: Teacher Students' Estimation of the Impact of Criteria-based Organization of Inquiry Learning Arrangements on Pupils

Study description and research question: To analyze estimations of the impact of Inquiry Learning Arrangements according to CrEEd on pupils in lower secondary schools, Reitinger (2013a) collected information from 22 student teachers (pp. 168–171) of an Austrian teacher training college. The investigated persons were all students in their final semester of their teacher education program, having just finished participating in a CrEEd arrangement at the university college as well as organizing their own CrEEd arrangement with pupils at training schools.

Within the questionnaire-based inquiry, the following dimensions of impact were focused on and requested by using eight single items: (a) pleasure in learning, (b) prolonged intrinsic motivation, (c) individual growth of knowledge, (d) reflective thinking, (e) self-efficacy, (f) competence in methods of inquiry, (g) ability to work in a team, and (h) development of individual strategies in solving problems.[7]
Results: Table 3 shows the calculated means (M), standard deviations (SD), and confidence intervals (CI) of the responses, as well as the applied scale.

Table 3: *Teacher students' estimation of the impact of Criteria-based Organization of Inquiry Learning Arrangements on behalf of pupils. Used scale: "negative" (1), "rather negative"(2), "rather positive" (3), "positive" (4)*

Single Items	*M*	*SD*	*CI*
(a) pleasure in learning	3.77	0.429	3.58–3.96
(b) prolonged intrinsic motivation	3.41	0.503	3.19–3.63
(c) individual growth of knowledge	3.68	0.477	3.47–3.89
(d) reflective thinking	3.41	0.590	3.15–3.67
(e) self-efficacy	3.41	0.590	3.15–3.67
(f) competence in methods of inquiry	3.73	0.456	3.53–3.93
(g) ability to work in a team	3.50	0.673	3.20–3.80
(h) development of individual strategies in solving problems	3.73	0.456	3.53–3.93

7 Original German wording: (a) "Freude am Unterricht", (b) "anhaltende intrinsische Motivation", (c) "individueller Wissenszuwachs", (d) "reflektiertes Denken", (e) "Selbstwirksamkeitserwartung", (f) "forschungsmethodische Kompetenz", (g) "Teamfähigkeit", and (h) "Entwicklung in individueller Problemlösestrategien".

The descriptive statistical analysis of the students' responses indicate high confidence, however, due to the limited sample size this conclusion cannot be generalized.

2.4 OUTLINE OF STUDY 4: THE EVOLVEMENT OF THE CRITERIA OF INQUIRY LEARNING WITHIN A CREED ARRANGEMENT IN COMPARISON TO CONVENTIONAL LEARNING SETTINGS IN TEACHER EDUCATION

Study description and hypothesis: The following study review deals with the question concerning the actual evolvement of criteria of inquiry learning within a CrEEd arrangement. The regarded hypothesis in this concern examined by Reitinger (2015b) was:

H: Courses in teacher education, in which the CrEEd Concept is applied, lead to a stronger evolvement of the criteria of Inquiry Learning on behalf of the students than other courses in teacher education do (referring to a randomized and representative set of courses).

To verify this hypothesis, Reitinger (ibid.) applied an English-language inventory developed to measure the criteria's evolvement with a focus on inquiry-related action domains, (pp. 615–619). This inventory called CILI (Criteria of Inquiry Learning Inventory) is currently available as a completely tested scale of 12 items with adequate statistical parameters of fit (see documentation in Chapter 4). The version used for this study review was a so-called beta-version (CILI- β; Reitinger 2015a) including 16 items. At the time of application, CILI-β was already tested by exploratory analyses, whereas confirmatory analyses were still outstanding. The items of CILI-β consist of statements concerning the evolvement of criteria of inquiry learning (e.g.: "This learning activity encouraged me to discover open questions"), associated with a seven-level rating scale (1 = "not true at all"; 2; 3; 4 = "somewhat true"; 5; 6; 7 = "very true").

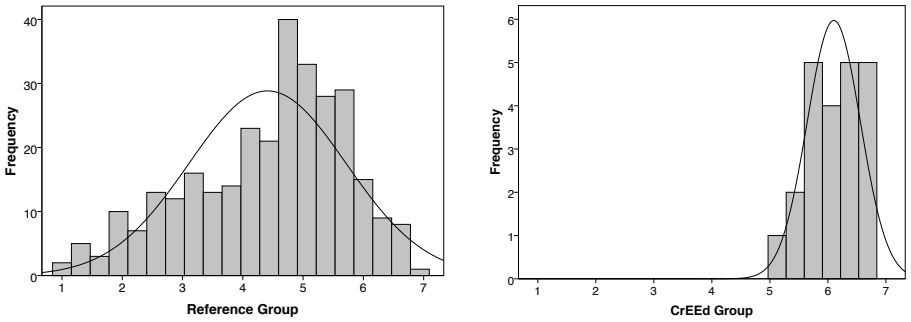
To investigate the hypothesized differences, two groups were compared. The CrEEd Group (CG) consisted of 24 student teachers of an Austrian university who participated in a CrEEd arrangement. All 24 persons had to outline their own CrEEd arrangement with pupils at training schools and could freely decide whether to conduct the arrangement in reality or not[8], which distinguishes them from to the group of students described in Section 2.3. CILI-β was offered to the CrEEd Group members online through a Unipark Survey (QuestBack, 2015), delivering 22 valid responses. As a Reference Group (RG), a normal distributed sample of 302 student was applied. Their estimations refer to a randomized set of various courses in teacher education.

Results: A descriptive comparison of the means ($M_{RG} = 4.41$; $M_{CG} = 6.10$) reveal that the CrEEd arrangement, compared with other courses in teacher education, lead to a high-

8 Twelve out of the 24 inquiry learning endeavors outlined by the students were de facto transferred into real practice (cf. Chapter 7).

er evolvement of the Criteria of Inquiry Learning (see Figure 3). A One-Sample *t*-Test denotes this difference as significant ($t(21) = 20{,}05$; $p < 0{,}001$) with a very high effect size ($r_F > 0.8$; r_F calculated according to Field 2009, p. 332).

FIGURE 3: *Comparison of the histograms and normal distributions*



The juxtaposition of the distributions of the reference group and the CrEEd Group visualizes the differences between the means as well as the standard deviations ($SD_{RG} = 1.35$; $SD_{CG} = 0.46$) of the calculated total scales (mean scale of 16 Items). In other words, within the CrEEd Group the ratings are categorically higher and, further, the deviation of the ratings is obviously lower. These visual and parametric comparisons indicate that the ratings within the CrEEd Group are quasi exclusively positioned on the positive side of the applied rating scale.

3 Discussion

As described, Criteria-based Explorations in Education (CrEEd) refer to an experimental concern-oriented modality of organizing Inquiry Learning Arrangements driven by the intention to evolve the six criteria of Inquiry Learning of TILA on behalf of the learners' perception. It seems to be noteworthy that the CrEEd concept is universally applicable, as its meta-intention is not tied to any specific context or method. Though the examples of the application of CrEEd documented in the anthology in hand (see Chapter 5 and 6) refer to institutionalized educational contexts, it is easily possible to transfer the CrEEd-specific meta-intentional acting to other social scopes, e.g. learning experiences in private rooms or continuing education within non-educational institutions. Nevertheless, especially in these fields research is pending but necessary to gain evidence of efficacy.

As a last point, it is worth mentioning that practical attempts of the widely open and unpredictable concept CrEEd require accompanying post-interventional reflection. Reflection on action, or aware critical reconsideration (Korthagen & Vasalos, 2010; cf. OPeRA Organizational Model in Chapter 1), understood as a catalyst between the

experience of the learning arrangement and clever decision-making in the context of the outline and performance of some upcoming learning arrangements may unveil hidden but important facets of the interpersonal learning endeavor. Already the simplest approach, the subjective reflection and estimation of experiences, could deliver useful information for the teacher or the inquiry coach, e.g., information concerning the actual evolvement of the criteria of inquiry learning. To define this insight more precisely, a standardized questionnaire about the learner's estimations could be helpful. As mentioned above in Section 2.4, such a questionnaire already exists and is freely available (CILI; Criteria of Inquiry Learning Inventory; see Chapter 4). Hence, the reader is invited not only to implement CrEEd in the practical field of teacher education but also to use this inventory for his or her own reflective purposes.

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4 On the Nature and Empirical Accessibility of Inquiry Learning: The Criteria of Inquiry Learning Inventory (CILI)

Johannes Reitinger

The treatise at hand[1] refers to the autonomy-oriented approach of Inquiry Learning, published under the acronym TILA (*Theory of Inquiry Learning Arrangements*). This theory focuses on opportunities and necessities of self-determination within institutionalized learning arrangements by revealing a nexus of six definitional inquiry-related criteria (General Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, and Conclusion-based Transfer; see Chapter 1 in this anthology). These criteria are discussed according to their capacity to evolve within educational endeavors. Further, this paper deals with the question of how to yield transparency concerning the conceptual evolvement of Inquiry Learning and points out the important role of post-interventional reflection (reflection on action; Schön, 1983) and analysis in this regard. The account continues with a summarizing outline of the empirical accessibility of the approach. In this context, an inventory to measure the evolvement of Inquiry Learning is introduced (CILI; *Criteria of Inquiry Learning Inventory*). The article closes with a perspective to potential uses of the regarded inventory to investigate the performance of learning arrangements in tertiary education. This inventory may also have practical relevance for teacher education as teacher trainers may use it to measure the degree of authentic and autonomous inquiry within their courses.

Keywords: criteria of inquiry learning, practice, unpredictability, inventory development

1 This paper is a translated and actualized version of a German-language publication of the author entitled "Selbstbestimmung, Unvorhersagbarkeit und Transparenz: Über die empirische Zugänglichkeit forschenden Lernens anhand des Criteria of Inquiry Learning Inventory (CILI)" (see Reitinger, 2016). Independent of the languages of the concerned publications, the Criteria of Inquiry Learning Inventory was developed in English which means that both versions (the exploratory tested CILI-β as well as the standardized CILI) are composed of anglophone items.

1 Conceptualizing the Idea of Self-determined Inquiry Learning

Self-determination has become a common term within the discourse of educational science, having been popularized by Ryan & Deci (2004) and their publications about motivational theory as well as the basic psychological needs autonomy, competence, and social relatedness. Nevertheless, several other approaches with a strong affiliation to self-determination also exist, some of them featuring a relation to the inquiry paradigm:

One of the earliest representatives of a self-determination-oriented and inquiry-related education was Dewey (1933). Dewey argued that meaningful learning starts with the location of a personally important problem. Subsequently, stages of hypothesizing, experimenting, and application characterize the Inquiry Learning process, leading to sustainable knowledge.

According to Moegling (2010, p. 100), self-determined Inquiry Learning begins in early childhood with sensory tangible discoveries. More sophisticated forms of Inquiry Learning are systematic explorations and methodological scientific activities (research). Kashdan (2010) argues that each form of Inquiry Learning is originally driven by curiosity.

Constructivism assumes that the human brain does not reproduce, but rather create reality. Communication with other learners in the form of a Critical Discourse that is free of heteronomy is necessary to discuss outcomes, processes and contexts of meanings (Reich, 2010, pp. 60–63, 2008, p. 161) as well as to check the viability of created knowledge (viability check; Patry, 2001, p. 74).

Self-determination implies the consideration of the learners' demands and needs to facilitate constructive opportunities for detection and alteration of a subjective significance and for development towards autonomous and responsible existence (principle of invitation to autonomous and dialectical thinking and acting; Benner, 2012, pp. 78–80, 2011; Klafki, 1999).

These approaches substantiate a self-determination-oriented image of personhood. They underpin the assumption that humans engage in their personal development through inquiry. They can develop if they find themselves in an autonomy-oriented and esteeming environment, free of heteronomy.

From this point of view, the question about an educational theory arises that satisfies this self-determination-oriented and inquiry-related image of personhood. The Theory of Inquiry Learning Arrangements (TILA) according to Reitinger (2013a) represents such an attempt.

1.1 THE THEORY OF INQUIRY LEARNING ARRANGEMENTS (TILA)

The framework TILA (Reitinger, 2013, pp. 186–189) synthesizes the self-determination-oriented and inquiry-related premises quoted above by conflating the earlier roots of Inquiry Learning coined by Dewey (1933) with contemporary approaches (Moegling,

2010, p. 100; Reich 2008; Patry 2001) and psychological findings (Ryan & Deci, 2004; Reeve, 2004; Roth, 2009) as well as arguments represented by the German *Bildungstheorie* (scholarly debate of the issue of *Bildung*: cf. Benner, 2012, 2011; Klafki, 1999).
TILA is assembled by three frame constructs, as follows:

(1) The *Action-orchestrating Frame Construct*: This frame construct includes a set of educational *Principles of Inquiry Learning*. Its recognition within preparation, performance, and reflection of learning arrangements features a beneficial effect on the learning process (Reitinger, Haberfellner, & Keplinger, 2015, pp. 3–4). These principles are not explicitly the content of the paper at hand and are therefore not considered in detail (for further information see Chapter 1 in this anthology).
(2) The *Organizational Frame Construct*: The process of organization described by this frame construct refers to a model published by the author under the acronym OPeRA.
(3) The *Definitional Frame Construct*: This frame construct embraces the definition of Inquiry Learning by stating indispensable elements, so called *Criteria of Inquiry Learning* (Reitinger, 2013a, p. 186).

The definitional frame construct includes six definitional criteria in total. The assertion that a learning arrangement is a kind of Inquiry Learning depends by definition on the occurrence of these criteria within the learning arrangement concerned. Hence, these criteria play a crucial role as indicators of Inquiry Learning Arrangements. Reitinger (ibid., p. 43) differentiates two categories of Criteria of Inquiry Learning. On the one hand, he speaks about inquiry-related dispositions (*Discovery Interest, Method Affirmation*), which play an important motivational role. On the other hand, he derives from respective literature and research four inquiry-related action domains (*Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, Conclusion-based Transfer*; ibid., p. 44), which characterize the act of self-determined inquiry itself (for a detailed description of these criteria as well as the definition of self-determined Inquiry Learning see Chapter 1 this volume).

1.2 SETTINGS OF INQUIRY LEARNING: WHY NAME THEM ARRANGEMENTS?

Within TILA, learning settings are described as Inquiry Learning Arrangements. According to the Merriam-Webster Dictionary (2015), the term arrangement means "… the way that things or people are organized for a particular purpose or activity; the way that things or people are arranged; something that is done to prepare or plan for something in the future; a usually informal agreement". Within a setting of self-determined Inquiry Learning according to TILA the collaborate organization of activities as well as informal agreements concerning something in the future are indeed part of the endeavor. Thus, the term Inquiry Learning Arrangement seems to be appropriate.

1.3 DEALING WITH UNPREDICTABILITY

The objective to motivate students to formulate hypotheses, to learn authentically, and to engage in critical discourses cannot be transferred into practice by directive instruction or by a specific replicable educational step-by-step method (Pauli & Reusser, 2000, pp. 424–427). Hence, self-determined Inquiry Learning Arrangements with the objective of high evolvement of the presented six criteria represent a type of learning settings with a high degree of unpredictability.

Instead of directing the performance of learning activities or giving directive instructions, teachers or inquiry coaches are rather engaged with the buildup of structure (Reitinger, 2013a, pp. 71–81) and transparency through the integration of learners' demands (Seyfried, 2002, pp. 19–21), the organization of flexible learning environments (Pauli & Reusser, 2000, p. 434; Reitinger, 2013a, pp. 68–70), various offers of discourses (Reich, 2008, p. 161) and viability checks (Patry, 2001, p. 74), persistent reflection (Dewey, 1933) in and on action (Schön, 1983), followed by realignments of the arrangement if necessary, orientation on principles that feature a beneficial effect on the learning process (e.g. trust, safety, or personalization; Reitinger, 2013a, p. 61), or the application of open, autonomy-supportive conceptions of Inquiry Learning as, e.g., AuRELIA (Authentic Reflective Exploratory Learning and Interaction Arrangement; (Reitinger, 2013b, pp. 18–26) or CrEEd (Criteria-based Explorations in Education; ibid., pp. 27–31).

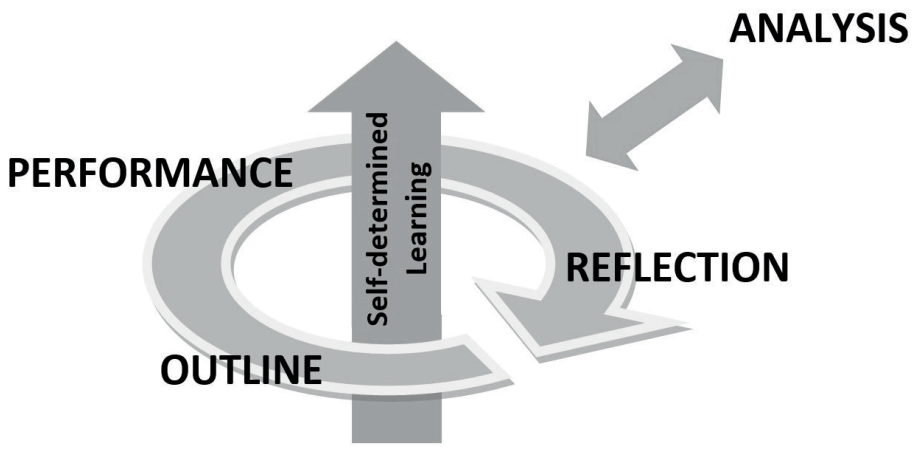
Nevertheless, despite considering these issues, a teacher or an inquiry coach will maximally be able to foster the evolvement of the six Criteria of Inquiry Learning and, thus, the probability of self-determined inquiry within a learning arrangement through his or her engagement of preparation and coaching. He or she will never be able to ensure that curiosity, autonomy, authenticity, discourse, personally meaningful inquiry, or the need of transfer will actually evolve. Thus, creating transparency concerning the important question to what extent self-determined inquiry could be actually realized within a learning arrangement is a crucial and inevitable matter of post-action reconsideration.

2 Yielding Transparency concerning the Conceptual Evolvement of Inquiry Learning: The Necessity of Post-interventional Reflection and Analysis

This high degree of unpredictability makes it difficult to anticipate what exactly will happen within a learning arrangement that pursues the objective of unfolding the six Criteria of Inquiry Learning. However, the less the performance of an arrangement is determinable, the more important a reflective-analytical reconsideration of already performed (phases of) Inquiry Learning Arrangements will become. For the purpose of reasoning this thesis, the organizational model OPeRA (Outline-Performance-Reflection-Analysis; Reitinger, 2013a, pp. 73–78) may be useful.

OPeRA embraces four dimensions that meet the requirements of a phenomenological description of the process of organizing Inquiry Learning Arrangements, or, in a wider sense, self-determined learning in general (see Figure 1).

FIGURE 1. *OPeRA Organization Model*



(1) The dimension *Outline* stands for all endeavors around the preparation of a learning arrangement, emphasizing that this process is rather a multi-perspectival outlining than a linear-specific planning one.
(2) The actual thread of an arrangement is represented by the dimension *Performance*.
(3) OPeRA differentiates two dimensions of follow-up reconsiderations: *Reflection* stands for the profound and critical thinking about arrangement-related experiences by the teacher or the inquiry coach.
(4) *Analysis* emphasizes that, in addition to reflection, "a kind of meta-regulation based on scientific criteria" (Reitinger, Haberfellner, & Keplinger, 2015, p. 5) is at least occasionally recommendable to be able to get estimations concerning the arrangement as accurate as possible and to derive plausible conclusions and supportive personal perspectives with regard to further attempts.

In conclusion, it can be stated that, within the outline as well as the performance of Inquiry Learning Arrangements according to TILA, it is the main objective to foster the unfolding of the Criteria of Inquiry Learning. To what extent this engagement succeeds is neither determinable by a specific method nor per se predictable before or significantly perceivable during the performance of the Inquiry Learning Arrangements. Therefore, a post-interventional reconsideration in the form of Reflection or, ideally, Analysis in the sense of the third and fourth dimension of OPeRA is necessary to yield transparency concerning the actual conceptual evolvement of Inquiry Learning.

3 Empirical Accessibility

It follows from the previously stated characteristic of uncertainty that only post-interventional Reflection and Analysis of a performance of an Inquiry Learning Arrangement will create transparency whether learning activities are actually self-determined (or inquiry-oriented), or not. Here, the question concerning concrete opportunities of post-interventional reflection and analysis arises, and, with it, the question concerning the empirical accessibility of indicators of Inquiry Learning.

3.1 Measuring the Evolvement of Criteria of Inquiry Learning with a Focus on Inquiry-Related Action Domains

To investigate the degree of evolvement of self-determined Inquiry Learning several modes are conceivable. As already implied, one of the simplest approaches is a subjective reflection and estimation of the experienced arrangements by the teacher or the inquiry coach after the learning activity (affecting the dimension Reflection of the OPeRA Model). A more objective approach that already reaches into the dimension Analysis of the OPeRA Model could be an investigation based on a questionnaire about the learner´s estimations. Within such an inventory, the Criteria of Inquiry Learning may serve as indicators, as stated above. Hence, the main objective of this study is the development and testing of such an inventory. Thereby, the focus is put on the following action domains that are related to inquiry: Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, and Conclusion-based Transfer. The primary reasons for such a focus are the following:

(1) The criteria Discovery Interest and Method Affirmation indicate inquiry-related dispositions of the learners. They do not proximately point at the performance of an action of Inquiry Learning. The endeavor of the treatise in hand, however, concentrates especially on obtaining transparency concerning action domains, not on individual dispositions.
(2) Dispositions, such as interest, curiosity, or appreciation of performed activities or methods have already been the subject of several scale development activities. Thus, standardized inventories already exist, e.g., the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989), the Situational Motivation Scale (SIMS; Guay, Vallerand, & Blanchard, 2000), or the Acceptance and Action Questionnaire-II (AAQ-II; Bond, Hayes, Baer, Carpenter, Guenole, Orcutt, Waltz, & Zettle, 2011).
(3) Finally, the focus on four partial constructs instead of six brings about a simplification of the process of inventory development.

3.2 BASIC DELIBERATIONS CONCERNING THE DEVELOPMENT OF THE INVENTORY

The overall attempt of the endeavor of inventory development is the creation of a post-interventional, retrospective scale applicable for the measurement of the evolvement of the Criteria of Inquiry Learning with a focus on the inquiry-oriented action domains. Hence, the theoretical partial constructs embodied in the inventory are (a) Experience-based Hypothesizing (*exhy*), (b) Authentic Exploration (*auex*), (c) Critical Discourse" (*crdi*), and (d) Conclusion-based Transfer (*cotr*). These constructs are operationalized into English-language items that refer to an experienced learning activity. The study specifically deals with the following intentions:

Int 1: A statistically sufficient set of items should be found that mirrors the four partial constructs of Inquiry Learning.
Int 2: The inventory to be developed should be adjusted to the linguistic and contentual comprehension of adults.
Int 3: The study should clarify whether Inquiry Learning, represented by four inquiry-related action domains (partial constructs), encompasses a more homogeneous or heterogeneous overall construct.

The author refers to this set of items as CILI (Criteria of Inquiry Learning Inventory; see Appendix[2]).

3.3 INITIALIZING INVENTORY DEVELOPMENT: EXPLORATORY STUDY

The major objective of the exploratory study is to prepare selection and adjustment of items as well as confirmatory analysis for the development of the targeted post-interventional inventory.

Participants, Item Generation, and Data Collection

To perform initial exploratory item analyses, the author investigated a sample of 302 student teachers (273 female; 29 male) from an Austrian teacher training college (179 primary school student teachers; 83 lower secondary school student teachers; 26 special needs student teachers; 12 student teachers for religious education for primary and lower secondary school). All of them could be identified as German native speakers with sufficient English language skills (Matura, equivalent to Common European Framework of Reference for Languages Level B2). The participants' mean age was 22.52 (SD = 4.87) years.

As an initial step within inventory development, the author created a preliminary pool of 12 situational items per each partial construct (48 items in total). Four items out of 12

2 As expressed in the Appendix, the exploratory tested, semi-standardized version of the inventory was called CILI-β (Criteria of Inquiry Learning Inventory β-Version) and already published by Reitinger in 2015. The final and full-standardized version of the scale tested by confirmatory analysis is presented within this paper and bears the name CILI (without the adjunct "β"; see Appendix).

per partial construct were formulated negatively. All items were revised by four scholars who are experienced in teaching and learning matters as well as social research methods (expert review; DeVellis, 2011, pp. 99–101).

Subsequently, the participants rated the 48 preliminary items online via a Unipark Survey (QuestBack, 2015). In order to make sure that the participants referred their estimations to a random learning activity within their teacher education, the following instruction was implemented into the initial part of the online questionnaire: *"Bevor Sie mit der Einschätzung der Aussagen beginnen, stellen Sie sich bitte eine zufällige Zahl von 1 bis 6 vor (also 1, 2, 3, 4, 5 oder 6). Merken Sie sich bitte diese Zahl!" – "Holen Sie sich nun bitte jene von Ihnen besuchte Lehrveranstaltung in Erinnerung, die vom aktuellen Zeitpunkt rückwärts gezählt der von Ihnen zufällig gewählten Zahl entspricht. Beurteilen Sie nun sämtliche der folgenden Aussagen bezugnehmend auf diese eine konkrete Lehrveranstaltung!"*[3]

The gained data set originally contained complete responses from 331 participants. This data set was cleaned up by erasing 29 responses with a very low value of quality (v_q), calculated by Unipark Survey ($v_q < 0.20$; QuestBack, 2013, p. 578). The remaining 302 complete responses encompassing all 48 items represent the cleaned data set applied for the descriptive and exploratory analyses documented in the following paragraphs.

Preliminary Analysis of Items

Single item analysis with foci on normal distributions, means, and modal values led to an exclusion of 20 items from the preliminary pool (7 positively, 13 negatively formulated items). These items did not reach at least one of the defined elimination parameters ($M < 3.00$; $M > 5.00$; $Mod = 1$; $Mod = 7$). These consulted parameters were set by the author to prepare a sufficient item pool with a suitable normal distribution for further analysis and to pave the way for the standardization of the inventory.

Hence, 28 items with suitable descriptive attributes remained for an exploratory factor analysis (1 neg. and 8 pos. formulated items out of partial construct *exhy*; 2 neg. and 7 pos. formulated items out of partial construct *auex*; 6 pos. formulated items out of partial construct *crdi*; 4 pos. formulated items out of partial construct *cotr*).

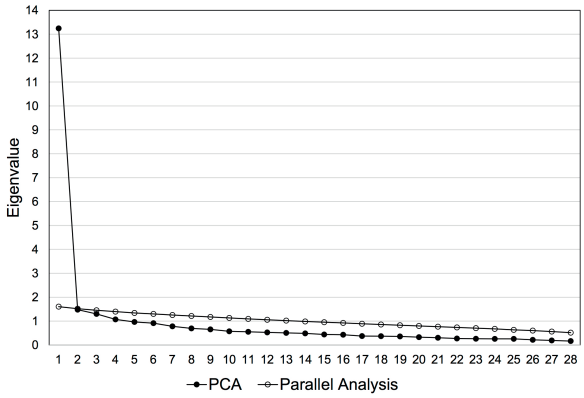
Exploratory Factor Analysis (EFA)

The selection of 28 adequately performing items of the preliminary pool were subjected to Principal Components Analysis (PCA; oblimin rotation) using the software SPSS and Parallel Analysis (PA; DeVellis, 2011, p. 130; Pallant, 2010, p. 191) using the software MonteCarlo PCA (Watkins, 2000). The correlation matrix of 378 coefficients revealed

3 "Imagine a random number between 1 and 6 (that is, 1, 2, 3, 4, 5, or 6) before you begin your estimations. Please, memorize this number!" – "Now, remember the course/lecture that matches, counted backwards from now, your randomly chosen number. Estimate all of the following statements according to this concrete course/lecture!" (author's translation)

the presence of only 7 coefficients below 0.20. The Kaiser-Meyer-Olkin value was 0.96 (recommended value is 0.6 and higher; Kaiser, 1974). The Bartlett's Test of Sphericity showed statistical significance, indicating appropriateness for factor analysis. These values indicate the presence of a data set, convenient for the implementation of EFA.
The visualized results of the scree plot (elbow at factor two) indicate under consideration of a Parallel Analysis a one-factor solution with an eigenvalue of 13.25, explaining 47.30 % of variance (see Figure 2).

FIGURE 2. *Scree plot and Random Eigenvalues from Parallel Analysis*



Although, in total, 4 factors reveal an eigenvalue above 1, the plot's elbow at factor 2 and especially the calculated average eigenvalues of 100 randomly generated samples within the Parallel Analysis (DeVellis, 2011, p. 131) relativize this outcome as displayed in Table 1. Only the eigenvalue of factor 1 exceeds the calculated eigenvalue from random data.

TABLE 1. *Comparison of Eigenvalues from PCA with Random Eigenvalues form Parallel Analysis*

	Factor 1	***Factor 2***	***Factor 3***	***Factor 4***
Eigenvalue PCA	**13.25**	1.48	1.30	1.07
Eigenvalue PA	**1.60**	1.52	1.45	1.40
Comparison	**PCA > PA**	PCA < PA	PCA < PA	PCA < PA

The Component Matrix calculated by an unrotated factor analysis with a fixed number of 1 factor also underpins a one-factor solution by showing high loadings of nearly all items on one factor (26 items out of 28 revealed loadings higher than 0.50). Nevertheless, the differentiation into four partial constructs is at least theoretically justifiable. On this account, the author decided to consolidate an equal number of the highest loading items from each partial construct (a) to mirror the theoretical background of the operationalized construct Inquiry Learning and (b) to leave the door open for further examination of the hypothetical four-dimensional structure of the construct through

confirmatory analysis. 4 items per *exhy* (factor loadings: 0.83; 0.72; 0.71; 0.70), *auex* (factor loadings: 0.83; 0.80; 0.76; 0.69), *crdi* (factor loadings: 0.82; 0.76; 0.75; 0.70), and *cotr* (factor loadings: 0.77; 0.67; 0.60; 0.52) were selected. By doing this, the 28-item pool was reduced to an appropriate inventory of 16 items.

Internal Consistency and Partial Construct Correlations

Analysis of the Internal Consistency (Schermelleh-Engel & Werner, 2012, pp. 130–132) features a Cronbach's Alpha of 0.94 (corr. Item-Scale-Correlations: $0.51 < r < 0.80$) for the total 16-items scale. This reliability value of the entire construct slightly tops the reliability values of the partial constructs *exhy* (α = 0.84; corr. Item-Scale-Correlations: $0.63 < r < 0.75$), *auex* ($\alpha = 0.87$; corr. Item-Scale-Correlations: $0.68 < r < 0.77$), *crdi* ($\alpha = 0.86$; corr. Item-Scale-Correlations: $0.71 < r < 0.82$), and *cotr* ($\alpha = 0.79$; corr. Item-Scale-Correlations: $0.53 < r < 0.67$). Comparing the single partial constructs per Correlation Analysis (Pearson and Spearman) it becomes evident that each pairing shows high significant correlations (see Table 2).

TABLE 2. *Correlations between the Partial Constructs*

	exhy	*auex*	*crdi*
auex	0.79**		
crdi	0.73**	0.70**	
cotr	0.68**	0.72**	0.66**

** Significant correlation (Pearson); $p < 0.01$

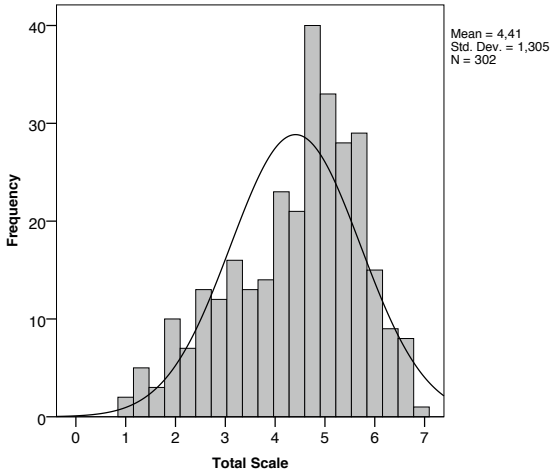
This outcome emphasizes the correspondence between the four theoretical criteria of inquiry-related action domains and supports the thesis that the total 16-items scale represents a homogeneous entire construct. Nevertheless, further investigations are necessary to confirm or disconfirm this thesis (see confirmatory analysis further below).

Normal Distribution of the Total 16-Items Scale

As a next step, the statistical adequacy of the mean scale of the inventory of 16 items was tested. Descriptive analysis shows a mean value of M = 4.41 (SD = 1.31). Figure 3 provides a histogram of the mean scale. An interpretation of this graph leads to the conclusion that an appropriate normal distribution[4] is given.

4 The Kolmogorov-Smirnov Test (K-S Test) shows a highly significant difference ($D(302) = 0.11$, $p < 0.001$) between the distribution of the recruited sample and a standard normal distribution. However, this test has its limitations "because with large sample sizes it is very easy to get significant results from small derivations from normality, and so a significant test doesn´t necessarily tell us whether the deviation from normality is enough to bias any statistical procedures that we apply to the data." (Field, 2009, p. 144) For this reason, the author recommends applying an interpretation of the histogram rather than the outcome of the statistical K-S Test.

FIGURE 3. *Normal Distribution of the Total Scale (Mean Scale of 16 Items)*



Conclusion

This exploratory study succeeded in approaching the further up mentioned intention to find a statistically sufficient set of items that mirrors the action domains of Inquiry Learning. This set of 16 items published by Reitinger (2015) under the acronym CILI-β (Criteria of Inquiry Learning Inventory β-Version; see Appendix), can be understood as a semi-standardized Inventory. CILI-β indicates a one-factor solution. This outcome leads to the thesis that the inventory may represent a homogeneous overall construct Inquiry Learning. Nevertheless, it is a thesis, not a fact, as exploratory analysis is too vague to prove this conclusion. Thus, in the following, the further development of this inventory through evidence-based modification of items as well as confirmatory analysis is documented. Thereby, the two hypothetical models (one-factor model and four-factor model) are tested again.

3.4 FINALIZING INVENTORY DEVELOPMENT: CONFIRMATORY STUDY

To complete the endeavor of inventory development, some further empirical analyses with another independent sample are necessary (DeVellis, 2011, pp. 151–158). After item generation and exploratory analyses (Moosbrugger & Schermelleh-Engel, 2012, p. 341), the fit of the inventory has to be tested by confirmatory factor analysis (Byrne, 2009, pp. 53–96).

Participants

The recruited sample consisted of students (435 female; 108 male; 1 missing statement) from six Austrian tertiary educational institutions (4 teacher training colleges and two universities). At the time of ascertainment, 294 participants were studying to be primary teachers, 209 secondary teachers, and 18 teachers for economics. 20 students were

studying educational sciences, and 2 students social economics (1 missing statement). The mean age of the 544 participants was 21.85 years ($SD = 4.25$). All investigated persons have sufficient English language skills (*Matura*, equivalent to Common European Framework of Reference for Languages, Level B2).

Item Modification and Data Collection

Based on the information gained through the exploratory analysis, some of the 16 items were linguistically trimmed (e.g., "I want to do more with the insights I have made during this learning activity.", > "I definitely want to do more with the insights I have gained during this learning activity."). The set of items was submitted to the participants in the form of a paper-and-pencil questionnaire. The instruction implemented in the initial part of the questionnaire was equivalent to the instruction used within the exploratory analysis. Only questionnaires with complete responses concerning the 16 investigated items were included into the following analyses[5].

For the purpose of psychometric comparisons with standardized measurements (testing of construct validity) further inventories were integrated into the questionnaire:

(1) *Situational Motivation Scale* (SIMS); Dimensions "Intrinsic Motivation" and "Identified Regulation"; Guay, Vallerand, and Blanchard (2000),
(2) *Intrinsic Motivation Inventory* (IMI); Dimension "Effort"; McAuley, Duncа, and Tammen (1987),
(3) *Curiosity and Exploration Inventory II* (CEI-II); Dimensions "Stretching Curiosity" and "Embracing Curiosity"; Kashdan, Gallagher, Silvia, Winterstein, Breen, Terhar, and Steger (2009).

Analysis of Items

In advance of the Confirmatory Factor Analysis (CFA), all 16 items were examined concerning mean, normal distribution, reliability (Cronbach's Alpha), and semantics. Subsequently, each item per partial construct with the weakest attributes was excluded. By doing this (exclusion of 4 items in total), the inventory was reduced to a set of 12 items.

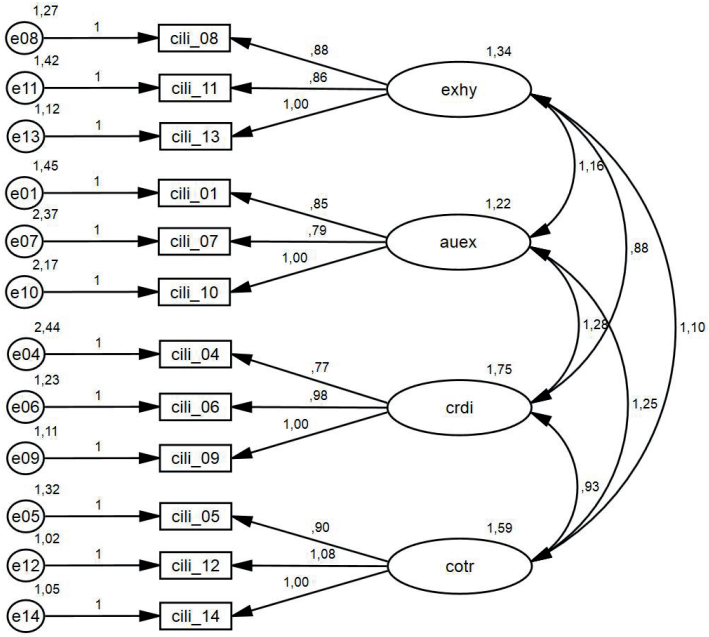
Confirmatory Factor Analysis (CFA)

The reduced battery of 12 items (3 items per partial construct) was tested by a Confirmatory Factor Analysis (CFA) using the Software IBM AMOS. Two models were analyzed. The first model (see Figure 4) represents the consulted theoretical model, which indicates that the construct Inquiry Learning embraces four inquiry-related action domains (experience-based hypothesizing, authentic exploration, critical discourse, conclusion-based hypothesizing). The second model represents a one-factor-model of

5 The reason for the exclusion of fragmentary responses (21 in total) is that Confirmatory Factor Analysis (CFA) performs best when accessing complete data.

the construct Inquiry Learning. With this model, the thesis predicting a homogeneous overall construct (see previously documented exploratory study) should be tested.

FIGURE 4. *Four-Factor-Model derived from the Theoretical Approach TILA and tested by CFA*



The four-factor-model (see Figure 4) compliant with the approach TILA shows, all in all, a good fit. Calculations of common fit indices (Standard Root Mean Square, *SRMR*; Comparative Fit Index, *CFI*; Root Mean Square Error of Approximation, *RMSEA*; see Byrne, 2010, p. 73) deliver suitable results, all located within recommended thresholds. $SRMR = 0.038$ (threshold: < 0.05; ibid., p. 77); $CFI = 0.955$ (threshold: > 0.95; Schreiber, Stage, King, Nora & Barlow, 2006, p. 330); $RMSEA = 0.063$ (threshold: < 0.07; Steiger, 2007). The Chi-Square-Test for Goodness-of-Fit is significant with a result of $\chi^2(48) = 151.115$; $p < 0.001$ and, therefore, does not meet the commonly recommended threshold ($p > 0.05$). However, this result can be attributed to the large sample size and should be rectified according to the formula $k = \chi^2 / df$ (see Kline 2004, cit. by Iacobucci, 2010, p. 91). With a value of $k = 3.15$ this corrected parameter lies within the immediate proximity of the recommended threshold.

By contrast, the testing of the statistical adequacy of the one-factor-model reveals insufficient results ($SRMR = 0.068$; $CFI = 0.831$; $RMSEA = 0.115$). A rectification of the significant Chi-Square-Test for Goodness-of-Fit ($\chi^2(54) = 442.038$; $p < 0.001$) delivers a k-value (8.19) far off from any recommended threshold. Hence, the thesis predicting a homogeneous overall construct with no statistically identifiable partial constructs finds no verification through CFA and can be rejected.

The analyses of these two hypothetical models lead to the conclusion that the four theoretically justifiable partial constructs can actually be derived from the investigated data. Therefore, the theory-compliant four-factor-model (see Figure 4), represented by 3 items per factor[6], prevails over the one-factor-model.

Internal Consistency and Partial Construct Correlations

The reliability values (Schermelleh-Engel & Werner, 2012, pp. 130–132) of the partial constructs are $\alpha = 0.72$ for *exhy* (corr. Item-Scale-Correlations: $0.52 < r < 0.58$), $\alpha = 0.58$ for *auex* (corr. Item-Scale-Correlations: $0.35 < r < 0.43$), $\alpha = 0.73$ for *crdi* (corr. Item-Scale-Correlations: $0.46 < r < 0.61$), and $\alpha = 0.80$ for cotr (corr. Item-Scale-Correlations: $0.61 < r < 0.68$). The total scale of 12 items features a Cronbach's Alpha of 0.87 (corr. Item-Scale-Correlations: $0.44 < r < 0.65$). These calculated values indicate sufficient internal consistency of the partial constructs. The high internal consistency of the total scale as well as the high correlations documented in Table 3 underline a strong correspondence between the partial constructs.

TABLE 3. *Correlations between the Partial Constructs*

	exhy	*auex*	*crdi*
auex	0.60**		
crdi	0.44**	0.58**	
cotr	0.57**	0.62**	0.44**

** Significant correlation (Pearson); $p < 0.01$

Construct Validity – Psychometric Comparisons with standardized Inventories

Testing the construct validity, the partial constructs *exhy*, *auex*, *crdi*, and *cotr* were correlated with other psychometric inventories. Table 4 lists the concerned results of comparisons with the dimensions "Intrinsic Motivation", "Identified Regulation", "Effort", "Stretching Curiosity", and "Embracing Curiosity", taken from the SIMS (Guay et al., 2000), the IMI (McAuley et al., 1987), and the CEI-II (Kashdan et al., 2009).

6 Coding of items in the course of the confirmatory analyis (see also Appendix):
Dimension *exhy*: cili_08 → (c); cili_11 → (g); cili_13→ (k).
Dimension *auex*: cili_01 → (a); cili_07 → (d); cili_10 → (h).
Dimension *crdi*: cili_04 → (b); cili_06 → (f); cili_09 → (j).
Dimension *cotr*: cili_05 → (e); cili_12 → (i); cili_14 → (l).

TABLE 4. *Correlations with other Inventories –Investigation of Construct Validity*

	Intrinsic Motivation (SIMS)	*Identified Regulation (SIMS)*	*Effort (IMI)*	*Stretching Curiosity (CEI-II)*	*Embracing Curiosity (CEI-II)*
α	0.90	0.82	0.82	0.71	0.68
exhy	0.44**	0.39**	0.25**	0.23**	0.14**
auex	0.57**	0.46**	0.30**	0.24**	0.15**
crdi	0.51**	0.34**	0.16**	0.16**	0.09*
cotr	0.69**	0.58**	0.31**	0.23**	0.13**

* Significant correlation (Pearson); $p < 0.05$ ** Significant correlation (Pearson); $p < 0.01$

The Situational Intrinsic Motivation Scale (SIMS) according to Guay et al. (2000) was developed with reference to the taxonomy of human motivation (Ryan & Deci 2004). TILA also refers to this theoretical approach. Thus, the high correlations between the partial constructs of Inquiry Learning (*exhy, auex, crdi, cotr*) and the motivational dimensions of the SIMS (*Intrinsic Motivation, Identified Regulation*) underpin the validity of the investigated constructs.

The moderate correlations with the consulted IMI-dimension (McAuley et al., 1987) support the supposition that Inquiry Learning Arrangements evoke an enhanced perception of *Effort*. In the context of the Intrinsic Motivation Inventory, effort is figured as an effective variable of human evolvement of competence. This thesis is reasoned with findings of self-determination research (Deci & Ryan, 2004). With regard to these arguments, a further theoretical link to TILA and, therefore, to the partial constructs of Inquiry Learning can be found that supports the assumption of a valid operationalization.

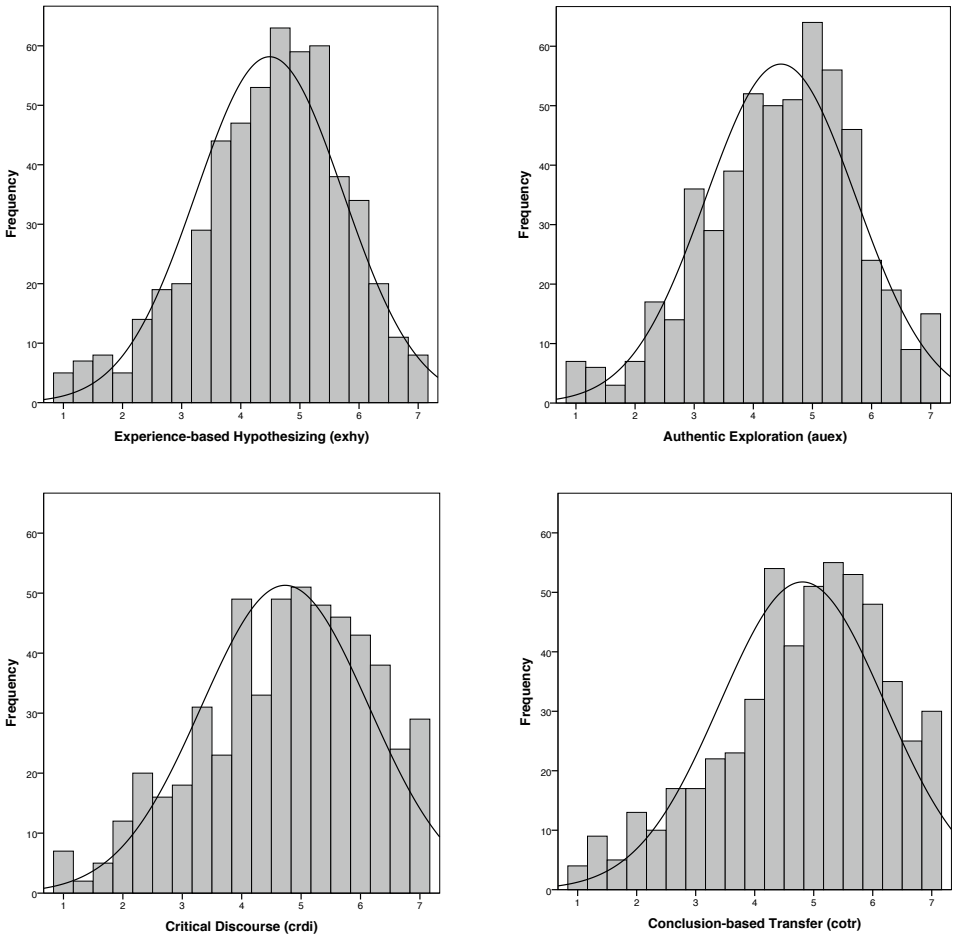
Correlations with the curiosity-dimensions (*Stretching Curiosity, Embracing Curiosity*) according to Kashdan et al. (2009) are significant but weak concerning their size of effect. This outcome matches well as it indicates that post-interventional estimations of the evolvement of Criteria of Inquiry Learning perform independently of the level of the personal dispositional curiosity (trait).

Analysis of Normal Distribution

The averaged variables of the partial constructs[7] feature the following means and standard deviations: $M_{exhy} = 4.49$ ($SD = 1.24$); $M_{auex} = 4.47$ ($SD = 1.27$); $M_{crdi} = 4.73$ ($SD = 1.41$); $M_{cotr} = 4.81$ ($SD = 1.40$). The histograms of the four construct variables (see Figure 5) show sufficient normal distributions that are slightly shifted to the positive moiety of the seven-fold scale (1 = "not true at all"; 2; 3; 4 = "somewhat true"; 5; 6; 7 = "very true").

7 MEAN(cili_08,cili_11,cili_13) for *exhy*; MEAN(cili_01,cili_07,cili_10) for *auex*; MEAN(cili_04,cili_06,cili_09) for *crdi*; MEAN(cili_05,cili_12,cili_14) for *cotr*.

FIGURE 5. *Histograms of the Partial Scales*



Conclusion

In applying databased modification of an exploratory tested set of items and subsequent Confirmatory Factor Analysis (CFA), a statistically sufficient inventory to measure the evolvement of Inquiry Learning could be created. The battery comprises 12 items: 3 items per each criteria, i.e., experience-based hypothesizing, authentic exploration, critical discourse, and conclusion-based transfer. The results of the CFA reveal the best statistical fit for the theoretically underpinned four-factor-model. This model assumes that Inquiry Learning is a heterogeneous overall construct. It occurs where the described Criteria of Inquiry Learning evolve. By using the developed inventory, these degrees of evolvement can be measured subsequently to an Inquiry Learning Arrangement (in tertiary education). The author refers to this four-dimensional set of items as CILI (Criteria of Inquiry Learning Inventory; see Appendix)

4 Summary and General Discussion

This paper refers to the educational framework TILA (Theory of Inquiry Learning Arrangements; Reitinger, 2013, pp. 186–189). TILA consists of three theoretical frame constructs, namely definitional frame construct, action-orchestrating frame construct, organizational frame construct. The definitional frame construct is based on six criteria: discovery interest, method affirmation, experience-based hypothesizing, authentic exploration, critical discourse, and conclusion-based transfer. These criteria are grounded in a theoretical synthesis of the early roots of Inquiry Learning coined by Dewey (1933), contemporary approaches of learning (Moegling, 2010, p. 100; Reich, 2010, 2008; Patry, 2001), psychological findings (Ryan & Deci, 2004; Reeve, 2004; Roth, 2009), and arguments represented by German *Bildungstheorie* (cf. Benner, 2012, 2011; Klafki, 1999).

According to TILA, the main objective of both outline and performance of an Inquiry Learning Arrangement is to foster the evolvement of the Criteria of Inquiry Learning. Nevertheless, this ambition is neither determinable by a specific method nor per se predictable before or perceivable during the performance of the Inquiry Learning Arrangement because self-determined Inquiry Learning represents a learning with high degrees of openness oriented on the individual concerns of the learners. Despite this, it is important to gain transparency concerning the actual evolvement of the criteria to be able to make accurate arrangement-related estimations, which are necessary to derive plausible conclusions and supportive personal perspectives with regard to further teaching engagements. To yield the demanded transparency concerning the actual conceptual evolvement of Inquiry Learning, reconsiderations are necessary after the arrangement. In the eyes of the author, the post-interventional inventory CILI (Criteria of Inquiry Learning Inventory) introduced in this Chapter is well suited to meet this need.

Appendix: The Criteria of Inquiry Learning Inventory (CILI)

This finalized inventory, first published by Reitinger (2016)[8], can be used as a standardized inventory to measure the evolvement of Inquiry Learning within educational learning settings in tertiary education.

8 The standardized 12 English-language items of CILI were first published within a German-language treatise (Reitinger, 2016) entitled "Selbstbestimmung, Unvorhersagbarkeit und Transparenz: Über die empirische Zugänglichkeit forschenden Lernens anhand des Criteria of Inquiry Learning Inventory (CILI)". The exploratory tested precursory version of the Inventory (named CILI-β, consisting of 16 items; see section 3.3; Initializing Inventory Development: Exploratory Study) was already published by the author in 2015 as a semi-standardized measurement (see Reitinger, 2015). The 16 items of CILI-β were: "This learning activity encouraged me to discover open questions. / I really thought a lot about possible outcomes concerning open questions. / I wish I could deal with the topic of this learning activity for a longer time. / At this learning activity, many opportunities occurred to tell my ideas. / I want to do more with the insights that I have made during this learning activity. / I remember many interesting conversations during this learning activity. / I explored actively exciting insights. /→

For the application of the inventory, the following instruction should be used: *Please rate the statements below with regard to the experienced X, termed hereafter as learning activity!* (X stands for the considered concrete learning activity, e.g., didactics seminar, physics lesson, scientific workshop, cooking class, language course, pedagogic project.)

(a) This learning activity encouraged me to discover open questions.
(b) Many situations occurred where I was able to tell my ideas.
(c) This learning activity led me to suppositions about possible solutions.
(d) I gained exciting insights into the matter through exploration.
(e) I definitely want to do more with the insights I have gained during this learning activity.
(f) I remember many interesting conversations during this learning activity.
(g) At this learning activity, many suppositions came to my mind.
(h) During this learning activity, I found out new insights by myself.
(i) I have many ideas about meaningful things I can do with the new insights.
(j) This learning activity was full of meaningful discussions.
(k) I thought about possible solutions.
(l) This learning activity gave me ideas for interesting further activity.

Items (a), (d), and (h) refer to authentic exploration (*auex*).
Items (b), (f), and (j) refer to critical discourse (*crdi*).
Items (c), (g), and (k) refer to experience-based hypothesizing (*exhy*).
Items (e), (i), and (l) refer to conclusion-based transfer (cotr).
All Items are anchored on the following scale:
1 = "not true at all"; 2; 3; 4 = "somewhat true"; 5; 6; 7 = "very true".

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This learning activity led me to deepened assumptions about possible solutions. / This learning activity was full of meaningful discussions. / During this learning activity, I really found out new insights by myself. / At this learning activity, many assumptions came to my mind. / I have many ideas about meaningful things I can do with these new insights. / I thought a lot about possible solutions at this learning activity. / This learning activity gave me ideas for interesting further activity. / I was often invited to disclose my ideas. / I really researched at this learning activity."

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Part II

Research on the Theory of Inquiry Learning Arrangements

5 Let's CrEEd Student Teachers of English: Focus on Individualization in Tertiary Education

Gudrun Keplinger

In this article the application of the concept CrEEd is discussed in the context of the education of student teachers of English at an Austrian teacher training college. The qualitative analysis of data collected in two phases gives insight into how the criteria and principles of Inquiry Learning unfolded in the participants' points of view.

Keywords: CrEEd, teaching English as a Foreign Language (EFL), independent learning

1 Introduction

Foreign language teaching has undergone a large number of changes over the last centuries, and so has the terminology used to describe procedures included in the process of teaching, learning, and acquiring a language other than one's mother tongue. In this article the term *English Didactics* is used as it seems to most widely cover a procedural approach to describing language teaching practices (cf. Bell, 2003; Hall, 2011; Kumaravadivelu, 2006; Richards & Rodgers, 2001). When aiming to be consistent with the theory of Inquiry Learning, the language teacher has to be able to draw on a multitude of methods in order to facilitate authentic and individual exploration. According to recent publications on language pedagogy explored through second language acquisition research (cf. Ellis & Shintani, 2014, p. 292), "language pedagogy pays only lip service to the idea of individualized instruction in a classroom setting". This article focuses on how criteria-based exploration can take place in the education of student teachers of English in order to better enable them to identify their language learners' needs and provide them with materials which are both motivational and appropriate for their proficiency level.

2 Teaching English in the Context of Austria's Changing Educational Paradigm

Over the last decade, both teachers and pupils in Austrian lower secondary schools (pupils aged between 10 and 14) have been confronted with a number of substantial changes. First, educational standards (BiSt E8) based on the six competence levels A1 to C2 of the Common European Framework of Reference for Languages (CEFR; Council of Europe, 2001) were developed and signed into law in July 2008 (Bundesinstitut bifie, n.d.a). Hence, these days, pupils are supposed to show a degree of language proficiency equal to the definition of CEFR A2 in all four skills and selected areas of CEFR B1 in Listening, Reading and Writing at the end of their education in lower secondary schools (cf. *Bundesministerium für Bildung und Frauen,* (*bmbf,* n.d.b)[1]. Owing to external testing which is carried out by language teachers assigned by the *Bundesinstitut für Bildungsforschung, Innovation & Entwicklung des Österreichischen Schulwesens (bifie)*[2], the regular language teachers' primary role now incorporates the qualities of a coach who helps the pupils reach a common goal and facilitates learning processes.

Second, the introduction of the New Secondary School in 2012 provided the legal grounds for one type of school for all pupils aged between 10 and 14. In other words, the distinction between General Secondary Schools and Academic Secondary Schools (lower level), which has proved to be a determining factor in how pupils continue their professional career, is meant to become obsolete in the near future. In this New Secondary School, pedagogic practice is geared specifically towards individualization, differentiation, focus on thorough understanding rather than accurate reproduction, social learning, all-day schooling, teachers cooperating in teams, criteria-based assessment covering a wide range of different complexity levels, and development of digital competence (cf. bmbf, n.d.c, p. 6).

Consequently, in order to meet these demands, language teacher education had to be reconsidered, which has led to interdisciplinary discussions among representatives of both universities and teacher training colleges, which now share responsibilities for the development and realization of an up-to-date curriculum. This interdisciplinary approach is also clearly visible in modern definitions of English teaching methodology. It is now considered not only to refer to the subject specific scientific disciplines, e.g. linguistics, literary studies, and cultural studies, but also to include relevant findings from the fields of pedagogy and psychology (cf. Gehring, 2010; Thaler, 2012; Voss, 2007). In view of all these developments and changes of perspective, finding new ways in which language teachers can cope with growing demands and evaluating new concepts seem perfectly reasonable if not absolutely necessary steps in the continuous advancement of courses offered in teacher education. The following sections will give an example of an endeavour of this kind.

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1 Austrian Federal Ministry of Education and Women's Affairs (footnotes 1 & 2: author's translation)

2 Federal Institute for Educational Research, Innovation, and Development of Public Education

3 CrEEd and the OPeRA-Portfolio

The concept CrEEd (Criteria-based Explorations in Education) was developed out of the AuRELIA-concept (Authentic Reflective Exploratory Learning and Interaction Arrangement) with the intention to open up the latter to even more flexible use in a variety of both institutional and non-institutional educational settings (Reitinger & Hauer, 2012). Both concepts are similarly grounded in TILA (Theory of Inquiry Learning Arrangements), i.e., they consistently refer to both the *definitional frame construct* defining the six criteria of Inquiry Learning (General Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, Conclusion-based Transfer) and the *action-orchestrating frame construct* including the six pedagogical principles (Trust, Self-determination, Safety, Clearness, Structuring, Personalization) of Inquiry Learning (Reitinger, 2013). Hence, CrEEd and AuRELIA alike can make use of the *organizational frame construct* OPeRA (Outline-Performance-Reflection-Analysis) in order to facilitate Inquiry Learning processes.

The OPeRA-Portfolio is offered for common use to support the organization of Inquiry Learning (Reitinger, 2012) and aims to guide the inquiry coach in the processes of *outlining*, *performing* and *reflecting* his or her educational work. First, the inquiry coach is encouraged to briefly analyse the conditions under which the learning process is meant to take place. Moreover, the portfolio suggests framing some broad objectives which are not yet related to actual learning outcomes. Second, the portfolio lists the six criteria of Inquiry Learning and provides room for the inquiry coach to take notes concerning the *outlining*, *performance* and *reflection*. See Table 1 for an extract from the portfolio.

TABLE 1. *Extract from OPeRA-Portfolio (Reitinger 2012; see also Table 1 in Chapter 3)*

You (name, seminar group)		**Your students (school, year, number of students, subject)**	
Main idea			
Short analysis of conditions			
Non-operationalized broad objectives			
Criterion	**Outline (Notes)**	**Performance (Notes)**	**Reflection (Notes)**
General Discovery Interest Inquiry Learning begins with the existence of a general interest. The original root of this required curiosity lies within the innate cognitive-emotional structure of an individual…	*How can I activate hidden interest concerning some relevant content?*	*What actually happened during the Self-determined Inquiry Learning Arrangement that could be associated with the criterion "general discovery interest"?*	*Was I able to help pupils feel intrinsically motivated?* *or:* *Was I able to raise my pupils' intrinsic motivation?*
Method Affirmation …			

In the columns entitled *Outline*, *Performance* and *Reflection*, examples of possible guiding questions are given which can help the inquiry coach when using the portfolio for the first time. It is important to point out that successful inquiry coaching is not measured by means of completeness, i.e., by the extent to which the criteria of Inquiry Learning are met in a learning situation. To the contrary, it is the process the inquiry coach is undergoing which is in the focus of interest. Hence, any development of the provider of learning settings in the direction of encouraging learners to follow their individual interests and exploring their fields of interest after posing questions and speculating about possible answers is seen as value contributions to this person's competence concerning the facilitating of Inquiry Learning processes.

4 Project 1: CrEEd Meets English Didactics

The need to establish educational settings in which student teachers of languages can gain experience concerning individualized and autonomous learning settings became evident in a study which was carried out among student teachers of English at an Austrian teacher training college from 2012 to 2014 (cf. Keplinger, 2015). The results of this study showed that teacher trainees who were asked to self-assess their competences at various stages of their teacher training according to the 195 descriptors of the European Portfolio for Student Teachers of Languages (EPOSTL; Newby et al., 2007) considered themselves least prepared for their future life as English teachers in the area of *Independent Learning* (ibid., pp. 36-38). This area comprises *Learner Autonomy*, *Homework, Projects*, *Portfolios*, *Virtual Learning Environments*, and *Extra-curricular Activities*. In the EPOSTL the introduction to the passage including the descriptors for Independent Learning reads as follows (ibid.):

> "Language learning in a school context is both a matter of learning individually and in cooperation with peers, as well as independent learning with the guidance of a teacher. This means giving the individual learner or groups of learners a chance to take charge of aspects of their own learning processes in order to reach their full potential.
> As far as learner autonomy and project work are concerned, taking charge means choosing objectives, content, activities, outcomes and forms of assessment. [...]. Autonomous learning is an integral part of learning foreign languages, not an additional method of teaching. Teachers need to know how to structure lessons and design tasks which assist the learners in their choices and their ability to reflect on and evaluate their learning. [...] It is the teacher's responsibility to provide real learning opportunities for students beyond the classroom."

In many respects, this passage makes the same strong plea for Inquiry Learning which has found expression in TILA and does not seem to have to be restricted to work being done in the sciences (maths, physics, chemistry, biology) but appears very likely to be applicable to the teaching of languages, too. In this section the first of two endeavors to implement Inquiry Learning in tertiary education among students training to be lower secondary English teachers will be described.

4.1 STUDY DESCRIPTION AND RESEARCH QUESTIONS

The Inquiry Learning was facilitated in a type of university course which consisted in equal shares of a seminar with compulsory attendance and self-study and stretched over a period of one semester. The seminar focused on different methods of assessment and was organized in fortnightly double periods, whereas the self-study phase was meant to set tasks which the students could master in approximately 40 hours of work. In order to provide the teacher trainees with sufficient time and guidance, parts of the seminar were used to introduce and discuss CrEEd, and to allow students to share and discuss their ideas and findings. All in all, 15 teacher trainees took part in the project and were encouraged to explore independently a topic area related to teaching English at lower secondary level. The three criteria *General Discovery Interest*, *Method Affirmation* and *Experience-based Hypothesizing* were given room in the attendance phases, as those seemed to be likely to demand a setting in which opinions and ideas could be discussed cooperatively. In this phase, we were following the "Algorithmus des Lernens"[3] (Patry, 2014, p. 19), which places the existence of a clearly defined issue and question at the beginning of the process of solving a problem. The criteria of *Authentic Exploration*, *Conclusion-based Transfer* and *Critical Discourse* were hoped to unfold without any guidance. Referring to Reitinger (2015, p. 614), the learning arrangement included two levels of performance characteristic of CrEEd-arrangements, namely the *theoretical level*, and the *level of participation*. The *level of transfer* was to be focussed on in the follow-up project, which will be described later.

It should be mentioned that the course in which the CrEEd concept was applied followed the conceptual framework of CLIL (Content and Language Integrated Learning). This means that the language students who took part in the project had to deal with both new content and language because they explored their topic area in a foreign language. Coyle, Hood and Marsh (2010) describe four dimensions which are included in this process, the 4Cs, namely *Content*, *Cognition*, *Communication*, and *Culture*. For the application of CrEEd it was important for the inquiry coach to be aware of this added complexity and to provide content-related as well as linguistic support.

Materials gathered from the involved student teachers of English were their *CrEEd-reports* (r_{01}-r_{15}), a written account of their exploratory work, and *reflection notes* (n_{01}-n_{07})

3 algorithm of learning (author's translation)

which they were asked to take at various steps of the Inquiry Learning process. These documents were analysed by use of content analysis applying deductive categories (cf. Mayring, 2000) according to the criteria and pedagogical principles of Inquiry Learning. Table 2 sums up the twelve categories which were being used.

TABLE 2. *Categories for Content Analysis*

Criteria of Inquiry Learning	Principles of Inquiry Learning
Category 1: General Discovery Interest	Category 7: Trust
Category 2: Method Affirmation	Category 8: Self-determination
Category 3: Experience-based Hypothesizing	Category 9: Safety
Category 4: Authentic Exploration	Category 10: Clearness
Category 5: Critical Discourse	Category 11: Structuring
Category 6: Conclusion-based Transfer	Category 12: Personalization

The following research questions guided the empirical work:

RQ 1: How are the *criteria* of Inquiry Learning represented in the student teachers' reports?

RQ 2: How are the *pedagogical principles* of Inquiry Learning represented in the student teachers' reports?

RQ 3: How are the *criteria* of Inquiry Learning represented in the student teachers' reflections?

RQ 4: How are the *pedagogical principles* of Inquiry Learning represented in the student teachers' reflections?

RQ 5: Do student teachers of English choose *topics related to Inquiry Learning* for their individual exploration?

4.2. RESULTS

In this section, a summary of the most striking answers to the five research questions derived from the analysis of the CrEEd-reports and reflection notes will be given.

RQ 1: How are the *criteria* of Inquiry Learning represented in the student teachers' reports?

In order to find an answer to RQ 1, a content analysis of eleven student reports was carried out, four of which had been written collaboratively by two student teachers of English. In other words, the pieces of work of 15 teacher trainees could be included in the content analysis. The results will be presented according to the above mentioned twelve categories, resp. the six criteria and six pedagogical principles of Inquiry Learning which constitute the definitional frame construct of TILA.

In Category 1, *General Discovery Interest*, two subcategories could be determined which encompass the roots of curiosity of the participating students. Subcategory C_{1_1}: *Internal Roots* includes two opposing concepts, namely *lack of knowledge and skills* and *abundance of knowledge and skills* as the main sources of interest. The following two statements illustrate the student teachers' primary source of motivation to choose their topic: *"The main reason why we have chosen the topic "testing" is, that we did not have a lot of information about ways of testing"* ($r_{08\_}r_{09}$[4]), and, *"the most decisive argument for choosing this topic is that both of us are passionate actors who enjoy using the classroom as a stage"* ($r_{10\_}r_{11}$).

Subcategory C_{1_2}: *External Roots* comprises reference to events or activities which triggered off the interest in a particular topic. Here, student teachers most frequently referred to experiences in their teaching practice, followed by interest developed through extensive literature review or brought about by controversial discussions about a subject matter. In the following statement an interrelation of the two subcategories becomes evident:

> *"I tried to find out interesting facts about this topic because I really didn´t know a lot about it. I had a dyslexic child when I was in my teaching practice, but I had no idea how I should deal with it"* (r_{12}).

All in all, the student teachers demonstrated an intense sense of curiosity about exploring topics related to teaching and learning English in the lower secondary classroom, which clearly showed in the frequent use of the adjective *"interesting"*.

Statements which could be attributed to Category 2, *Method Affirmation*, were rare among the data which were analysed. However, two statements pointing into opposite directions may help to raise awareness among educators planning to employ CrEEd in their educational work concerning heterogeneity of groups of students: On the one hand, student teachers were happy to be allowed to follow their individual interests in an autonomous way, *"This time we could actually choose a topic by ourselves and that was a great idea! So we could all do some (research) work on topics we were actually interested in"* (r_{07}). On the other hand, teacher trainees expressed uncertainty at the beginning of the process, *"When we were told to write about a methodological topic, chosen by ourselves, we were unsure what we should actually write about"* ($r_{08\_}r_{09}$).

Category 3, *Experience-based Hypothesizing*, was represented to a full extent in the student teachers' reports. Statements ranged from mere assumptions, *"I was sure that everybody must know about the great improvement a movie can add to the English classroom"* (r_{07}), to research questions, *"Why does teaching grammar in the abstract way not work in lower secondary school?"* (r_{06}), and hypotheses, *"Including drama in classrooms helps pupils to de-*

4 The combination of two codes by use of an underscore indicates the collaborative work of two student teachers.

velop and increase self-confidence, especially regarding their speaking skills" (r_{10}_r_{11}). All participating student teachers were able to put their scholarly interest into words.

The participants in the study found a multitude of ways to explore their topic areas in an authentic way (C_4: *Authentic Exploration*). Most student teachers decided to carry out some literature review which was followed by empirical work employing qualitative methods such as classroom observation (r_{01}, r_{13}_r_{14}), surveys (r_{02}), and expert interviews (r_{02}, r_{04}_r_{05}, r_{13}_r_{14}), or conducted action research (r_{03}, r_{10}_r_{11}, r_{13}_r_{14}, r_{15}). Their choice was sometimes guided by experiences they had gained previously, e.g., *"Since I already have some experience with action research […], I decided to use it for my report, too"* (r_{03}).

C_5: *Critical Discourse* was represented only to a small degree in the analysed data. It is referred to in statements which describe the high value of working together with a fellow-student and having the possibility to discuss the subject matter with other teachers and pupils (r_{03}, r_{08}_r_{09}).

Similar to the results described in the section about Category 1, *General Discovery Interest*, a distinction can be made concerning the statements subsumed in Category 6, *Conclusion-based Transfer*. Subcategory C6_1: *Internal Transfer* refers to effects of knowledge gained by means of exploration on the student teachers' teaching style. A large proportion of student teachers of English declare readiness to incorporate their findings in their future life as language teachers and to continue their research, e.g., the writer of r_{15} wants to make sure she is *"going to find more ideas how to reduce Teacher Talking Time (TTT) in order to make the pupils work independently as often as possible"*. For some students, the exploration already had an impact on their actions: *"I changed my way of teaching"* (r_{06}).

Moreover, student teachers of English feel the urge to pass on their knowledge, which finds expression in Subcategory C6_2: *External Transfer*. They want other teachers to get to know what they have discovered, *"the theory should be spread out to all teachers, so that all teachers can adapt their preparation and teaching to this fact"* (r_{06}), they would like to tell parents *"if the language course had an effect on the language competence and if their parent's money was spent in an appropriate way"* (r_{02}), and they go so far as to suggest how the current situation should generally be changed: *"abstract teaching has no place in lower secondary school and must be banned from our E[F]L (English as a Foreign Language) lessons"* (r_{06}), or, *"in school we need more specialists to give the children what they need"* (r_{12}).

All in all, the results show that all criteria of Inquiry Learning unfolded to various degrees in the student teachers' reports.

RQ 2: How are the *pedagogical principles* of Inquiry Learning represented in the student teachers' reports?

This part of the article aims to show if and how student teachers of English refer to the action-orchestrating frame construct of TILA in their CrEEd-reports. In general,

only three of the six pedagogical principles could be determined in the teacher trainees' writings, namely *Self-determination, Structuring* and *Personalization*. As the latter was referred to predominantly, it will be given some consideration here.

Personalization was evident both linguistically and as regards content. Individual perceptions are expressed by means of first-person accounts of activities such as *"choosing", "being interested", "wondering", "considering"* (r_{02}, r_{10}–r_{11}, r_{13}–r_{14}), *"focussing on"* (r_{03}), *"thinking about", "remembering"* (r_{07}), *"discovering", "aiming at"* (r_{08}–r_{09}), *"trying to find out", "being shocked"* (r_{12}), *"being motivated"* (r_{13}–r_{14}), *"keeping in mind"* (r_{13}–r_{14}), and *"being aware of"* (r_{13}–r_{14}). In addition, the aspects discussed in the presentation of the results in Category C_{1_1}: *Internal Roots* and C_{6_2}: *Internal Transfer* point in the direction of a very personal approach to exploring a topic area. Regarding *Self-determination*, all three components, *autonomy*, *competence-orientation,* and *social relatedness* could be determined in the student teachers' reports.

RQ 3: How are the *criteria* of Inquiry Learning represented in the student teachers' reflections?

As one might expect, there were many similarities between the representation of all criteria in the student teachers' reports and their reflection notes. However, some opinions only became evident in the documents which teacher trainees were asked to produce in addition to the actual CrEEd-report. Therefore, they will be presented in the following section.

Regarding Category 1, *General Discovery Interest*, one new aspect emerged in the student teachers' notes which will also be relevant in the presentation of the results in other categories, namely the *reference to the bachelor thesis* which student teachers have to write as a final academic paper. Teacher trainees stated that they had already been or were still dealing with the topic or a related one in the context of writing their bachelor thesis (n_{03}, n_{06}). Another student teacher showed characteristics of a reflective practitioner (Schön, 1983) stating that he wanted *"to know what the theory says about this and if it covers the reality"* (n_{05}).

The general tenor of statements in Category 2, *Method Affirmation*, is very positive and student teachers fully accept and appreciate that they are given the possibility to explore a topic area of their own choice in a self-determined manner. However, some teacher trainees asked mention that they would have preferred carrying out a task like this at an earlier point of time in their studies at the teacher training college (n_{01}, n_{02}, n_{05}, n_{07}). The reasons they give are two-fold. On the one hand, student teachers refer to the workload they have to cope with in their second last semester, especially because of the fact that many of them are writing their bachelor thesis in addition to doing their regular coursework, *"it is simply hard to reconcile all the requirements"* (n_{05}). On the other hand, teacher trainees believe that gaining competence in exploring a topic area in a self-determined way and reporting on it in written and oral form in English would have helped

those who were writing their thesis in English or would even have encouraged more people to write their bachelor theses in the field. This idea finds expression in sentences such as *"maybe more people would have decided to write their bachelor thesis in English if we had done something like this before"* (n_{01}).
In the trainees' points of view, the criterion Experience-based Hypothesizing (C_3) demanded intense involvement with the chosen topic to unfold (n_{01}, n_{02}, n_{03}, n_{06}, n_{07}). They chose different strategies to arrive at conclusions which enabled them to phrase their research questions and hypotheses, ranging from indulging in reading about the topic (n_{01}, n_{03}, n_{06}) to drawing up mind maps collaboratively (n_{07}).
Some trainee teachers stated that the process of Authentic Exploration (C_4) was inhibited by the fact that the college's library did not offer sufficient reference literature to work with (n_{01}). Additionally, being able to *"talk about different ideas"* (n_{01}) was considered very helpful in this part of the Inquiry Learning experience and was seen as conducive to the unfolding of the criterion.

The criterion *Critical Discourse* (C_5) did not find complete expression in the student teachers' reflection notes. This is partly due to the fact that some of the student teachers had already handed in their reflection notes before the procedure could be discussed in a plenary session, partly because of the fact that some of the students had not finished their explorations by the end of the accompanying seminar. In general, in their reflections student teachers focussed more on the actual results of their own and their colleagues' explorations than on the whole process.

Concerning the criterion *Conclusion-based Transfer* (C_6), many student teachers seemed rather indifferent, a few even reluctant to share their newly-acquired knowledge with their fellow students. As a whole, trainees did not consider their results to be valuable enough to be passed on, *"[my wish to share what I've found] depends on how groundbreaking my discoveries were"* (n_{03}), or did not want to impose their views on other people, *"I do think that my results are very important for teaching but I would not tell a soul about it if no one asks me"* (n_{05}). However, as mentioned above, student teachers expressed willingness to apply their knowledge to their own teaching (n_{06}).

RQ4: How are the pedagogical principles of Inquiry Learning represented in the student teachers' reflections?

The action-orchestrating frame construct of TILA was fully represented in the student teachers' reflections. Referring to the principle of Trust, they stated that they felt *"free to ask"* (n_{01}, n_{03}, n_{05}, n_{07}) and that they could trust that the tutor was *"interested in this topic area"* (n04) and *"would try to help […] with suggestions"* (n_{05}).

Self-determination was expressed in a multitude of statements. The main prominence was given to the aspects of *autonomy* and *social relatedness*. Trainees used the terms *"intrinsic motivation"* (n_{03}, n_{05}), *"self-determined"* (n_{07}) and went so far as to use the noun *"freedom"* (n_{06}). Moreover, they pointed out the importance of not being alone in the

process of investigating and developing one's concept further: *"Writing in pairs gives you the chance to connect and extend your main ideas"* (n_{07}).
The following statement sums up how the criterion *Safety* found expression in the student teachers' reflection notes: *"It is fine to explore things in a self-determined way because all of us know that our tutor helps us if we need help"* (n_{01}).

As far as the pedagogical principle *Structuring* is concerned, one trainee teacher said that he would not have written down his research questions if he had not been asked to do so (n_{04}). Considering the importance of consistently pursuing a clearly defined aim for any kind of exploration, it could be argued that granting criteria-orientation produced the desired effect in this particular situation.

The pedagogical principle *Personalization*, in other words, the individual person's perception of the activity as relevant, can be summed up best by providing a statement made by one of the student teachers of English: *"While reading the theory and writ[ing] my paper, I was able to connect the theory to past experiences and, consequently, I had some wonderful "WOW"-moments"* (n_{05}).

RQ 5: Do student teachers of English choose topics related to Inquiry Learning for their individual exploration?

Taking a closer look at the ten topics the 15 student teachers of English chose for their exploratory learning phase, one can detect three strands. First, a group of widely discussed issues relating to teaching English as a foreign language, namely *"Grammar and Language Acquisition"* (r_{06}), *"Testing"* (r_{08}–r_{09}), and *"Dyslexia"* (r_{12}). Interestingly, even in these areas student teachers of English came up with suggestions which are consistent with the theory of Inquiry Learning insofar as they clearly focussed on individualization:

> *"It is our aim to give pupils the chance to prove their personal skills and strengths in several fields. In our opinion it is important to take away pupils' fear when it comes to testing by giving several opportunities which count equally for a mark"* (r_{08}–r_{09}).

Second, the teacher trainees chose topics which are loosely related to Inquiry Learning, these are *"Immersive English Language Week"* (r_{02}), *"What to Do How and Why When Watching English Movies with Pupils"* (r_{10}), and *"Drama in the English Lesson"* ($r_{10—11}$). Again, despite the loose connection, a statement made about the use of drama in the English classroom clearly refers to the pedagogic principle of trust: *"The kids taught us to believe in their abilities, as all of them did a great job"* (r_{10}–r_{11}).

Third, there are four topic areas which show a close connection to Inquiry Learning: *"Time on Task – Two Schools in Comparison"* (r_{01}), *"Pupil Motivation by Pupil Activation"* (r_{03}), *"Homework versus Cyber Homework"* (r_{04}), and *"Effectiveness of Homework"* (r_{13}–r_{14}). As the titles cannot give a full account of what is covered in the report, some

short extracts will be given in order to illustrate this connection. The following quote is taken from one student's introduction to the report, entitled *"Time on Task – Two Schools in Comparison"* (r_{01}): *"I recognized that a lot of pupils lose their curiosity as well as their thirst of knowledge, which made me think"*. This observation made the student record and analyse the time teacher and students spent on tasks practising the four skills in an English lesson. *"Does autonomous learning activate pupils and create more motivation in English lessons?"* (r_{03}), was another question which was posed by a teacher trainee. In the context of exploring the use and effectiveness of homework the following statement was made: *"We strongly believe that if you have options, you are much more interested in doing your exercises than everybody doing the same type and nothing individual"* (r_{13}–r_{14}). In general, the analysis carried out in order to answer RQ5 showed how ever-present Inquiry Learning is in the student teachers' perspectives.

5 Project 2: Moving on – CrEEd at Work in Secondary Education in the United Kingdom (UK) and Austria (A)

In this section, a follow-up project to "CrEEd meets English Didactics" is presented, which developed, in a real CrEEd-manner, in a rather different direction than originally planned.

5.1 STUDY DESCRIPTION AND RESEARCH QUESTIONS

The above mentioned change of plan was brought about by the fact that half of the student teachers of English involved chose to do their practical work placement the UK, instead of gaining some teaching experience in an Austrian lower secondary school. Therefore, the original outline of the project, which would have focused on the process of changing roles from inquiry learner to inquiry coach, could only partly be followed. Only two teacher trainees actually outlined a CrEEd-sequence in the classes they taught; the other students assumed the roles of observers who analysed the lessons they were allowed to sit in on during their placement in the UK according to the criteria of Inquiry Learning. In other words, they took notes which they then tried to fit into the OPeRA-Portfolio (see Table 1). They were encouraged not only to use the "performance"-section of the portfolio but also to reflect on what they were able to observe in class, and to include ideas of how they could outline a similar learning situation. All in all, eight CrEEd-observations of lessons ($CO_{1\text{-}8}$) and six personal comments ($PC_{1\text{-}6}$) on lessons by student teachers could be examined. The CrEEd-arrangement at the Austrian school was accompanied by a detailed description in the OPeRA-portfolio (CO_{A1}) and written feedback given by 18 Austrian pupils, which was coded as CO_{A2}. With reference to this two-fold international focus, the following research questions were examined:

RQ1: How do the *criteria* of Inquiry Learning unfold in lessons observed by student teachers in the UK?
RQ2: How do the *pedagogical principles* of Inquiry Learning unfold in lessons observed by student teachers in the UK?
RQ3: How do the *criteria* of Inquiry Learning unfold in lessons taught by student teachers in their practical work placement in A?
RQ4: How do the *pedagogical principles* of Inquiry Learning unfold in lessons taught by student teachers in their practical work placement in A?
RQ5: Does the unfolding of the *criteria* and *pedagogical principles* in A differ from the UK in the descriptions of the teacher trainees?

5.2 RESULTS

The following section summarizes the key findings of the study.

RQ1: How do the *criteria* of Inquiry Learning unfold in lessons observed by student teachers in the UK?

As regards Category 1, *General Discovery Interest*, the two subcategories which emerged in the preceding study, *internal* and *external* roots which trigger off curiosity, could be determined in the obtained data again. Pupils involved in the observed lessons were described as either having had the chance to choose the school subject themselves or being genuinely interested in the topic, both of which hints at high intrinsic motivation, or were encouraged to indulge in a topic by means of suitable pictures, presentations, or impressive examples.

Concerning *Method Affirmation*, the teacher trainees all assert that Inquiry Learning was commanded and individualization was restricted to allow pupils to choose from a pre-defined range of topics. *Experience-based Hypothesizing* was described as having taken place individually as well as collaboratively in the observed lessons. Pupils were encouraged to create mind maps and mood boards in order to structure their foreknowledge and to make and share their assumptions.

Data which could be attributed to the criterion *Authentic Exploration* described autonomous, authentic and collaborative demeanour of the observed inquiry learners. Autonomy was granted by encouraging pupils to use a variety of resources such as webpages, magazines, handouts, coursebooks, and realia. Teachers employed two strategies in order to enhance authenticity. First, they invited *"ten executives of external companies [who] worked with the pupils in different groups"* (C_{O4}); second, pupils could learn through hand-on experience when they designed a product step-by-step from a first draft to placing it on the market. Additionally, students point out the importance of suitable framework conditions under which the learning experience is supposed to take place. According to their descriptions, teachers had rooms especially equipped for their subject-specific purposes in which they could display all the materials which were needed throughout the whole phase of Inquiry Learning.

Critical Discourse was given a considerable amount of attention in the student teachers' statements. Pupils were encouraged to reflect on both their results and working processes in plenary sessions. Self- and peer-assessment were carried out, and external experts gave additional feedback. In general, this phase is marked by a large amount of positive encouragement and praise. In some cases pupils received a prize if their result was considered to be the best. Interestingly, accuracy did not seem to be of major concern in the external experts' reactions to the pupils' work.

In the English setting, *Conclusion-based Transfer* took place both in the classroom and beyond, ranging from traditional presentations to a fashion show (C_{O7}) in which the results were shown, board games (C_{O6}), and an invitation to present the main findings at the one of the headquarters of a big mulitnational technology company (C_{O1}).

RQ2: How do the *pedagogical principles* of Inquiry Learning unfold in lessons observed by student teachers in the UK?

The six pedagogical principles of Inquiry Learning were all determined in the data. In order to better establish rapport between learners and teachers and, consequently, foster a feeling of *Trust*, 30 minutes a day (divided into ten minutes in the morning and 20 minutes after lunch time) were set aside for *"registration time"* (PC_5) which was used by the form teachers to discuss matters with their pupils. Moreover, pupils were consistently encouraged to *"speak their mind"* (PC_3) and there was room for *"everyone's opinion"* (PC_1).

Regarding *Self-determination*, the analysis of the data indicated a clear focus on fostering independent thinking among pupils. One respondent went so far as to state that he could determine a difference between merely *"accepting pupils' opinions"* (PC3) and *"really encouraging them to think different[ly] and independent[ly]"* (ibid.). The principle of *Safety* was adhered to in the form of guidance given by teachers as well as external experts.

In all educational settings which were included in this analysis, the overall aims and objectives of the learning process were clearly communicated to the learners, so that both the principle of *Safety* as well as *Structuring* was adhered to. Some teachers gave time limits by which a certain step in the learning process had to be completed.

Personalization took place to a high degree according to the descriptions of the student teachers. Pupils took over roles in a company (PC_6). Teachers used pictures to show what the life of children was like at a certain period of time in history ($C0_6$). Own opinions were obtained by use of brainstorming, asking for opinions, making assumptions, and sharing personal experiences.

RQ3: How do the *criteria* of Inquiry Learning unfold in lessons taught by student teachers in their practical work placement in A?

In the Austrian context, *General Discovery Interest* was triggered off by *Personalization* by asking pupils to research their favourite or future job. *Method Affirmation* and *Experience-based Hypothesizing* were the criteria which unfolded only partially in the educational setting provided by the student teachers. In their opinions, this was mainly due to the fact that Inquiry Learning took place in a fairly heterogeneous and unexperienced group. Despite the fact that pupils agreed to work independently at first, some of them did not reach the declared aim, and in general pupils were lacking experience concerning posing questions and making assumptions. All in all, pupils appreciated being allowed to choose their individual research method, especially using computers. Some would have preferred carrying out their *Authentic Exploration* in teams rather than working individually. The time set aside for *Critical Discourse* was not sufficient in the student teachers' point of view. This is said to be particularly true for the process of reflecting the process. Opinions of participants in the project differ widely as to whether *Conclusion-based Transfer* was to be regarded as a useful and necessary part of the process. Some pupils had not reached the stage at which they wanted to share their knowledge and were *"horrified"* (CO_{A1}) when asked to do so, the reasons for which were not explained in detail by the student teachers.

RQ 4: How do the *pedagogical principles* of Inquiry Learning unfold in lessons taught by student teachers in their practical work placement in A?

Apart from the above mentioned principle of *Personalization*, statements concerning *Trust, Safety,* and *Clearness* could be determined. Demand-orientation in the context of providing safety appeared to be of particular importance in the largely heterogeneous group of pupils.

RQ 5: Does the unfolding of the *criteria* and *pedagogical principles* in A differ from the UK in the descriptions of the teacher trainees?

The main differences between the Inquiry Learning phases in A and the UK will be summed up divided into the two areas *external educational settings* and *internal educational settings*, and their respective relations to the criteria and pedagogical principles of Inquiry Learning. When focussing on the impact of *external* regulations on Inquiry Learning procedures, three aspects were referred to in the data. First, providing opportunities to choose subjects individually seems to support the unfolding of the criterion *General Discovery Interest* and the principle *Personalization* in the UK. Moreover, including external experts contributed to demand-oriented support of the inquiry learners. In addition, aim orientation helped to bring into effect the principles of *Safety* and *Clarity*. However, student teachers stated that they liked that *"teachers have more freedom in Austria"* (PC_6).

Internal regulations showed differences concerning the principle of Trust and the criteria *Authentic Exploration, Experience-based Hypothesizing,* and *Critical Discourse*. In the UK, the school provided regular times at which teachers and pupils could build and

strengthen their relationships. Teachers had allocated rooms in which they could set up a learning environment in which pupils could find materials they needed for the phase of exploration. Emphasis was placed upon developing the ability to pose questions and make assumptions based upon individual experiences, and finally, not only the result but also the working process was consistently the focus of feedback and reflection.

6 Conclusion

In order to further pursue the overall aim of the empirical work presented in this article, that is to further develop ways in which Inquiry Learning can be facilitated in the context of the education of student teachers of English, the main purpose of this final part of the article is to point out the desiderata which became obvious due to the analyses of the data.

As regards Project 1, "CrEEd Meets English Didactics", *Method affirmation* was inhibited by some student teachers' inexperience in finding their own area of interest. In the context of Second Language Acquisition (SLA), this aspect has received special attention (e.g. Chaudron, 1988; Long & Sato, 1984 Brock, 1986) in numerous analyses of teacher-talk, especially teacher questions. The main problem might be that "the general picture is one of teacher explaining, questioning and commanding. In contrast, learners mainly respond" (Ellis, 2014, p. 181). For the Inquiry Learning process it might, therefore, be conducive to the course of action if teacher trainers gave their teacher trainees ample opportunity to choose topic areas and pose questions themselves.

Moreover, *Critical Discourse* did not seem to unfold to a large degree in the setting in which the empirical work was carried out. This post-actional phase, whose main purpose is to "evaluate the outcome of the actions undertaken and form causal attributions about the reasons for the success or failure of the action plan" (Ellis 2014, p. 305), most certainly deserves more attention in future projects. In general, it seems as if a clearer focus on formative rather than summative assessment could aid teacher trainees in reflecting on whether a certain procedure has a forming influence on learning (cf. Müller-Hartmann 2014, p. 145).

Project 2, "Moving on – CrEEd at Work in Secondary Education in the UK and A", showed the motivational force of the inclusion of external experts in the learning processes of pupils. In addition, the importance of suitable spatial framework conditions for the phase of authentic exploration was pointed out by the participating teacher trainees. Moreover, establishing rapport and encouraging learners to express their own opinions, even if those differ from the tutor's points of view, seemed to be of particular relevance, especially in the English setting.

As pointed out above, the strong conviction expressed in the concept of CrEEd that a learning process can be regarded as successful even if a set goal is not reached, in other words, focusing on the process rather than the product, applying formative rather than

summative assessment in order to facilitate Inquiry Learning, is not yet held widely among educators and therefore requires careful attention.

Another aspect which became obvious in the description of the CrEEd-phase which took place at an Austrian lower secondary school is the importance of avoiding language anxiety. Second language acquisition research has defined "apprehensiveness about communicating in the L2 in front of the whole class" (Ellis 2014, p. 294) as one of the three major sources of anxiety in the EFL-classroom. In the light of this result, it does not come as a surprise that the criterion *Conclusion-based Transfer* was only represented to a small degree in the teacher trainees' descriptions of the CrEEd-process. Hence, language teachers need to carefully consider how they can help this criterion unfold in an anxiety-free environment.

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6 Need for CrEEd: Chances and Challenges of Inquiry Learning in Student Teacher Training in English as a Foreign Language

Karin da Rocha

The Criteria-based Explorations in Education concept (CrEEd; Reitinger, 2015a) is applicable in various subject areas and for manifold learning situations. This chapter outlines its use in a course in student teacher training in English as a Foreign Language (EFL). On the one hand, the students' experiences with CrEEd are investigated. On the other hand, it is observed how the criteria of CrEEd unfolded. Participant observation, group discussions, and a content analysis of the Inquiry Diary, a learning log based on Reitinger's OPeRA Portfolio (2012), were used to shed light on the processes in the seminar. The students' overwhelmingly positive feedback will be taken into account when pondering the benefits and challenges of CrEEd in this setting.

Keywords: English as a Foreign Language (EFL), learner autonomy, Content and Language Integrated Learning (CLIL)

1 Learner Autonomy at Stake: Introduction

When students at university level are asked to work autonomously in a course, first-hand experience shows that typically two kinds of reactions are displayed. Either learners cheer that they are finally treated like capable adults who are responsible for their own learning, or students are overcome with at least a slight feeling of panic as to how they are supposed to accomplish this seemingly unmanageable task at hand.

Lately, research has increasingly addressed the underachievement of students due to a lack of motivation or of capability of autonomous learning (Balduf, 2009 and references therein; Glynn, Taasoobshirazi & Brickham, 2009; Reeve & Jang, 2006; Reeve, 2009; Shepherd, 2006; Wilde, Wright, Hayward, Johnson & Skerett, 2006). For this

reason Reitinger's Theory of Inquiry Learning Arrangements (TILA; Reitinger, 2013, pp. 186–189) is investigated in order to provide students with an approach which equally encourages autonomous learning and provides a scaffolding structure for that process.

In addition to that, new learning arrangements are considered with the intention of finding a way to increasing the significance of course content for the students. Moreover, the aim is also to raise their awareness of the course's relevance concerning their individual professional development. In recent years, oral presentations and written analyses were dutifully carried out by the students. However, their interest and passion for learning seemed to have been awoken rather infrequently. Thus, the structure of several courses was re-arranged and the Theory of Inquiry Learning Arrangements was incorporated into their design.

In the seminar *Analyzing Course Books* at the University College of Teacher Education Styria, Austria, Reitinger's Criteria-based Explorations in Education concept (CrEEd; Reitinger, 2013) was applied to introduce and enable Inquiry Learning. The learning environment was organized around the concept's main criteria: General Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse and Conclusion-based Transfer. Hence, a semi-experimental small-scale study with 33 student teachers of English as a Foreign Language (EFL) was conducted in the spring term of 2015 to assess the students' perceptions of the new learning setting.

This article briefly touches upon autonomous learning methods and Content and Language Integrated Learning (CLIL) that combine well with the Theory of Inquiry Learning Arrangements in a foreign language learning setting. Moreover, the students' experiences with the novel learning environment will be investigated. Drawing upon these findings, the chances and challenges of inquiry learning arrangements in foreign language student teacher training will be pondered. Finally, the need for employing such strategies regularly in educational settings to help learners develop their learning and critical thinking skills will be addressed.

2 Promulgating a CrEEd: Theory

Reitinger (2013) first tested Inquiry Learning with lower secondary school pupils in science classes. He also used this approach with students to help them structure and reflect on their teaching placement. However, a concept like CrEEd (see Chapter 2 in this volume) is equally employable in other subject areas, e.g., student teacher training in EFL.

CrEEd provides a concept employing the four dimensions *Outline, Performance, Reflection,* and *Analysis*. Outline refers to opting for a learning arrangement "emphasizing that this process is rather a multi-perspectival outlining than a linear-specific planning one" (Reitinger, 2015, n. p.). Performance relates to the implementation of the learning

arrangement. The dimension Reflection contains "profound and critical thinking about arrangement-related experiences" (ibid.) by the instructor. Analysis is recommended to draw conclusions for the future application of Inquiry Learning Arrangements. With regard to Performance, CrEEd aims to enable the evolvement of six specific criteria (Reitinger, 2015a, see also Chapter 3 this volume) in learning arrangements that are characterized by a high grade of individualization and self-responsibility:

(1) *General Discovery Interest* is considered an important factor of motivation. Hence, the learners focus on the analysis of research questions that are of special interest to them.
(2) *Method Affirmation* ensures that the learners approve of the application of CrEEd for the design of the respective learning arrangement. Thus, the instructor, or "inquiry coach" (Reitinger, 2013, pp. 73–75), is responsible for requesting the learners' consent.
(3) *Experience-based Hypothesizing* relates to learners' pre-knowledge and experiences as a basis for further inquiry into a certain research question.
(4) *Authentic Exploration* comprises the learner's individual access to inquiry and research. This includes his or her co-operation with colleagues and inquiry coaches.
(5) *Critical Discourse* within the learning arrangement enables the learners to negotiate perspectives, draw conclusions and construct meaning individually.
(6) *Conclusion-based Transfer* provides the learners with an opportunity to disseminate results of inquiries and individual perceptions. Consequently, learners are encouraged to demonstrate their competence and expertise in the subject in question.

Below, CrEEd will be related to approaches in foreign language didactics that promote learner autonomy.

Implementing autonomous learning in academic courses with future teachers is an ambitious goal to achieve in pre-service training. While intuitively we may know the meaning and scope of autonomous learning, there seems to be little consensus on a definition of the term or its designation. This is visible in the multitude of expressions such as "autonomous", "self-directed", "independent" "self-regulated" "learning" or "study" (Benson, 2011; Bocanegra & Haidl, 1999; O'Doherty, 2006, Arnold & Lermen, 2013 among others). With regard to language learning, Benson (2011) points out that

> [p]erhaps the most important distinction to be made in the field of language learning is between autonomy as an attribute of the learner and self-directed learning as a mode of learning, in which the learner makes important decisions about contents, methods, and evaluation. (Benson, 2011, p.3)

Reitinger's emphasis on the term "inquiry" adds another valuable aspect to the design of learning processes. In this respect, he strongly focuses on taking into account the learners' interests (Reitinger, 2013, p. 29–33). In a more general context, Forster (1972)

succinctly summarizes the core content of independent study in higher education in four central statements:

(1) Independent study is a process, a method and a philosophy of education, in which a student acquires knowledge by his or her own efforts and develops the ability for enquiry and critical evaluation;
(2) it includes freedom of choice in determining those objectives, within the limits of a given project or program and with the aid of a faculty adviser;
(3) it requires freedom of process to carry out the project;
(4) it places increased educational responsibility on the student for the achieving of objectives and for the value of the goals. (Forster, 1972, p. ii, in Candy, 1991, p. 13)

In his Theory of Inquiry Learning Arrangements, Reitinger (2013, pp. 34–36) draws attention to the importance of support in autonomous settings. He explicitly follows Forster's call for an adviser who takes on responsibility for the learning arrangement. This "inquiry coach" (Reitinger, 2013, pp. 73–75; also see Chapter 1 this volume) has to provide models for settings which simultaneously allow individual development and aid the learners in reaching their goals. Thus, responsibility is shifted from teaching to learning (Brown & Atkins, 1990).

Due to the scaffolding inherent in CrEEd, it can be successfully adapted for university students of other subjects than natural sciences. However, when applying such a theory in a foreign language class with pupils, another aspect has to be taken into account. Beginning English language learners' limited range of vocabulary may severely impede the inquiry. Hence, a strong emphasis on *Content and Language Integrated Learning* (CLIL; Mehisto, Marsh & Frigols, 2008; Hallet & Königs, 2013) is recommended. As an essential strategy for foreign language teaching, CLIL "involves using a language that is not a student's native language as a medium of instruction and learning for primary, secondary and/or vocational level subjects such as maths, science, art or business" (Mehisto et al., 2008, p. 11). Consequently, CLIL promotes a dual approach. On the one hand, it encourages language learning in so-called content classes e.g., history or geography. On the other hand, content from various subjects is included in language-learning classes (ibid.). Even though English classes have also always focused on content, CLIL adds another quality. Here, the use of language to describe phenomena or observations including grammatical structures to predict or evaluate and the use of technical terms is strongly reinforced. This strategy is essential when introducing Inquiry Learning in EFL with pupils. Scaffolding is also one of the core features of CLIL methodology, which it shares with Inquiry Learning. Authenticity and active learning (Mehisto et al., 2008, pp. 29–30) are integral parts of both CLIL and Inquiry Learning (Reitinger, 2013, pp. 29–33) and are most appreciated by learners as will be seen below.

3 Credible Sources: Research Design and Methodology

Rooted in the tradition of qualitative research (Flick, 2014), the following research questions were pursued:

(1) How do the students experience the learning arrangement?
(2) How do the students cope with the high amount of choice, freedom, and unpredictability?
(3) How did the criteria of CrEEd become visible in a particular subject?

Participant observation by the instructor (Lamnek, 2010, pp. 498–573), group discussions (Bohnsack & Przyborski, 2010, pp. 233–248) and an Inquiry Diary (based on Reitinger, 2012) were used to shed some light on the processes in the course of the seminar.

The Inquiry Diary was a learning log, which was created especially for the purpose of this project. This structural guideline is based on Reitinger's OPeRA Portfolio (2012), a tool which was designed to assist student teachers in including Inquiry Learning in their teaching placement. One of the six criteria of the CrEEd concept, Method Affirmation, was agreed to in a general introduction of Inquiry Learning in the first session. The other five criteria were incorporated in the development of the Inquiry Diary to raise the students' awareness for research-based work and to foster their critical thinking skills. Moreover, the model invited the students to focus on individual areas of interest and to immerse themselves in a topic of their choice within the given framework of the course.

The diary, which included the criteria General Discovery Interest, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse and Conclusion-based Transfer, was enriched with questions guiding the students into the topic of the course. Moreover, a section for reflective thoughts after the project was added. Table 1 displays the structure of the Inquiry Diary.

TABLE 1. *Inquiry Diary file for Analyzing Course Books*

<table>
<tr><td colspan="3">General Discovery Interest
1. What do you want/need to know about course books?
2. Which criteria can you use to evaluate a course book?
3. In an in-depth analysis of 3 course books, what do you want to focus on?</td></tr>
<tr><td colspan="3">Before you start: Experience-based Hypothesizing
1. What do you expect of a course book?
2. What is your opinion on course books? Are they valuable resources? Why (not)?</td></tr>
<tr><td colspan="3">Authentic Exploration (You can use the table below to take notes.)</td></tr>
<tr><td>Focus of Analysis</td><td>Observations</td><td>Commentary</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="3">Critical Discourse: During the Process (Please take notes during plenary sessions!)</td></tr>
<tr><td colspan="3">Conclusion-based Transfer
1. How do you want to present your results – how will your colleagues learn about your findings?
2. Which criteria can be used to evaluate your presentation?</td></tr>
<tr><td colspan="3">Reflection
1. Did you find out what you wanted to know (see section General Discovery Interest)?
2. Experiences with self-evaluation:
3. Experiences with the course setting:</td></tr>
</table>

When designing the Inquiry Diary Reitinger's suggestion to divide the space for Authentic Exploration into the sections Focus of Analysis, Observations and Commentary were used to draw the students' attention to distinguishing between observation and interpretation.

In the course of the project, a large amounts of data was gathered. The participants' identities were protected by replacing their names with a code including the respective group they had worked in (A, B, C or D), their gender (f: female; m: male) and sequential numbers, e.g., A_f_1. In addition to the completed Inquiry Diaries transcripts of group discussions and minutes of observations were analyzed by applying Mayring's content analysis (2015). Categories emerged inductively while using QCAmaps (Mayring, 2014), an online tool for data analysis. In the presentation of findings below, the categories experience, scaffolding structures, challenges and organization of the individual learning process will be discussed. Table 2 provides the contextualization of the categories mentioned above.

TABLE 2. *Description of categories*

Category	Conceptualization
experience	learners' general commentaries on personal experiences with working in the Inquiry Learning Arrangement
scaffolding structures	learners' references to various means of support
challenges	challenges learners faced that were caused by the new setting
organization of the individual learning process	strategies that were developed by the learners in the course of working in the new setting

An additional look from a deductive perspective was taken to observe if the criteria of CrEEd had unfolded. Before going into detail about the results, the course outline will be briefly summarized.

4 The CrEEd Crowd: Participants and Description of the Course Setting

Thirty-three students of EFL, 16 women and 17 men, at the University College of Teacher Education Styria, Austria were offered an altered learning arrangement in the seminar Analyzing Course Books in the summer term of 2015. This course was divided into eight 90-minute periods. In the first session, Reitinger's Theory of Inquiry Learning Arrangements was introduced and an overview of English school books in Austria was given. After a short summary of the CrEEd concept's features, the students were free to choose between a more familiar teacher-guided approach and the new setting. What Reitinger calls Method Affirmation (Reitinger, 2013, p. 196) reached a one hundred per cent agreement among the students. They were willing to try out the new arrangement without exception. After a short theoretical explanation of the criteria

of CrEEd, the Inquiry Diary was introduced. With the help of this learning log, the approach was put into practice.

The students were not only encouraged to choose their individual focus of research but also their workplace, pace, and way of working, i.e., individually, in pairs or groups. Moreover, the participants were asked to decide on the way of presenting their results and to develop criteria for self-evaluation and teacher (and perhaps colleagues') assessment. A timetable for the presentations in each group was set up after the students had decided who would perform orally, individually or in pairs, as it turned out.

The course's participants were not only provided with a wide range of course books and additional material approved for Austrian schools but also with a scaffolding structure. On the one hand, the goal here was to help them organize their individual learning if necessary. On the other hand, the students were reassured that there would be support available if needed. The Inquiry Diary, which was to be used throughout the term, was introduced in the first session. Furthermore, the last ten minutes of each course unit were scheduled for plenary discussion and questions. Additionally, mid-term feedback sessions were arranged for all four groups. The course instructor was present at all times and open to individual questions and available for professional advice. Table 3 shows the course outline including several scaffolding structures that were offered to enable the criteria of CrEEd to unfold.

TABLE 3. *Course outline*

Setup for the seminar *Analyzing Course Books*						
Session	Method Affirmation	General Discovery Interest	Experience-based Hypothesizing	Authentic Exploration	Critical Discourse	Conclusion-based Transfer
1st	Introduction of TILA and CrEEd; Inquiry Diary	Inquiry Diary	Inquiry Diary	Inquiry Diary		
2nd 3rd					10-minute plenary discussion per session	
4th					Mid-term feedback – group discussions	Mid-term feedback – group discussions
5th 6th 7th					10-minute plenary discussion per session	
8th						Presentations and discussions

Finding a research question to focus on and hypothesizing about it took some learners longer than others. For this reason, General Discovery Interest and Experience-based Hypothesizing cover several sessions in Table 3. Generally, it must be clearly pointed out here that the criteria of CrEEd represent continuous development and not stages to be passed.

Below, the students' experiences with the learning arrangement will be described. First, results from the group discussions that took place after three sessions are presented. Next, an analysis of the Inquiry Diaries is provided, and, finally, the inquiry coaches' perspective is discussed.

4.1 CREEDIBILITY CONFIRMED: STUDENTS' CONTRIBUTIONS TO GROUP DISCUSSIONS

In the feedback sessions, all students agreed that they particularly liked the possibility to choose the research topics according to their interests and the way of presenting results. Thus, two students pointed out that this way of studying *"is not boring"* (D_m_4), *"makes more sense"* (C_m_4) and *"doesn't feel like work"* (A_f_5). Participants clearly referred to the differences to other learning environments. They detected that *"otherwise courses are highly structured. This course is not unstructured but has a different focus: on the students working"* (B_f_2). They felt that the *"learning outcome is higher"* (D_m_3), because if *"you research on your own, you will remember more"* (C_m_2). Furthermore, the students mentioned the advantage of working at their own pace *"without any pressure"* (D_f_3) because *"if you want to, there is the possibility to work at home, too"* (B_m_2). Interestingly, the students observed that they worked harder and more intensively on their topics in this course compared to others because it *"is more interesting if you can choose a topic you like"* (A_f_1) and *"you work for yourself without just fulfilling a task"* (C_m_1).

With reference to scaffolding, students mentioned the general introduction in the first lesson, which proved to be helpful. They especially appreciated the Inquiry Diary which *"offers a useful structure for the process"* (A_m_1) and *"helps to make progress"* (D_f_2). Another student noted, *"I do not feel left alone with the task at hand. The instructor is always there. Help is provided if necessary"* (D_m_4), and *"feedback from colleagues and discussions are possible"* (C_m_1). Their colleagues' comments and contributions were particularly interesting for the participants because the students worked on many different topics. Moreover, the availability of the course books and teaching resources in class was highly valued. One student perceived that *"no buying or lending was required"* (A_f_4) which enabled the participants to *"work in class effectively"* (B_f_1).

Despite the scaffolding, the setting was challenging for many students. As one participant stated, it was *"hard in the beginning, to decide what to do and to choose what to focus on"* (A_f_1). Many of her colleagues agreed, *"It needs [sic] time to get into the topic and to decide what to investigate but then progress is quick"* (B_f_4). One student added that it is *"good that there is a due date for the final presentation, a deadline"* (B_f_4). Many participants commented on their individual learning experiences in an emotional and

very personal way. One student even declared *"I don't know how I learn. I have never had the chance to find out"* (A_m_4). Here he refers to teacher-centered classes at school and at university. Another colleague argued that succeeding in such a setting *"depends on the learner type. For me, school-like instruction is easier"* (D_f_1). Her teammate elaborated on this thought, *"I had not learned how to learn autonomously, how to structure or organize my own learning"* (D_f_2). Several colleagues agree that this needs *"discipline; you have to think for yourself and plan on your own"* (C_m_3). These comments confirm research results from a project conducted in a course on autonomous learning a year earlier (da Rocha, 2015a). These days many students struggle with their learning skills because they were 'taught' and hardly ever intellectually challenged in terms of individual learning.

Finally, some strategic developments which took place in the course of the term will be addressed. First, working in pairs turned out to be a supportive tactic for some learners. One student admitted that *"working with a partner is quite motivating because you feel obliged to do your part"* (A_f_1). Second, cross-group teams emerged when two students found out that they had chosen the same research focus. They co-operated in the course of the process and gave a joint presentation. Third, people who had never worked with each other before paired up because of their topical focus. Other students referred to their strategies, e.g, they *"set a clear goal in the beginning of each lesson and always reached it"* (A_f_5). A few participants stressed how much they enjoyed *"sharing experiences of the working efforts undertaken as it kindles new ideas and can help to resolve problems in one's own research"* (C_m_1).

The results summarized above already show how much the new approach was appreciated after only a few lessons. However, numerous learners struggled with the difficulty of choice when asked to focus on a certain topic. Others detected shortcomings concerning their learning strategies. Nevertheless, remarkable changes referring to the significance of the tasks for the students, the organization of learning and individual strategies became apparent. This was even more clearly recognizable when the Inquiry Diaries were analyzed after the course.

4.2 STUDENTS' CREEDS: REFLECTIONS AFTER THE COURSE

In the last section of the Inquiry Diary the students were asked to reflect on their experiences in the new learning environment after the course had finished. Statements from this section illustrate their individual experiences concerning learning and outcomes.

Most students believed that they were able to answer their research questions and *"they found out even more than what the actual goal was"* (A_f_3). One participant was surprised that her in-depth work *"turned out to be more time-consuming than expected"* (A_f_4). Several students emphasized that the *"detailed research based on defined criteria proved to be exciting"* and *"many further questions for continuative research were raised"* (C_m_1).

A few participants thought deeply about their personal learning processes. One student contemplated that she learned most from her own inquiries *"but also profited a lot*

from colleagues' findings and presentations" (D_f_2). Her teammate also mentioned the value of the group's feedback. She was overwhelmed by the manifold perspectives in the discussions. Her commentary: *"The same topic but so many different views! But I was also proud to have found out things on my own"* (D_f_3). Another student endorsed the importance of debates within the group, which *"confirmed our findings but also clarified that our research is subjective. That was enlightening"* (D_m_4). Thus, Critical Discourse proved to be a valuable asset for the learners.

When asked about their experiences with the course setting, all students agreed that they had learned much about themselves and about the content matter in this course. The statements below highlight this conclusion:

> *The atmosphere was relaxed. There was no pressure. I did more work in the lessons than expected. I always thought that I needed pressure to complete projects but this experience showed me that things can be done in a quite relaxed environment, too.* (A_f_1)

> *I loved it that you [the instructor] let us do whatever we wanted, because if we were not working, it was our problem and our decision.* (A_f_2)

> *I think the idea of having as little teacher input as necessary is great, because the students realize that it is their responsibility to get the job done and to work independently a lot.* (A_m_4)

In these reports the students stress how important it is for successful learning to feel responsible for one's own actions. In addition, these utterances clearly address the necessity that learning arrangements provide ample opportunities to find out about personal learning preferences, strengths and weaknesses. When it comes to coping with a large amount of choice and freedom, struggling participants feel that *"it is a matter of practice to succeed in an inquiry learning environment"* (B_f_1). One student argues that being challenged does not necessarily lead to losing interest,

> *I found the setting of this course demanding, but very good. Once I got used to the unusual freedom, I really enjoyed working this way.* (D_f_2)

These statements, along with the feedback obtained in the students' group discussions, show that competence for individual learning cannot be taken for granted. In addition to the students' perspectives, which were collected in different forms and at various points in time, the inquiry coach's viewpoint was documented.

4.3 CREED OBSERVED: THE BELIEVER'S PERSPECTIVE

The instructor's main tasks in the course of this semester were providing support if needed and observation. In contrast to the usual course settings in which students are required to stay in one room, the participants of the seminar Analyzing Course Books were encouraged to choose where they wanted to work. Interestingly, the students asked permission to leave the room in each lesson. This was especially surprising as they enjoyed working somewhere else, e.g., the computer lab, the library or outside. The learners organized their work differently in every lesson and in each group. Sometimes all of the students stayed in the course room; on other days everyone but one student left. The atmosphere was calm and relaxed, but, nevertheless, the students were concentrated and mindful of others. This was obvious when they quietly discussed issues with a partner and tried not to impede their colleagues' work.

In the semester's early sessions, there was not much work to 'do' for the instructor, which was a completely unfamiliar experience. On the one hand, usually a more active teacher role was taken on. On the other hand, it was difficult not to interfere when students were obviously doing something else and not working on their project. This situation, however, occurred very rarely.

In general, little support was needed. Discussions, e.g., on the process of writing and publishing a school book, legal matters, electronic school books, course books' content, task instructions, the structure of books and extra resource material, took place on a regular basis. Additionally, questions about the final 'product' concerning requirements for the seminar paper, the duration of presentations, and the choice of topics were raised. The regularity of the 10-minute-sessions at the end of each lesson and the mid-term feedback discussion proved to be a scaffolding structure that was much appreciated. The students willingly shared their views, discussed in a lively manner, and participated actively.

In the fifth meeting, the schedules for the final sessions were organized. 25 students opted for oral presentations; 8 participants decided to hand in seminar papers as is shown in Table 4.

TABLE 4. *Students' decisions for presenting their works*

total	female	male	total
oral presentation	11	14	25
paper	5	3	8
	16	**17**	**33**

Remarkably, about a third of the women (5 students) wrote a paper in contrast to only 3 out of 17 men. As participants had been taking notes in the Inquiry Diary from the start, writing a paper probably seemed to be a more logical course of action to these students.

It was not surprising that 25 participants prepared oral presentations for several reasons. First, the students were aware of Conclusion-based Transfer as a criterion for CrEEd and they were interested in learning about and discussing their colleagues' topics and findings. Second, some students pointed out they had to produce numerous papers in their studies and, thus, welcomed oral performances.

The quality of the presentations and papers in this course was exceptionally high compared to those of former years. The students had developed coding systems, visual aids, and rating scales to highlight advantages and disadvantages of certain books. Genuine interest in their topics was perceptible. Specialist topics, like an analysis of music genres in listening tasks, attracted wide interest among the participants. Numerous students went into great depth and shared their reflective thoughts. They elaborated on aspects that could be improved or replaced by more efficient ideas and analyzed their topics in detail. In addition to that, the students engaged in discussions when their colleagues raised questions and involved them in topics of their presentations. This also proved to be very different compared to experiences from earlier years in which students followed their colleagues' performances rather indifferently.

In summary, it can be stated that the adapted learning arrangement not only raised the students' interest in the topic but also added significantly to the reflection on their personal learning. Thus, lively communication and critical analysis consistently accompanied the process.

5 CrEEdtical Criteria: When CrEEd Becomes Visible

With respect to the evolvement of the criteria defining CrEEd, General Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse and Conclusion-based Transfer, Reitinger (2015b, n. p.) alludes to the fact that, despite thorough preparation, the instructor cannot assure that they will emerge within a learning arrangement. As the responsibilities for learning are shifted, 'mentors' (rather than teachers) are merely able to lay the ground for the criteria, and with them to foster Inquiry Learning to develop. With this in mind, connecting topics to learners' interests and making learning individually relevant may be the only way of keeping up motivation for self-determined lifelong learning (Dewey, 1910/2015; Ryan & Deci, 2004; Moegling, 2010; Reich, 2010; Benner, 2015).

Drawing upon the research results, the implementation of Inquiry Learning led to the evolvement of criteria of CrEEd. The analysis shows that these determined categories contribute to making progress visible in such a setting. Table 5 arrays criteria, ways of how their evolvement was enabled, and their visibility.

TABLE 5. *Evolvement of the criteria of CrEEd*

CrEEd criteria	Evolved?	How enabled? (pre-active)	How visible? (post-active)
General Discovery Interest	✓	✓ general course introduction ✓ discussion ✓ Inquiry Diary	✓ rich variety of research topics and in-depth analyses ✓ lively participation and discussion on criteria for book analysis
Method Affirmation	✓	✓ TILA and CrEED introduced ✓ more guided alternative setting introduced ✓ choice	✓ all 33 students agreed on working with the CrEEd approach
Experience-based Hypothesizing	✓	✓ Before you start section in the Inquiry Diary ✓ initial discussion	✓ Inquiry Diary entries ✓ whole-class discussion on personal opinions
Authentic Exploration	✓	✓ Inquiry Diary section ✓ note-taking	✓ choice of individual topics for presentations or papers ✓ completed Inquiry Diary
Critical Discourse	✓	✓ scaffolding structure (time slot for discussion in each lesson) ✓ mid-term feedback discussion	✓ discussions about progress and interesting interim results ✓ focus on several topics (law, process of course book publishing, approval of course books etc.)
Conclusion-based Transfer	✓	✓ discussions among students and with the instructor possible at all times ✓ final 'product' to make findings accessible for the colleagues ✓ final discussion	✓ presentations ✓ papers (and handouts with most important findings for colleagues) ✓ communication in the course of the 'product' presentations

The indicators collected above may serve as a starting point to evaluate if and to what extent CrEEd was evident in this setting. Here, qualitative indicators seem to be especially appropriate as they vary according to the arrangement in which the concept is applied. Thus, course instructors must be willing to adapt scaffolding procedures while implementing the different criteria according to the content areas of their subject. One of the key advantages of CrEEd, then, is its applicability in various fields. A remarkable feature of the concept is its openness to achieving goals which were not defined in advance (Krathwohl, 2002; Reitinger, 2013, p. 81). This refers mainly to metacognitive objectives (Krathwohl, 2002, p. 214).

Currently, Reitinger (2015) is working on an assessment scale for the criteria pertaining to CrEEd. In a nutshell, this tool called Criteria of Inquiry Learning Inventory (CILI) aims to measure the scope of the criteria's manifestation. Here students are asked to evaluate the relevance of several statements concerning the CrEEd concept (see Chapter 4 in this volume).

6 It's CrEEd We Need: Discussion

Taking into account the students' responses from the study depicted above, it becomes evident that, for "the capacity or ability to take charge of one's learning" (Holec, 1979, p. 3), it is urgent and necessary to offer adequate learning arrangements in school and higher education contexts. It can be clearly detected in the participants' experiences that the chosen approach stimulated their motivation (Glynn et al., 2009; Reeve & Jang, 2006; Reeve, 2009) and raised the significance of the seminar's content for their personal professional development. Learners' feedback in the inquiry above confirm "Higher Perceived Competence", "More Positive Emotionality", "Pleasure from Optimal Challenge", "Stronger Perception of Control" and "Higher Rates of Retention" as Reeve (2004, p. 184) observes.

Taking into consideration various experiences with autonomous learning in the preceding semesters (da Rocha, 2015a; 2015b), approaches like CrEEd promote learners' critical thinking and study skills significantly. Student teachers in particular need to experience learning arrangements in which they are responsible for their own progress to a large extent. As such, students come to know both aspects of autonomy as distinguished by Benson (2011, p. 3) as an attitude inherent in the learner and as a way of self-directing the learning process. Testing this approach in the field provides prospective teachers with valuable insight not only for themselves but also for their future work with pupils. Thus, by trying out Inquiry Learning in person the participants contemplate the necessary steps and scaffolding structures. This will aid them in applying the concept in their own foreign language classes and will increase their understanding of the importance of using CLIL.

Despite the positive implications visible in many students' statements above, attention must be paid to the challenges that emerged from the approach taken. Although this study is limited in scope, it reveals several alarming shortcomings in students' learning skills. This, however, is not necessarily substantiated by demerits of CrEEd but a more general ineptitude of participants untrained in learning autonomously. A lack of opportunities to practice at school and in higher education may have contributed to the situation at hand. Here, Inquiry Learning provides a way of strengthening learners' autonomy and self-responsibility. Despite structural obstacles, such as subjects organized in 50-minute-lessons, crowded classrooms, and limited equipment, CrEEd can be incorporated in project-based settings. Indeed, this approach requires instructors, or inquiry coaches, to be not only experts in their fields but also willing to support learners in their endeavors to conduct research.

On balance, the students' overwhelmingly positive reactions and commentaries convey the impression that learners benefit highly from Inquiry Learning Arrangements in student teacher training. Hence, the CrEEd approach affords a structure which enables both scaffolding and working independently. Nevertheless, approaching more open ways of learning in institutionalized settings requires instructors' willingness to see the

necessity of students developing their individual learning skills, to adapt the learning environment accordingly, including the design of scaffolding and evaluation tools, to redefine their own role and activities in class, and to accept the students' choices and decisions concerning topics and their ways of working. It is vital that teachers encourage and support learner autonomy (Reeve, 2004; 2009; Reeve & Jang, 2006). Tools like OPeRA (Reitinger, 2012) or the Inquiry Diary help structure analyses and concurrently leave enough space for proceeding individually.

In order to apply CrEEd instructors need to believe in their students' abilities. They must offer them structures and support if necessary but otherwise let the learners take the lead, or, as one student so succinctly stated,

> *I'd like to thank you for this interesting course and your committed way of conducting it. I think it needs a lot of preparation and courage to embark on such an open way of working. I really appreciate your initiative and this unorthodox course, because I benefitted tremendously from this experience. Only in open learning arrangements and mutual exchange of experiences can this teacher training program achieve what it is supposed to: internalized understanding instead of mere theoretical information.* (C_m_1)

There is definitely a need for CrEEd.

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7 Reflecting the Relevance of Principles of Inquiry Learning: Student Teachers' Estimations

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This article examines an Austrian university course set up according to the CrEEd concept. We investigated the experiences and resulting views as well as patterns of behavior and interpretation articulated by the students in the context of the relevance of Inquiry Learning principles. First, the theoretical reference, the research question, and research design are determined. After a description of the learning set-up, the findings obtained in 27 face-to face talks are presented to reflect the experiences. It becomes clear that with a total number of 45 categories, which can be allocated to 14 main categories, a great variety of opinions was mentioned. The results presented relate to (1) aggregated main categories, which are presented in regard to their frequency of occurrence, (2) a description of various levels of categories referring to the identification, the combination of statements, ambivalent aspects as well as the frequency of occurrence from the students' perspective, and (3) categories and main categories respectively are linked to personal variables. The question whether the practical implementation of the CrEEd concept (see Chapter 3) has an influence on the naming of categories is also investigated. The results allow to establish action inducing conclusions, which are presented in the discussion.

Keywords: CrEEd, university course, student teachers' estimations

1 Introduction

Inquiry Learning can be clearly defined with the help of various concepts. The focus lies on "independent search for personally relevant insights" (Reitinger & Hollick, 2014, p. 55) gained in autonomous, though simultaneously structured processes. In this book, projects are presented that have been carried out with Austrian pupils or Austrian students following AuRELIA (Authentic Reflective Exploratory Learning and Interaction

Arrangement) and CrEEd (Criteria-based Explorations in Education). This contribution examines a CrEEd-based course at an Austrian university. At the end of the winter semester two-phased talks were conducted with the students. In the first part, leading questions aimed at determining the students' experiences and resulting views as well as patterns of behavior and interpretation to establish those in the context of the relevance of Principles of Inquiry Learning. After determining the theoretical reference, research question and research design, the core issue of this treatise will be the description of the learning arrangement as well as the insights gained from the face-to-face talks.

2 Theoretical references

Inquiry Learning, according to Reitinger's approach, allows autonomous, self-determined learning processes. The fundamental intention of Inquiry Learning is based on an orientation along the following criteria: General Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, and Conclusion-based Transfer (Reitinger, 2013, pp. 43–44; Reitinger, Haberfellner, & Keplinger, 2015, pp. 2–3; see also Chapter 3). A multitude of these criteria should, but need not, be expanded. This can mean a complete absence as well as a full evolvement in the sense of a continuous process. The "criteria are understood as indicators, not as procedural steps" (Reitinger, 2013, pp. 17–19, pp. 71–81). CrEEd, therefore, does not provide any procedual steps for this process (Reitinger, 2013, p. 194). However, learning arrangements for Inquiry Learning processes cannot be prepared in detail and are unpredictable concerning the degree of complexity. In order to prevent failure of Inquiry Learning in class, six principles need to be observed. These serve as orientation guidelines on a meta- level and support the learning processes. They are as follows: the principle of Trust, of Self-determination, of Safety, of Clearness, of Structuring, and of Personalization (Reitinger, Haberfellner, & Keplinger, 2015, p. 4). The implementation of Inquiry Learning conforms to the model of OPeRA (Organizational Frame Construct of TILA; see Chapter 1) with its dimensions of Outline, Performance, Reflexion and Analysis as well as following the above mentioned six criteria and principles (Reitinger, Haberfellner, & Keplinger, 2015, p. 5).

3 Description of the Inquiry Learning Arrangement under Examination

The learning arrangement under examination was organized according to CrEEd. To realize the experience of the criteria's evolvement (meta-intention of CrEEd; see Chapter 3) for both the teacher (inquiry coach) and the student teachers, CrEEd was contextualized on several different levels as explained in the following section.

3.1 REALIZING CREED ON THREE LEVELS OF CONTEXTUALIZATION

When applying CrEEd in teacher education, it is recommended to use a multi-level approach that embraces theoretical, social, and practical considerations. To realize this endeavor, at least three levels of contextualization seem to be important:

(1) *Theoretical Level*
An Inquiry Learning arrangement in tertiary education may pursue the goal to introduce Criteria-based Inquiry Learning theoretically to illuminate the conceptual background.
(2) *Participatory Level*
On another level, the inquiry coaches may apply the concept when organizing his or her course pursuing the meta-intention of CrEEd. Hereto, they try to make the emergence of the Criteria of Inquiry Learning perceptible and appreciable for the participating students.
(3) *Transferring Level*
To allow individual experiences concerning the organization of CrEEd on behalf of the students, the inquiry coach may invite them to outline and, in the best case, to arrange a CrEEd scenario for themselves, e.g., in training schools or in other social fields. Afterwards, it is up to the students to keep the meta-intention of CrEEd (best possible evolvement of the Criteria of Inquiry Learning) in mind.

Moreover, the threefold contextualization of CrEEd opens a wide range of possible approaches to organize the pedagogical practice and is, therefore, fruitful for multi-methodological acting on behalf of the inquiry coach as well as the students, not least in the sense of critical multiplism (Patry 2013; see also Chapter 12).

3.2 PERFORMANCE OF THE CREED ARRANGEMENT

In Table 1 a consolidated description of the CrEEd Arrangement targeted in this paper is given[1]. The notes are differentiated according to the three levels of contextualization introduced above.

1 Within another research project published by Reitinger (2015a), this CrEEd arrangement was investigated by applying a quantitative approach. Thereby, the degree of the evolvement of the Criteria of Inquiry Learning Arrangements was measured using the questionnaire CILI-β (Criteria of Inquiry Learning Inventory – β-Version; Reitinger 2015b; see also Chapter 4). The analysis revealed, that the Criteria of Inquiry Learning unfolded significantly better than they do in average learning arrangements in teacher education (see also Chapter 3).

TABLE 1. *The CrEEd Arrangement Concerned*

Level	Description of the Performance of the CrEEd Arrangement
	Type of course Tutorial at an Austrian university *Participants* Twenty-seven students of business education from various terms *Title of course* Didactics of Inquiry Learning *General content* Theory and practice of Inquiry Learning, research on Inquiry Learning, autonomy and participation at school, reflection
theoretical	Through partly media-supported instructions and discussions the students got the chance to internalize necessary fundamental knowledge about TILA (frame constructs of the Theory of Inquiry Learning Arrangement, Criteria of Inquiry Learning, concepts, meta-intention of CrEEd, …)
participatory	The course instructor (Author 3) organized the tutorial according to CrEEd. Thereby, the students were able to experience how an inquiry coach acts by way of example.
transferring	Based on the experiences collected in the tutorial, the students outlined Criteria-based Inquiry Learning Arrangements themselves. They pursued, similarly to the course instructor, the goal to make the Criteria of Inquiry Learning (discovery interest, method affirmation, experience-based hypothesizing, authentic exploration, critical discourse, conclusion-based transfer) perceptible and appreciable for the learners. Regarding the context of learning (school, private domain, other social contexts) and the issues, the students received no constraints.

To outline educational practice according to CrEEd (transferring level), the students chose, among others, the following issues and contexts (see examples in Table 2):

TABLE 2. *Issues and Contexts Chosen by the Students (examples)*

Issue	Context of Learning
Example 1 Plants' dependency on light	Oriented to personally important questions of pupils around botany a differentiated learning environment is organized by the student teacher. This environment offers the possibility to collect information around the issue as well as a range of experiments to attempt. As some questions are also unanswered for the student teachers, they interpret themselves not only as a coach but also as interested members of the learning group.
Example 2 The lifestyle of snails	Four children with special needs and of preschool age are very interested in snails. The acquainted female student teacher asks for their parents' permission and arranges an Inquiry Learning setting for the four children. Preliminary inquiries and discourses lead them to various hypotheses about the lifestyle of snails. Within the Inquiry Learning setting, snails are collected and systematically observed to check the hypotheses. They further establish a snail farm and care for them for some time.
Example 3 Economic systems	Two cousins of a student teacher, aged 10 and 14 years, are interested in economic systems. Therefore, the student teacher arranges a private learning setting and motivates several specified research questions by using picture vignettes (Hauer & Reitinger, 2012). In the course of the investigations and the discourses, ethical questions arise, e.g., "Is it ok to produce products in low-wage countries?"

Twelve out of the 24 Inquiry Learning endeavors outlined by the students were de facto transferred into real practice.

4 Research question and methodological approach

What are the experiences, and resulting views as well as patterns of behavior and interpretation voiced by the students in the context of the relevance of Inquiry Learning

principles? Starting from the treatment, the intervention and the analysis method are described. Then the inductively derived system of categories is presented.

4.1 INTERVENTION

Twenty-seven students of business education at an Austrian university participated in a course that offered concepts of Inquiry Learning like OPeRA and AuRELIA on a theoretical basis and CrEEd on a theoretical as well as practical level. The structure of the course contained three levels (Table 1) and ensured a) theoretical knowledge of Inquiry Learning, b) practical experience of Inquiry Learning, and c) acquisition of the skills to individually design Inquiry Learning Arrangements. A face-to-face reflection talk was conducted at the end of the course (see below).

As only few students had access to authentic school settings, fictitious CrEEd-scenarios were accepted as well as out-of-school arrangements. This open-mindedness resulted in various differentiated projects (Table 2). This variety induces expectations as to differentiated experiences of the students which allow conclusions regarding principles relevant for the students.
The final reflection talk was structured as follows:

a) Main part: guided interview
b) Collaborative evaluation of the performance
c) Final part: assessing feed-back (to check viability) if desired by the students

The reflection talk was also part of the collaborative assessment process. The students' independently compiled contribution towards the course was the basis of the assessment. The grade was established discursively by mutual agreement with the teacher and each student. The criteria were set up by the students themselves in the last course unit:

Criterion 1: Level of in-depth analysis of the topic
(Inquiry Learning, CrEEd, content of the course)
Criterion 2: Meeting the formal criteria in the documentation of the CrEEd scenario
Criterion 3: Degree of reflection

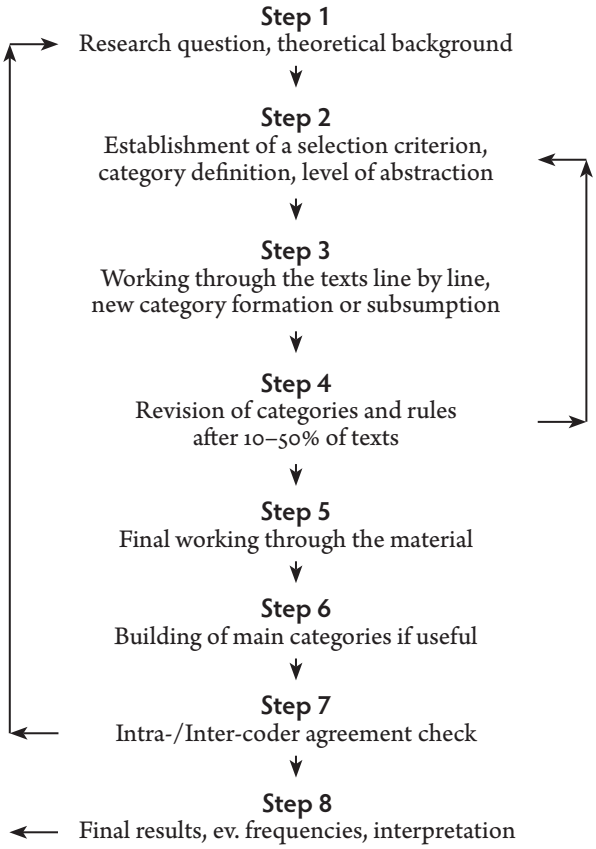
These criteria also justify the collaborative assessment method, as the teacher cannot have the insight to grade the students without their own analysis. The interview was the sole basis of the analysis. Project specific prototypical guidelines were established (see Appendix) and a trial interview was carried out with one student. The interviewee, thus, explained her views, convictions and patterns of behavior and interpretation in connection with the theoretical and practical experiences made with CrEEd. 24 students (5 male; 19 female) followed the invitation to participate in the collaborative assessment method and were subsequently interviewed.

4.2 EVALUATION

The interviews were transcribed and coded on the basis of inductively established categories with the help of the evaluation program QCAmap[2] (Mayring & Fenzl, 2013). It was specifically developed for the use of qualitative content analysis according to Mayring (2014). An advantage compared to other programs is that in a deductive process the guidelines are visible next to the text, while for an inductive approach the definitions of categories and the level of abstraction can be seen.

In an inductive process of finding categories the aim is, according to Mayring (2014, p. 79), to obtain summative categories in one step that can be derived directly from the material and do not stem from theoretical considerations on the basis of paraphrases. This process is diagrammed in Figure 1.

FIGURE 1. *Process of Inductive Building of Categories (cf. Mayring, 2014, p. 80)*



2 This program can be found on a web platform under the link www.qcamap.org and is free to use as open source software.

In Step 1, the research question and the theoretical background are established. For this explorative qualitative study the following question was asked: What are the experiences, and resulting views as well as patterns of behavior and interpretation voiced by the students in the context of the relevance of Inquiry Learning principles? The theoretical background refers to the deliberations of the six criteria according to TILA (Chapter 3).

Step 2 consists of the determination of the selection criteria as well as the category definition and the establishment of the level of abstraction. As meaningful phrases were determined as coding units, this means that neither full sentences nor single words need to be encoded. The complete interview is the analysis item. The emerging system of categories refers to all the interviews that were analysed. Multiple codings are possible, though analysed separately. The definition of categories in the course of the inductive categorisation (Mayring, 2014, p. 79) "serves as selection criterion to determine the relevant material from the texts" (Mayring, 2014, p. 82). The level of abstraction defines "how specific or general the categories have to be formulated" (Mayring, 2014, p. 82). For the research question at hand the category definition determines that only pieces of texts referring to convictions, justifications, patterns of interpretation, action inducing statements, and construction methods are analysed. Following the level of abstraction, very general statements are not taken into account.

Step 3 entails the factual work with the transcribed material. Considering the category definition, suitable pieces of text are identified. Referring to the level of abstraction, categories are then formulated.

After a certain amount of text had been encoded, the inductively established system of categories was revised (Step 4) to examine whether the categories were still compatible with the research question or if modifications had to be implemented. In Step 5 the complete material is encoded following the category definition and the same level of abstraction. Ensuing the encoding process, the single categories were subsumed in main categories. The results of Step 5 are presented in Tables 4 and 5. In the final stage of the process results and interpretation are displayed.

4.3 SYSTEM OF CATEGORIES

Based on the above described process a system of categories with 14 main and 45 sub categories was developed. (see Tables 4 and 5). This section presents the categories based on the summative content analysis. The content bearing passages were paraphrased, reduced by selection and grouping, and partly literally quoted (Mayring, 2010, pp. 66–68). The quotes are printed in italics.

INQUIRY LEARNING BASED ON CREED AS COMPREHENSIVE THEORY

In order to design Inquiry Learning based on CrEEd, it is necessary to understand this concept and to deal with the technical terms. Though from the students' point of view this causes some difficulty in the beginning, its usefulness is soon acknowledged. Some

students find that, in spite of the broadly applicable theory behind CrEEd, the implementation of Inquiry Learning is easy. Those students also underline the great variety of possible applications. Essential elements from the point of view of the students interviewed seem to be *Openness, Time Resources, Self-determination, Trust* and *Structure*.

OPENNESS AS AN ESSENTIAL ELEMENT

Students experienced CrEEd as more open than AuRELIA, which is tied to a procedural structure, thus, probably being more restrictive in its application. CrEEd is tied to the six principles, however, it does not have the rigid structure of AuRELIA and, thus, allows more room. The action inducing aspect of CrEEd's openness is remarkable and expressed in the following quote[3]: *"I find one should definitely pursue the openness that characterises this concept"*[4] (I_5, B32).

SELF-DETERMINATION AS AN ESSENTIAL FACTOR

Due to the high measure of Self-determination made possible by CrEEd, the learners can work on individually meaningful questions and interests. The participation in decision finding processes and the orientation towards the interests and needs of the learners have made Self-determination palpable. Therefore, when implementing their projects, students tried to put the experience of Self-determination into practice. In the following quote, an action inducing conclusion becomes apparent: *"Self-determination is part of my project, because pupils can decide themselves which questions they are able to answer, to which degree they want to look into the matter, which methods they want to use"*[5] (I_6, B9).

STRUCTURING AS A DISTINGUISHING MARK

What helped the structuring process among others was the analysis and examination of the theory behind CrEEd, as well as the decision what each of the students wanted to explore, the ensuing critical discourse, and the reflection talk. Structuring is an essential feature that helps not to feel lost and not to lose oneself. Structuring gives a feeling of security.

SECURITY AS AN ESSENTIAL FACTOR

The principle of security was seen as an underlying precondition for free development and addressed from two perspectives. Security is conveyed, on the one hand, by teachers being available when questions arise. On the other hand there is the structure of the process that supports the feeling of security.

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3 The interviews were conducted in German. For better readibility, the English translation was provided in the main text. The original wording can be found in the footnotes.

4 "Ich finde die Offenheit, die dieses Konzept charakterisiert, sollte man ganz stark verfolgen."

5 "Selbstbestimmung ist durchaus dabei, weil in meinem Entwurf die Schüler auch selbst bestimmen können, welche Fragestellung sie beantworten können, inwieweit sie das Thema behandeln wollen, mit welchen Methoden sie das bearbeiten wollen."

TRUST AS AN ESSENTIAL FACTOR

Building Trust was experienced as essential, and two aspects were addressed, namely Trust in another person and Trust in one's own abilities. During Inquiry Learning one needs to be able to rely on the others. Some students said that *"without Trust inquiry teaching and learning cannot work"*[6] (I_10, B4).

DEPENDENCIES REGARDING PERSONALITY RELATED VARIABLES OR PERSONS

According to some students, the authenticity of the teacher, the conviction and dedication with which they guide the process, and the self- confidence they radiate play an important role. Another important factor is the readiness and availability to deal with questions and to accompany the process. However, it is important that *"the teacher as facilitator does not structure the process too much"*[7] (I_22, B5). A further decisive factor is the relationship established with the learners.

DEPENDENCIES REGARDING SYSTEM RELATED VARIABLES

Half of the interviewees named the subject as a variable for a successful implementation of Inquiry Learning. At first, doubts were expressed as to the practical realization of Inquiry Learning in economically orientated subjects like business management or accountancy. Five of the sceptical students revised their opinions in the course of the semester. *"I wanted to find a topic for business management or accountancy to prove myself that Inquiry Learning can also be applied in those topics and not only in physics or biology"*[8] (I_3, B1).

Related to age groups, the realization of Inquiry Learning opinions were divided. While some assumed that pupils aged 15 to 18 years would show rather less interest in self- determined learning, others believed that Inquiry Learning would definitely be possible in the same age group.

Concerning types of schools, opinions differed in a similar way, though age groups or subjects were also included in the considerations: *"Primary school yes, secondary school perhaps, physics or so, business school I cannot imagine"*[9] (I_2, B34).

If one wants to do Inquiry Learning based on CrEEd, more time needs to be included in planning than with didactic teaching. Compared to traditional classroom teaching, Inquiry Learning is seen as more time consuming. If CrEEd is intended, more time will probably be reserved for it.

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6 "… ohne Vertrauen kann Forschendes Lehren und Lernen nicht funktionieren."

7 "die Lehrperson als Prozessbegleiter den ganzen Prozess nicht zu sehr strukturieren soll."

8 "Ich wollte vor allem ein Thema von Betriebswirtschaftslehre oder Rechnungswesen finden, weil ich mir das selbst beweisen wollte, dass man bei solchen Themen auch forschendes Lernen anwenden kann und nicht nur im Physik- oder Biologieunterricht."

9 "Volksschule ja, Hauptschule vielleicht, Physik oder so Handelsakademie oder so kann ich mir nicht vorstellen."

Two students assumed that small group sizes are a key success factor for this type of individualised learning. This form of learning suits individualisation and is ideal for heterogeneous groups.

INQUIRY LEARNING AND UNDERSTANDING

Some students emphasized the fact that they not only learned in theory what Inquiry Learning (CrEEd) stands for, but that they could experience Inquiry Learning in their seminars. Furthermore, they planned and implemented a project concerning this form of learning. By interlacing theory and practice, the understanding of CrEEd grew. Finally, some concepts were revised. In the beginning, persons adopted a skeptical attitude concerning the functioning of self-determined learning at school, but this assumption changed during the course of the seminar: *"At the beginning I believed that self-determination in schools would be a problem but gradually when I dealt with the question in depth, I thought, not really"* [10] (I_2, B6).

Furthermore, the notion that Inquiry Learning depends on the individual subjects was also revised. In the beginning, skepticism was prevalent whether Inquiry Learning could be implemented in subjects like business administration, but in the final interviews it was repeatedly stated that *"in retrospect I can actually say that I am convinced now that I can implement this concept"* [11] (I_23, B6). Inquiry Learning was experienced as something new and at the same time triggered ambivalences.

ASPECTS OF INNOVATION

Inquiry Learning was experienced as something new, something that *"sets itself apart from standard/mainstream procedures"* [12] (I_5, B24). It was seen, so to speak, as an alternative program to other courses, *"because these are usually all lectures"* [13] (I_8, B26).

The concept of Inquiry Learning does not have situations in which teachers "stands in front of their pupils" presenting content, regardless of whether the pupils pay attention or not, or learning phrases in which pupils practice mechanically, for example, accounting entries, but CrEEd fosters pupils to be active and self-determined in what they want to acquire.

10 "Am Anfang hab ich mir selber gedacht, vielleicht ist das in der Schule mit der Selbstbestimmtheit ein Problem, aber dann, wie ich mich näher damit auseinandergesetzt habe, hab ich mir gedacht, nein eigentlich nicht."

11 "… ich jetzt im Rückblick eigentlich sagen kann, dass mich das eigentlich davon überzeugt hat, dass man das einsetzen kann."

12 "von etwas Normalem abgrenzt"

13 "weil da sind normalerweise immer die Vorträge"

AMBIVALENCE IN RELATION TO INQUIRY LEARNING

By asking the introductory question of what learners are interested in and what they would like to do, they reacted showing irritation and even a feeling of excessive demand and uncertainty, *"because usually you always get everything ready-made"*[14] (I_5, B26); *"at the beginning there was a tiny factor of uncertainty"*[15] (I_5, B10). This Self-determination, however, *"was a brand new experience"*[16] (I_5, B10), which at the beginning was irritating but in the end opened new perspectives: *"for me the decisive learning point happened in the practice classes where I understood that there is a different type of teaching"*[17] (I_6, B20).

Doubts also existed with regard to the children's abilities to steer learning processes autonomously. Additionally, it was questioned whether small children can address learning content even if it is not interesting for them, for example, *"that they must know the fundamental operations of arithmetic"*[18] (I_17, B10).

In the beginning it was difficult to understand that openness and autonomy in the learning process need Structure nonetheless. Experience taught that these principles do not exclude each other but that both can exist simultaneously: *"Self-determination certainly is an important point, but only if linked to Structure, so there is really no room for contradiction"*[19] (I_15, B25).

Especially those students who appreciate a very structured approach understood that sticking to structures specified in advance can limit openness and, thereby, autonomy. Therefore, it would be important to tolerate the fact that not every single step can be planned in advance and that *"the result can be very different to what one has conceptualized in the beginning"*[20] (I_18, B21). One student assumed that with a growing pedagogical expertise one develops greater confidence in one's own skills and this confidence allows for more flexibility in one's actions (I_14, B25).

If a certain method of learning is stored in one's brain that describes a teacher as a person who can control all steps in the learning process of each learner only by working on the same topic at the same pace, an inner conflict arises and the learner starts having doubts about its implementation. A belief exists that the teacher-up-front-style or group work means centralized control and monitoring (I_22, B38). Furthermore, concern was expressed in relation to a certain openness *"in how far it gets out of control or may get out of control, when it is open to such an extent"*[21] (I_19, B38). Also doubts were

14 "weil man ja sonst immer alles vorgegeben bekommt"
15 "da war am Anfang ein bisschen ein Unsicherheitsfaktor"
16 „Selbstbestimmung war eine ganz neue Erfahrung"
17 "… für mich war der große Lernpunkt in der Übung, dass es auch eine andere Art des Unterrichtens gibt."
18 "dass es die Grundrechnungsarten können muss."
19 "Die Selbstbestimmung ist sicher ganz ein wichtiger Punkt, aber auch in Verbindung mit der Struktur, dass das wirklich kein Widerspruch ist."
20 "dass es dann ganz anders enden kann zum Schluss, als man sich das im Vorhinein gedacht hat."
21 "… wieweit artet das aus oder wieweit kann das ausarten, wenn das dermaßen offen ist."

raised which reactions this form of Inquiry Learning could cause among colleagues or parents, if they maybe put up resistance (I_3, B13).

LEARNING PROCESSES IN INQUIRY LEARNING

In order to design Inquiry Learning based on CrEEd, it is important to understand this concept and to deal with its terminology. Even if it seems to be extremely difficult to begin with, eventually, this concept will become obvious and logical (I_14, B7). As one student stated, factual knowledge is indispensable.

As one of the basic prerequisites for successfully implementing Inquiry Learning by CrEEd, two students state that it would be important for learners to understand that there is neither an explicit right nor wrong. They referred to the fact that they repeatedly encouraged their learners and tried to take away fears of making mistakes (I_3, B11).

Students link Inquiry Learning to an action focused approach and self-motivated activities, and it becomes clear for them that this form of learning has a higher efficacy in retaining facts in memory: *"If you can experience this learning process yourself, then you definitely learn it more easily than if a teacher stands in front of the class and talks about a certain topic"*[22] (I_17, B30).

In addition to the postulate that Inquiry Learning significantly helps to retain facts in memory and can support retentiveness (B46, B47), this form of learning was seen as an opportunity to reach taxonomically higher goals: *"The chalk and talk approach is most likely more effective if I want to drum certain content, which, as I've said, is based on facts but if I aim at taxonomically higher goals it is definitely more meaningful to work in that way"*[23] (I_22, B41).

In this learning setting, one student sees the opportunity for the learners *"to find out by themselves what they already know and what they still need to practice"*[24] (I_24, B44).

By implementing Inquiry Learning, learners assess their own level of knowledge. Furthermore, it must be stated that by not defining everything in great depth, by prescribing step by step procedures, the pupils are better prepared for their professional lives where they are not given detailed step by step instructions of what to do (I_24, B45).

The quote, *"I also do not think that Inquiry Learning will stop after one lesson or after project mornings"*[25] (I_3, B14), refers to Inquiry Learning as a starting point. Once curiosity and interest are aroused, the learning process can begin.

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22 "… wenn man auch selbst die Erfahrungen machen kann, dann lernt man das sicher leichter, wie wenn dann wer vorne steht und das erzählt über ein bestimmtes Thema."

23 "Frontalunterricht [ist] sicher sinnvoller, wenn ich irgendwelche Sachen einbläuen will, die, wie gesagt, auf Fakten basiert sind, aber wenn ich auf höher taxierte Ziele abziele, ist es sicher sinnvoller, wenn ich so arbeite."

24 "selbst herausfinden zu können, was sie schon kann und was sie noch nicht so gut kann."

25 "Ich glaube auch nicht, dass Forschendes Lernen nach so einer Unterrichtsstunde oder einem Projektvormittag aufhört."

MOTIVATION AND INQUIRY LEARNING

One of the characteristics of Inquiry Learning is that it fosters motivation, *"that pupils show a high degree of motivation, which cannot be seen in ordinary conventional teaching"* [26] (I_11, B49).

Motivation was fostered mainly through the high degree of Self-determination. If one allows a free choice of topic as part of the learning process, this enables learners to start their own learning process. They do not have to learn something that is preset from the outside. Intrinsic interest is fostered by having the wish to set out on individual research. One student attaches importance to the fact that intrinsic motivation and the interest in finding something new are important characteristics of Inquiry Learning, but at the same time states that intrinsic motivation is difficult to arouse from the outside (I_6, B29).

When the younger brother suddenly did not see himself as a pupil but as a researcher it was noted that *"learning can be a lot of fun […] And it happened that he was sitting there and was totally enthusiastic and wanted to know when they could do it again, and this weekend again when I was home he asked when we could do Inquiry Learning again"* [27] (I_14, B40).

5 Results

In the following sections first descriptive results according to the categories as stated in section 4 are presented. The first aspect relates to the aggregated main categories, which are presented in regard to their frequency of occurrence. This is followed by a description of various levels of categories referring to the identification, the combination of statements, ambivalent aspects as well as the frequency of occurrence from the students' perspective. In the third part, categories and main categories respectively are linked to personal variables. The question whether the practical implementation of the CrEEd project (see Chapter 3) has an influence on the naming of categories is investigated.

5.1 DESCRIPTIVE ANALYSIS OF THE IDENTIFIED MAIN CATEGORIES

The first aspect of interest should allow a rough summary, which of the defined main categories were most or least frequently named. In this paper, the absolute and the relative frequency respectively in relation to the number of mentions is described. The statements are grouped according to the main categories only. Detailed results in relation to the coded categories within the framework of creating categories inductively (Section 4.2) are summarized in Section 5.2. As main categories, the following were mentioned:

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26 "…, dass die Schüler mit einer Motivation dabei sind, was bei einem normalen konventionellen Frontalunterricht nicht da ist."

27 "… Lernen auch Spaß machen kann, (…) Und da war es so, er ist echt da gesessen und voll begeistert, na und tun wir das wieder und er hat mich auch dieses Wochenende, da war ich daheim, und da hat er dann auch wieder gesagt, tun wir wieder forschend lernen und so."

TABLE 3. *Absolute and Relative Frequency of Main Categories*

Main category	absolute frequency	relative frequency
Ambivalences related to Inquiry Learning	53	20%
Locating of dependencies related to system variables (e.g. age, subject, school type)	35	14%
The learning process and Inquiry Learning	30	12%
Trust as a crucial factor	29	11%
News character	24	9%
Self-determination as a crucial factor	20	8%
Inquiry Learning and understanding	18	7%
Motivation related to Inquiry Learning	18	7%
Locating interdependencies related to personality variables or persons	14	5%
Inquiry Learning as a comprehensive theory	7	3%
Openness as a crucial factor	6	2%
Individualization as a crucial factor	3	1%
Structure as a crucial characteristic	2	1%
Safety as a crucial factor	1	0%

Regarding the information in Table 3, the most frequent ambivalences are related to Inquiry Learning (53 namings = 20% of namings), the locating of dependencies related to system variables (35 namings = 14% of namings), the link between the learning process and Inquiry Learning in general (30 namings = 12% of namings), and finally Trust as an essential/crucial factor (29 namings = 11% of namings). Few namings occur in relation to the main categories of Safety, Structure, Openness and Individualization as crucial elements (less than 5% of namings). Moreover, Inquiry Learning as a comprehensive theory is mentioned only seven times (3%).

5.2 A DESCRIPTIVE ANALYSIS OF THE IDENTIFIED CATEGORIES

Relevant information can be gained from the analysis of namings related to the participating students. As explained in Section 4.1, altogether 27 students took part in the study. The absolute and percentage frequency shown in Table 4 do not refer to namings, but to the number of participating students. In this way, the frequencies of multiple answers of individual student are adjusted.

TABLE 4. *Absolute and Relative Frequency of Identified Categories*

Category	appears in N of documents	appears in % of documents
Ambivalences related to Inquiry Learning		
Irritation caused by allowed autonomy	7	29%
Acceptance (e.g., by colleagues, parents)	1	4%
Observation of thought out Structure in spite of self-determined processes of pupils	5	21%
Keeping the results open	4	17%
Ambivalence between Structure and autonomy	13	54%
Doubts as to practical implementation	9	38%
Learning process and Inquiry Learning		
Importance of factual knowledge	9	38%
Awareness that there is no right and wrong	2	8%
Inquiry Learning as the starting point for further learning	1	4%
Self-activity as the key for learning	5	21%
Visualization as a possibility to revise and reflect on what has been learned	2	8%
Inquiry Learning in order to achieve taxonomically higher goals	1	4%
Inquiry Learning as the possibility to learn to assess one's own level of knowledge	1	4%
Inquiry Learning as a possible theory for your practice in professional life	1	4%
Inquiry Learning supports memory performance	2	8%
Visualization increases retention rates	1	4%
Inquiry Learning as a comprehensive theory		
Easy feasibility	4	17%
Wide applicability of Inquiry Learning	1	4%
No influence of age, school type	1	4%
Inquiry Learning and Understanding		
Revising a subjective theory	10	42%
Personal experience as the key for understanding	5	21%
Individualization as crucial factor		
Inquiry Learning allows individualization	1	4%
Individualizations as a possibility of dealing with heterogeneity	1	4%
Motivation in the context of Inquiry Learning		
Interest in research as a prerequisite of Inquiry Learning	7	29%
Experimentation to increase motivation by pupils	1	4%
Fostering motivation by Inquiry Learning	5	21%
Increasing motivation through CrEEd	1	4%

Category	appears in N of documents	appears in % of documents
News character		
Inquiry Learning as an alternative to traditional methods of learning	3	13%
Inquiry Learning as a completely different learning method	6	25%
Contrasting program to other learning methods	10	42%
Openness as a crucial factor		
Openness varies according to different methods/one variant being Inquiry Learning	3	13%
Openness as a process characteristic of Inquiry Learning	2	8%
Locating of dependencies related to personality variables or persons		
Teacher as a crucial factor	6	25%
Influence of the personality	5	21%
Locating of dependencies related to system variables (e.g. age, subject, school type…)		
Influence of subject	13	54%
Influence of subject	5	21%
Influence of school type	5	21%
Influence of group size	1	4%
Influence of preparation time	2	8%
Self-determination as a crucial factor		
Issue management as a possible means of implementing Self-determination	13	54%
Safety as a crucial factor		
Safety as a prerequisite for free development	1	4%
Structure as a crucial characteristic		
Inquiry Learning needs Structure	1	4%
Structure creates Safety	1	4%
Trust as a crucial factor		
Existence of the three pillars of Trust	18	75%
Trust per se as the basis for Self-determination	1	4%

Looking at the information given in Tables 2 and 3, the following picture related to the frequency of occurrence of the individual categories emerges. Two thirds of the students name Trust as a crucial factor. This is apparently an aspect on which consensus prevails. More than half of the students (13 students = 54%) regard issue management as an opportunity to implement Self-determination. About 40% of the students address aspects such as doubts in the implementation (9 students = 38%), the importance of factual knowledge in the context of Inquiry Learning (9 students = 38%), Inquiry Learning as a possibility of revising subjective theories (10 students = 42%), and Inquiry Learning in contrast to other courses (10 students = 42%). Further aspects which were named by

at least one fifth of the students are the irritation caused by allowed autonomy (7 students = 29 %), self activity as the key for learning (5 students = 21%), one's own experience as the key for understanding (5 students = 21%), the interest in discovering as a prerequisite for Inquiry Learning (7 students = 29 %), the potential of Inquiry Learning as a completely different form of learning (6 namings = 25%).

Furthermore, the two categories of locating of dependencies related to the variables of personality or persons are named by more than one fifth of the students (teacher as a crucial factor, 6 students = 25%), influence of personality (5 students = 21%).

In this context it is an interesting aspect that the two principles of Safety and Structure are almost exclusively seen in terms of ambivalences. As this aspect became evident at an early stage of the study, already in the framework of inductive categories (Mayring, 2014), extra categories were created. Thus, students articulate that a well-reasoned Structure needs to be observed in spite of the self-determined process of pupils (5 students = 21%) or directly address the ambivalence between Structure and autonomy (13 students = 54%). As presented in Chapter 1, the existing concept, which allows elements such as Structure and autonomy to be very pronounced at the same time, apparently led to irritation among students at the beginning.

In addition, there are aspects which were interpreted by students in a diametrically opposed way. On the one hand, Inquiry Learning was seen as a comprehensive theory which can easily be implemented (4 students = 17%), is widely applicable (1 student = 4%) and is independent of age or school type (1 student = 4%). On the other hand the dependency between system variables like subject (13 students = 54%), age (5 students = 21%), school type (5 students = 21%), group size (1 student = 4%), and preparation time (2 students = 8%) are named.

Summing up, it can be stated that students who were in contact with Inquiry Learning for the first time clearly mention ambivalences and irritation. Furthermore, the dependence on individual subjects is addressed. Students attach high priority to factual knowledge in relation to Inquiry Learning. They talk about Inquiry Learning as having the potential to revise their subjective theories and they experience this method as something new. In particular, the principles of Self-determination and Trust seem to be of particular importance from the students' perspective.

5.3 Implementation of the CREED project and the emergence of main categories

The third aspect that was analyzed is related to the division of the main categories into two subcategories as described in Section 5.1. In total, the data of 24 students referring to the identified main categories are available. Out of the 24 students, 10 actually implemented the CrEEd project; 14 students planned it in theory. The cognition-inducing interest of this part lies in the identification of possible differences between these two groups of students. The question arises if those students who, in addition to the theoretical outlining, have realized the implementation, are now likely to pose questions

regarding different aspects of learning to those emphasized by students who did not put the theory into practice.

For the analysis, the namings were recoded according to students and categories so that only the naming of a particular category was noted and not the frequency of the namings. After the calculation of the relevant main categories (total score), the data were also revised so that the information for which main category at least one indicator was named was available for each student. In this way it was not taken into consideration whether one student named more than one indicator of a main category.

The summarized presentation of this information is shown in Table 5. Considering the most striking differences in relation to the subgroups, two categories which were named more frequently by the students who actively implemented CrEEd can be seen. They refer to Inquiry Learning as a possibility to build understanding and to foster motivation. In this context, revising a subjective theory and seeing one's own experience as the key for understanding are named in the main category, "Inquiry Learning and understanding". The outcome is plausible as regards content, as these two main categories become particularly visible in the framework of practical implementation. It should be noted, however, that the difference with one or two namings is very small and that a study would require a larger sample. The namings of students who only theoretically planned CrEEd have shown that there are also two main categories which are particularly notable (see Table 5).

TABLE 5. *The Implementation of the CrEEd Project and the Occurrence of Main Categories*

	persons with at least one naming in the given category						
ambivalences	**active**	**% active**	**passive**	**% passive**	**sum**	**Diff. abs.**	**Diff. rel.**
Inquiry Learning and Learning	9	90	10	71.4	19	-1	18.6
Inquiry Learning as comprehensive theory	3	30	3	21.4	6	0	8.6
Inquiry Learning and understanding	7	70	5	35.7	12	2	34.3
Individualization	1	10	1	7.1	2	0	2.9
Motivation	6	60	5	35.7	11	1	24.3
News character	6	60	9	64.3	15	-3	-4.3
Openness	2	20	2	14.3	4	0	5.7
Dependencies on personality variables	4	40	5	35.7	9	-1	4.3
Dependencies on system variables	8	80	9	64.3	17	-1	15.7
Self-determination	4	40	9	64.3	13	-5	-24.3
Safety	0	0	1	7.1	1	-1	-7.1
Structure	0	0	2	8.3	2	-2	-8.3
Trust	6	60	12	85.7	18	-6	-25.7

Note:
% active: percentage of students who actively implemented the CrEEd project
% passive: percentage of students who only planned the CrEEd project in theory
difference absolute: absolute difference in namings between the two groups (a negative sign means that this category was more frequently named by students who only planned the CrEEd project in theory)
difference relative: relative difference in namings between the two groups (a negative sign means that this category was more frequently named by students who only planned the CrEEd project in theory)

As Table 5 shows, these students name Self-determination more frequently and Trust as a principle of Inquiry Learning. These terms correspond to the exact wording in the theory of Reitinger (2013, pp. 46–60). In regard to the other main categories, there are either slight accumulations in the group of students who have planned the CrEEd project only in theory or no significant discrepancies at all.

In conclusion, it can be seen that students who have also actively implemented the CrEEd project mention aspects which occur in theory but were not explicitly named as principles there. This becomes strikingly obvious in the practical work. Students who have not made the transfer into practice, on the other hand, more frequently name fundamental notions which are directly taken from the theory. These were discussed within the courses in theory.

6 Discussion

Having dealt with the question which experiences, beliefs, perspectives and patterns of action and interpretation as well as construction methods students articulate in connection with the relevance of the Principles of Inquiry Learning in the process of reflection, it becomes clear that with a total number of 45 categories, which can be allocated to 14 main categories, a great variety of opinions was mentioned. Some of them can also be interpreted toward action-guiding deductions.

In the main category of Self-determination as a main factor, for instance, the following conclusions can be drawn. Self-determination when allowed and experienced guides learners' actions when implementing projects. It was an important issue for the students to experience and allow Self-determination when developing projects. Considering the locating of dependencies related to personality variables or persons, it can be seen that the teacher not being mature in his/her personality and not feeling competent enough could be a factor preventing the implementation of CrEED at school.

The locating of dependencies related to system variables, e.g., age, subject, type of school, seems to have an influence on action-guiding principles. The implementation of Inquiry Learning was seen from divergent perspectives when it comes to the age group. Some suggested that pupils between 15 and 18 are more likely to have less interest in self-determined learning while others thought that Inquiry Learning would definitely be feasible with the same age group. These subjective convictions could also have an effect on one's action-guiding principles.

The belief that Inquiry Learning cannot work in business-oriented education was partly revised by the belief that individual subjects would be of decisive influence. Two students think that the smaller the group, the more this form of individualized teaching would be successful. If a large group of pupils were to be taught, the action-guiding belief would result in rejecting Inquiry Learning as a suitable method.
From some students' point of view, there were doubts in regard to self-determined learning at the beginning of the course, some of which could be partly resolved during various activities. So, the following conclusion can be drawn that self-determined learning is highly likely to lead to an implementation of self-determined learning as long as the Principles of Inquiry Learning are applied. Another deduction refers to motivation in the context of Inquiry Learning. If Inquiry Learning is applied, this will have a positive impact on the motivation of pupils.

This article is an exploratory approach towards the subject of implicitly or explicitly mentioned beliefs of students which, in retrospect, opens up a wide field of possible research projects. In further studies, an explicit reference to action-guiding must be taken or subjective theories (Groeben et al., 1988) need to be taken into consideration respectively. At the present moment, this cannot be achieved through the collection of initial beliefs by means of guided interviews. Here, for example, methods of providing structure (Patry & Gastager, 2011) need to be used in order to take into account the complexity of subjective theories.

Appendix

Discussion guidelines (key questions) for the interviews conducted in the course of the final reflection setting after the investigated intervention (CrEEd arrangement):
In the course of our joint seminar you have a) experienced Inquiry Learning, b) studied Inquiry Learning in terms of content and theory, and c) designed a course yourself.

KQ1: What have you, according to your opinion, learned for the teaching profession?

KQ2a: Please remember the six principles of Inquiry Learning once more: on which of them did you personally put the focus while experiencing CrEEd in the seminar? In detail: Were there principles whose implementation in the seminar you could explicitly experience and some others in which difficulties and uncertainties became obvious?

KQ2b: In which way could you personally feel and observe these principles within the work in the seminar? Please name one concrete example to illustrate the concept.

KQ3: In retrospect, which of the principles of Inquiry Learning would you consider as most conducive to the joint course, practice, and/or project implementation? Please give reasons for your decision.

KQ4: Which principles do you feel ambivalent about when considering Inquiry Learning? Can you describe this feeling?

KQ5: Would you see additional action-guiding principles that could be of importance for you?

KQ6: Is there anything you would like to comment on in relation to experiences gained through Inquiry Learning in the course?

Additional questions

(1) Would you outline more projects according to CrEEd in the future? Is it practicable or profitable for you?

(2) Which advantages do you see in CrEEd compared to other approaches?

(3) Did you understand the model from the beginning? If not, what did you have problems with?

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8 AuRELIA Meets Mathematics Didactics: Inquiry Learning in Student Teacher Training

Beatrix Hauer

This article explores the application of a self-determined Inquiry Learning arrangement according to the AuRELIA concept in the field of mathematics didactics and shows its effectiveness with regard to the special self-efficacy of student teachers concerning the realization of inquiry-based learning arrangements. Moreover, it aims to show to what extent student teachers consciously experience the criteria of Inquiry Learning when carrying out an AuRELIA project.

Keywords: AuRELIA concept, inquiry learning, special self-efficacy, mathematics didactics

1 Introduction

This article deals with the application of the AuRELIA concept of self-determined Inquiry Learning in the context of teacher education. AuRELIA is an acronym for "Authentic Reflective Exploratory Learning and Interaction Arrangement". The project referred to in this article explores possible ways in which the new concept might be implemented in academic teacher education by testing and evaluating the learning arrangement, which was developed in the context of secondary education, in the field of mathematics didactics. Moreover, using the example of mathematics didactics, it will be discussed if AuRELIA, which claims to be open to all subject areas, especially to the natural sciences (Reitinger, 2012a, p. 75), can live up to these expectations.

2 Inquiry Learning in Mathematics

According to Messner (2009, p. 22), the process of researching is characterized by "einer bestimmten Haltung. Neugierde gehört dazu. Wissenwollen, die Bereitschaft, den Dingen auf den Grund zu gehen"[1]. Ulm (2009, p. 90) argues that Inquiry Learning takes place if learners at least partially become familiar with a topic area which was unknown to them and seemed complex before by means of independent cognitive activity.

The seven-part AuRELIA concept was developed by Reitinger (2012a, p. 78) based on Reich's (2006) levels of actions in the learning process and Demuth's (cited after Parchmann in Messner, 2009) theory of knowledge acquisition processes in the context of natural sciences, and is oriented towards the principles of self-determined, trust-based, clearly structured and individualized learning. It claims to allow both openness concerning the learning process, as well as structuring with regard to researching actions. Inquiry Learning according to the AuRELIA concept fosters individual, independent questioning, researching, and methodological proceeding (cf. Hauer, 2014, 2015).

AuRELIA is based on the assumed existence of a pre-existing *general discovery interest*. In a classroom, this wish or even need to explore something further can develop by itself or can be fostered, for example, by means of a stimulating conversation, impressive experiments, puzzling, unexpected or contradictory experiences (Reitinger, 2012a, p. 99). This is exactly the point where the realisation of the concept commences, when student teachers or pupils develop scholarly interest by themselves. In a seminar setting, which will be described further below, this interest was fostered by use of image vignettes.

Developing this scholarly interest and agreeing to adopt this particular method constitute the first stage of the seven-part structure (*Emergence*), as shown in Table 1.

TABLE 1. *Structure of the research process underlying the AuRELIA concept according to Reitinger (2012a; 2012b; 2013)*

Stages	Short Description
Emergence	developing an individual meaningful scholarly interest; showing agreement concerning the pre-defined structure of the research processes (= Method Affirmation)
Speculation	establishing a connection between questions posed at the first stage of the research process and pre-existing knowledge and cognitive models; formulating of hypotheses
Conception	cooperative planning of the study
Investigation	putting the concept into practice
Discovery	analysing the obtained data and findings; proving of hypotheses
Critical Phase	summarizing and evaluating the results and the research process; defining the areas of personal relevance
Transfer	applying; publishing (opening up the discourse to the public)

1 "a particular attitude. Curiosity is part of it. Wanting to know, the willingness to get to the bottom of something" (author's translation).

The following Table 2 shows how the Criteria of Inquiry Learning unfold at the different stages of the AuRELIA concept.

TABLE 2. *The Relation between AuRELIA and the Criteria of Inquiry Learning (Reitinger, 2013, p. 88; cf. also p. 14, this volume)*

AuRELIA phases / **Criterion**	Emergence	Speculation	Conception	Investigation	Discovery	Critical Phase	Transfer
Discovery Interest	*	**					
Method Affirmation							
Experience-based Hypothesizing							
Authentic Exploration							
Critical Discourse							
Conclusion-based Transfer							

The light-gray fields (**) mark phases in which the respective criterion generally unfolds. The dark-gray fields (*) mark the main parts of the phases which can be directly attributed to a specific criterion in the AuRELIA process (Reitinger, 2013, p. 88; see also Table 1, Chapter 2).

In addition to the six criteria of Inquiry Learning (General Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Exploration, Critical Discourse, Transfer), AuRELIA is oriented towards six principles, namely Trust, Self-Determination, Clarity, Safety, Structuring and Personalization. According to Reitinger (2013, p. 88), this orientation towards the criteria and principles of Inquiry Learning constitutes a "theoretisch begründete prozessförderliche und damit handlungsleitende Konzeptdimension, die auch unmittelbare Praxisrelevanz aufweist"[2]. To gain deeper insight into AuRELIA, please refer to Reitinger (2013) and to Chapter 2 in this volume.

2 Translation: dimension of a concept which is both theory-based and conducive to processes and directive to actions. Hence, it can be considered as directly practice-oriented.

ACCOUNT OF PRACTICAL REALISATION

At this point, a short description of the actual realisation of the individual steps of the AuRELIA concept in Maths lessons is given.

TABLE 3. *Account of Practical Realisation*

Stages	Short Description
Emergence	The Discovery Interest of the research partners when running an AuRELIA project on the subject of Modeling in Maths lessons was aroused by means of 40 image vignettes (methodological structure). In addition, Method Affirmation concerning carrying out the project was sought and given. The 40 image vignettes used in the phase of Emergence were chosen from the trainees' worlds of experience, including pictures taken on the university campus (indoor swimming pool, copying machine, library, beverage vending machine) and pictures showing hobbies, e.g., sports, or topical issues.
Speculation	In this phase, Discovery Interest was expressed, and specific hypotheses were formulated. The following topic areas were dealt with in the AuRELIA project by the teacher trainees: comparison between students' ways to the college (duration, distance); comparison of expenses between going to work by an own car or using public transport; extent and variety of physical activity of student teachers; reading habits of trainees; comparison between real estate prices, average income and the building of swimming pools in various regions of the federal state; questions concerning football/soccer.
Conception	The research partners developed possible concepts in teams. The inquiry coach was available on demand in order to support them. In this phase, the inquiry learning process took place in the library, at computer work stations, in a seminar room, and on the university campus.
Investigation	The phase of Investigation was organized in diverse forms including measuring, calculating, conducting expert interviews, carrying out internet and literature research, and performing video analyses.
Discovery	The interest of the research partners was constantly kept awake because of the fact that the research question had been formulated by themselves. Some hypotheses were not confirmed. These surprising results during the research process had a positive impact on the participating student teachers and made them search for additional facts which proved their initial assumptions incorrect.
Critical Phase	Each team shared their findings by means of power-point presentations and posters. After each presentation, some feedback was given.
Transfer	A summary of the findings could be made available for all participants on an online platform which accompanied the seminar.

3 Research Project

The following section provides a detailed description of the empirical study which was carried out in order to explore its effectiveness.

DESCRIPTION OF THE STUDY

In this project, first and second year student teachers of mathematics were encouraged to experience the seven phases of the AuRELIA concept. They were asked to develop and solve tasks with regard to Inquiry Learning related to "modelling", one of the areas of competence in mathematics, choosing freely within the topic areas "numbers, data, facts" in the context of a teacher training college and its teacher trainees.

The study focuses on teacher education. It aims to find out to what extent student teachers consider themselves enabled to apply the concept in a classroom after experiencing and testing the situation of the inquiry learner themselves (see Hypothesis 1). More-

over, the study explores if and to what extent teacher trainees implemented the criteria of Inquiry Learning when carrying out the learning arrangement (see Hypothesis 2). A quantitative analysis was carried out in order to examine the following hypotheses.

HYPOTHESES

H1: The implementation of the AuRELIA concept increases the special self-efficacy concerning self-determined arrangements for Inquiry Learning.

H2: Students who were taught according to the AuRELIA concept rate the extent to which they experienced Inquiry Learning higher than students who were taught in a traditional seminar setting.

EMPIRICAL STUDY DESIGN

In order to examine the two hypotheses, four seminar groups were taught according to the AuRELIA concept. These groups included in the project and the survey equalled the ones which had already been formed for various other classes in the two different years of teacher training, namely MB 2, MA 2, MB 4, and MA 4. The seminar was taught by the same person in all groups.

Hypothesis 1 was examined by use of a switched replication (Weinberger, 2013, p. 91). The procedure included four groups of teacher trainees, MB 2, N = 20; MA 2, N = 21; MB 4, N = 21, and MA 4, N = 13, who all served both as treatment and as control group[3]. In the first phase of the study, MB 2 and MB 4 underwent the treatment, and MA 2 and MA 4 acted as the control groups. In the second phase, the groups' functions were reversed, i.e., MB 2 and MB 4 served as the control groups and MA 2 and MA 4 as the treatment groups.

The following table shows the phases of the study which was carried out among the students in the second semester.

TABLE 4. *Treatment: 2nd Semester*

O_1 (April 2015)	**6 to 8 lessons**	**O_2 (April 2015)**	**6 to 8 lessons**	**O_3 (April 2015)**
special self-efficacy (H1)	*Treatment phase MB 2 (N = 20)*	*special self-efficacy (H1) ← Inquiry Learning (H2)*	*Baseline phase MB 2 (N = 20)*	*special self-efficacy (H1)*
special self-efficacy (H1)	*Baseline phase MA 2 (N = 21)*	*special self-efficacy (H1)*	*Treatment phase MA 2 (N=21)*	*special self-efficacy (H1) ← Inquiry Learning (H2)*

Table 5 illustrates the empirical study which was carried out among the students in the fourth semester.

3 Students of group MB 2 and MA 2 are students of the 2nd semester.

TABLE 5. *Treatment: 4th Semester*

O_1 (June 2015)	6 lessons	O_2 (June 2015)	6 lessons	O_3 (June 2015)
special self-efficacy (H1)	*Treatment phase MB 4 (N = 21)*	*special self-efficacy (H1) ← Inquiry Learning (H2)*	*Baseline phase MB 4 (N = 21)*	*special self-efficacy (H1)*
special self-efficacy (H1)	*Baseline phase MA 4 (N = 13)*	*special self-efficacy (H1)*	*Treatment phase MA 4 (N=13)*	*special self-efficacy (H1) ← Inquiry Learning (H2)*

The design of the study includes three measuring points (O_1-O_3) for each of its parts. At O_1, a questionnaire including items to measure self-efficacy was used. In the following treatment phase, groups MB 2 and MB 4 experienced self-determined Inquiry Learning according to the concept AuRELIA. The control groups MA 2 and MA 4 dealt with similar topic areas in a traditional seminar setting in which the tutor introduced the contents frontally, followed by a phase of solving pre-defined tasks. At the end of the treatment phase for groups MB 2 and MB 4, the questionnaire covering self-efficacy was used again in groups MB 2, MB 4, MA 2, and MA 4.

Following this phase, MB 2 and MB 4 switched roles with MA 2 and MA 4, as described above. MA 2 and MA 4 experienced learning according to the concepts AuRELIA and MB 2 and MB 4 served as control groups which differed from MA 2 and MA 4 insofar as those student teachers had experienced AuRELIA in the treatment phase before and had, therefore, already gained insight in Inquiry Learning. At the end of this second treatment phase for groups MA 2 and MA 4, the questionnaires were used for a third time (O_3) in all groups.

In addition, groups MB 2 and MB 4 were asked to fill in another questionnaire after trying out and going through self-determined Inquiry Learning in a seminar in Mathematics education (Treatment phase) which aimed to measure the extent to which they self-assessed their learning to be characterized by the criteria of Inquiry Learning in order to collect data for hypothesis 2. Moreover, groups MA 2 and MA 4 were asked to complete the questionnaire about Inquiry Learning after trying out and going through self-determined Inquiry Learning in a seminar in Mathematics education (Treatment phase) which aimed to collect data that could be analysed in order to prove Hypothesis 2.

In this phase, the control groups dealt with the topic areas of "modelling" and "considerate estimation", as these areas seemed to perfectly match the ones which were chosen by student teachers for their AuRELIA projects.

Data was collected by means of paper-and-pencil questionnaires and was analysed quantitatively. The method of data collection, analyses, and discussions of the data will be presented in the following sections divided into separate reports on the two hypotheses.

RESULTS OF THE RESEARCH: HYPOTHESIS 1

(H1) "The implementation of the AuRELIA concept increases the special self-efficacy concerning self-determined arrangements for Inquiry Learning."

The construct special self-efficacy was made quantifiable in a questionnaire including seven items, such as, "Ich traue mir zu, Unterricht zum selbstbestimmt-forschenden Lernen zu initiieren"[4], and, "Ich traue mir zu, Schüler und Schülerinnen zum Entwickeln eigener Lösungswege zu motivieren"[5], and a four-point scale which covered degrees of agreement (1 - "stimmt nicht" to 4 - "stimmt genau")[6]. This scale had already been used in a previous research project.[7]

NORMAL DISTRIBUTION (K-S-TEST)

Normal Distribution was tested by means of the Kolmogorov-Smirnov Test (K-S-Test). Table 6 shows a normal distribution of the values in all groups at all three measurement points.

TABLE 6. *Normal Distribution: Special Self-efficacy (K-S-test)*

group	O_1	O_2	O_3
MB 2	$D(20) = .11, p = .20$ *n.s*	$D(20) = .11, p = .20$ *n.s*	$D(20) = .14, p = .20$ *n.s*
MA 2	$D(19) = .14, p = .20$ *n.s*	$D(19) = .19, p = .08$ *n.s*	$D(19) = .15, p = .20$ *n.s*
MB 4	$D(16) = .13, p = .20$ *n.s*	$D(16) = .18, p = .18$ *n.s*	$D(16) = .19, p = .13$ *n.s*
MA 4	$D(11) = .24, p = .09$ *n.s*	$D(11) = .19, p = .20$ *n.s*	$D(11) = .21, p = .20$ *n.s*

RELIABILITY

The internal consistency (Cronbach's α) (Table 7) of the questionnaire with seven items shows the reliability in the groups and at the three measurement points.

TABLE 7. *Cronbach's α: Special Self-efficacy (Spseff)*

SPseff	MB 2 (N = 20)	MA 2 (N = 21)	MB 4 (N = 21)	MA 4 (N = 13)
O1	$\alpha = .82$	$\alpha = .68$	$\alpha = .83$	$\alpha = .76$
O2	$\alpha = .78$	$\alpha = .58$	$\alpha = .47$	$\alpha = .87$
O3	$\alpha = .80$	$\alpha = .70$	$\alpha = .53$	$\alpha = .86$

4 "I think I'm capable of initiating self-determined learning in class." (author's translation)

5 "I think I'm capable of motivating pupils to develop their individual strategies to solve problems." (author's translation)

6 1 - "not true at all" to 4 – "very true"

7 For further information refer to Hauer (2014, p. 64).

MIXED ANOVA

By means of a mixed ANOVA, the main effect and the interaction effect were measured. The preceding testing of the sphericity by means of a Mauchly-test showed a significant result, which called for a Greenhaus-Geisser correction of the data. The Analysis of Variance showed a highly significant main effect concerning special self-efficacy ($F(1.52/94.248) = 17.277$, $p < .01$, $\eta^2 = .218$) with a large effect size and a significant interaction effect ($F(4.56/94.248) = 2.478$, $p < .05$, $\eta^2 = .107$) with a medium effect size. This means that the difference has a practical relevance. This main effect shows that there are significant differences between the several measurement points.

The following sections provide more detailed information concerning the possible effectiveness of the treatment. The results of the t-tests for independent groups and the pairwise comparisons of group indicate the effectiveness of the treatment.

MB 2 AND MA 2

t-test for Independent Groups

Homogeneity was tested in all groups by means of a Levene-Test. The Levene-Test shows that the variances for the special self-efficacy are equal for students in group MB 2 and MA 2 at the three measuring points:

O_1: $F(38) = .08$, $p = .79$ *ns*; O_2: $F(38) = 1.74$, $p = .20$ *ns*; O_3: $F(39) = .19$, $p = .67$ *ns*.

The following Table 8 shows the means and standard deviations at the three measuring points in groups MB 2 and MA 2.

TABLE 8. *Descriptive statistic: Special Self-efficacy (Spseff)*

group	N	O_1	O_2	O_3
MB 2	*20*	$M = 3.23$ $SD = .44$	$M = 3.39$ $SD = .37$	$M = 3.44$ $SD = .36$
MA 2	*21*	$M = 3.29$ $SD = .39$	$M = 3.25$ $SD = .29$	$M = 3.39$ $SD = .31$

Comment: N = participant, M = mean, SD = standard deviation

Results of the t-test for Independent Groups

The results of the *t*-test for independent groups (Table 9) show that in general there is no significant difference between students of group MB 2 and MA 2 at the three measuring points concerning the special self-efficacy.

TABLE 9. *t-test - hypothesis (H1) special self-efficacy MB 2 and MA 2*

O	*t*	df	*p*	r_F	effect size
O_1	-.43	38	.67	.07	no relevant effect
O_2	**1.36**	**38**	**.18**	**.22**	**small effect**
O_3	.46	39	.65	.07	no relevant effect

However, students of group MB 2 ($M = 3.39$, $SE = .08$) have a higher mean value concerning the special self-efficacy than students of group MA 2 ($M = 3.25$, $SE = .06$) at the second measure point. This difference is not significant $t(38) = 1.36$, $p > 0{,}017$ (Bonferroni Correction); however, it represents a small effect size $r_F = .22$. (r_F; calculated in accordance with Field, 2009; p. 332)

MB 4 AND MA 4

t-test for Independent Groups

The Levene-Test shows that the variances for the special self-efficacy are equal for students of groups MB 4 and MA 4 at the three measuring points: O_1: $F(32) = .33$, $p = .57$ *ns*; O_2: $F(30) = .00$, $p = .99$ *ns*; O_2: $F(27) = 1.33$, $p = .26$ *ns*.

The following Table 10 shows the means and standard deviations at the three measuring points for groups MB 4 and MA 4.

TABLE 10. *Descriptive statistics: special self-efficacy MB 4 and MA 4*

group	N	O_1	O_2	O_3
MB 4	*21*	$M = 3.23$ $SD = .42$	$M = 3.63$ $SD = .31$	$M = 3.64$ $SD = .25$
MA 4	*13*	$M = 3.09$ $SD = .41$	$M = 3.13$ $SD = .37$	$M = 3.50$ $SD = .35$

Comment: N = participant, M = mean, SD = standard deviation

Results of the t-test for Independent Groups

There is a significant difference between students of group MB 4 ($M = 3.63$, $SE = .07$) and MA 4 ($M = 3.13$, $SE = .11$) at the second measure point concerning the special self-efficacy. This difference is highly significant $t(30) = 4.08$, $p < .017$ (Bonferroni Correction), with a large-sized effect $r_F = .60$, as shown below (Table 11).

TABLE 11. *Independent t-test - special self-efficacy MB 4 and MA 4*

O	*t*	df	*p*	r_F	effect size
O_1	*1.63*	32	.11	.28	small effect
O_2	4.08	30	.00**	.60	large effect
O_3	1.24	27	.23	.23	small effect

PAIRWISE COMPARISONS

The following pairwise comparisons of groups give some indication of a possible effectiveness of AuRELIA with regard to the hypothesis (H1) about special self-efficacy in the various groups.

Group MB 2

In group MB 2 there is no significant difference between O_1 ($M = 3.23$, $SD = .44$) and O_2 ($M = 3.39$, $SD = .37$; treatment phase), concerning the special self-efficacy (Table 12).

TABLE 12. *Group MB 2: Pairwise Comparisons*

O (N=20)	*Mean Difference*	*Std. Error*	*P*	*Partial Eta Squared*
Pair $O_1 - O_2$*	**-.16**	**.09**	**.07**	**.19**
Pair $O_2 - O_3$	-.04	.05	.40	.19
Pair $O_1 - O_3$	-.21	.10	.05	.19

* *treatment*

Group MA 2

There is a significant difference between O_2 ($M = 3.39$, $SD = .37$) and O_3 ($M = 3.44$, $SD = .36$) large-sized effect ($\eta^2 = .24$) in group MA 2 (Table 13).

TABLE 13. *Group MA 2: Pairwise Comparisons*

O (N=19)	*Mean Difference*	*Std. Error*	*P*	*Partial Eta Squared*
Pair $O_1 - O_2$	-.02	.07	.84	.24
Pair $O_2 - O_3$*	**-.12**	**.05**	**.03**	**.24**
Pair $O_1 - O_3$	-.11	.08	.23	.24

* *treatment*

Group MB 4

There is, however, a significant difference between O_1 ($M = 3.29$, $SD = .45$) and O_2 ($M = 3.62$, $SD = .34$) with a large-sized effect ($\eta^2 = .43$) in group MB 4 (Table 14).

TABLE 14. *Group MB 4: Pairwise Comparisons*

O (N=16)	*Mean Difference*	*Std. Error*	*P*	*Partial Eta Squared*
Pair $O_1 - O_2$*	**-.33**	**.12**	**.02**	**.43**
Pair $O_2 - O_3$	-.04	.05	.48	.43
Pair $O_1 - O_3$	-.37	.11	.01	.43

* *treatment*

Group MA 4

There is a significant difference between O_2 ($M = 3.13$, $SD = .39$) and O_3 ($M = 3.49$, $SD = .37$) large-sized effect ($\eta^2 = .58$) in group MA 4 (Table 15).

TABLE 15. *Group MA 4: Pairwise Comparisons*

O (N=11)	*Mean Difference*	*Std. Error*	*P*	*Partial Eta Squared*
Pair $O_1 - O_2$	-.04	.12	.76	.58
Pair $O_2 - O_3$*	**-.36**	**.11**	**.01**	**.58**
Pair $O_1 - O_3$	-.40	.14	.01	.58

* *treatment*

DISCUSSION OF THE RESULTS: HYPOTHESIS 1

In general, the means of the self-assessment concerning the special self-efficacy were relatively high in all test groups at the beginning of the project. In groups MB 2 and MA 2, no significant differences could be determined at the three measuring points, however, the means showed an increase in both groups MB 2 and MA 2 in the phase after the treatment, which hints at a positive effect of the treatment. The t-tests for independent groups in group MB 4 and MA 4, which showed a highly-significant result with a large-sized effect at O_2, confirm the effectiveness of the treatment with regard to self-efficacy. This significant difference cannot be detected anymore at O_3. This supports the conclusion that the treatment was also effective concerning the hypothesis in group MB 4 and MA 4.

The pairwise comparisons show a significant result with a large-sized effect between O2 and O_3 (Treatment-phase) in group MA 2. This increase can be attributed to the effectiveness of the treatment. For the same reason a significant increase with a large-sized effect could be determined in group MB 4 between O_1 and O_2 (Treatment-phase). In group MA 4 a significant difference with a large-sized effect was shown between O_2 and O_3 (Treatment-phase), which could be ascribed to the treatment. However, because of the small sample size, generalization can only be made with reservations.

RESULTS OF RESEARCH: HYPOTHESIS 2

(H2) "Students who were taught according to the AuRELIA concept rate the extent to which they experienced Inquiry Learning higher than students who were taught in a traditional seminar setting."

The construct Inquiry Learning was made quantifiable by the use of a special inventory called CILI-β (Criteria of Learning Inventory β-Version) developed by Reitinger (see Chapter 4). This questionnaire on the evolvement of the Criteria of Inquiry Learning was available in a semi-standardized form at the time it was used (CILI-β) with an internal consistency of $\alpha = .94$. (Reitinger, 2015b; n.p.) The 16 items of the questionnaire contained items such as, *"This learning activity encouraged me to discover open questions"*, *"During this learning activity, I really found out new insights by myself"*, *"I was often invited*

to disclose my ideas", were anchored on the scale 1 = not at all true; 2, 3, 4 = somewhat true; 5, 6, 7 = very true.
Consequently, the data was analysed applying descriptive and interference statistics. For this purpose, the data obtained in this study was compared to data which was gathered in a different study (cf. Reitinger, 2015a, p. 616) which aimed to examine the evolvement of the criteria of Inquiry Learning in an arbitrary selection of different university courses (N = 302).

Reliability (H2)
The internal consistency of the questionnaire with 16 items was rather high in all four groups MB 2, MA 2, MB 4, and MA 4. Table 16 shows the Cronbach's *α* values concerning Inquiry Learning after having undergone an AuRELIA project for each group.

TABLE 16. *Internal consistency: Inquiry Learning*

II	**MB 2** (N = 20)	**MA 2** (N = 21)	**MB 4** (N = 21)	**MA 4** (N = 12)
Post treatment	α = .54	α = .84	α = .80	α = .88

Normal Distribution (H2; K-S-Test)
The normal distribution of the data was tested by means of the Kolmogorov-Smirnov Test (K-S-Test). Table 17 shows a normal distribution of the data concerning Inquiry Learning in all groups.

TABLE 17. *Normal distribution: Inquiring Learning*

Group	
MB 2	$D(20) = .12, p = .20$ *n.s*
MA 2	$D(21) = .15, p = .20$ *n.s*
MB 4	$D(20) = .17, p = .14$ *n.s*
MA 4	$D(12) = .16, p = .20$ *n.s*

t-test for One Sample
Table 18 indicates the mean value for the four groups concerning Inquiry Learning after having undergone an AuRELIA project.

TABLE 18. *Descriptive statistics: Inquiry Learning*

group	*N*	*mean*	*standard deviation*	*standard error mean*
reference group	**302**	***M* = 4.41**	***SD* = 1.31**	
MB 2	20	*M* = 5.61	*SD* = .35	*SE* = .08
MA 2	21	*M* = 5.11	*SD* = .81	*SE* = .18
MB 4	20	*M* = 5.77	*SD* = .54	*SE* = .12
MA 4	12	*M* = 5.48	*SD* = .62	*SE* = .18

The descriptive comparison of the mean values derived from the data showed that the evolvement of the criteria was rated higher in the setting of the AuRELIA arrangement than in the reference group. In other words, university courses which were held according to the AuRELIA arrangement showed better results concerning the criteria of Inquiry Learning than a representative and randomly chosen group of university courses at a university college of teacher training in Austria.

On average, students of group MB 2, MA 2, MB 4 and MA 4, having experienced the AuRELIA concept in practice, rate the extent to which they experienced Inquiry Learning higher ($M = 5.49$; $SD = .65$) than students ($N = 302$) of the reference group ($M = 4.41$; $SD = 1.31$) (Reitinger, 2015a).

This difference is highly significant $t(72) = 14.25$, $p < .0125$ (Bonferroni Correction) with a very large-sized effect $r_F = .86$. Table 19 shows the results of each group including the calculated level of significance.

TABLE 19. *t-test of the question: Inquiry Learning (M = 4.41)*

group	*t*	*df*	*p*	r_F*	*effect size*
MB 2	15.22	19	.00**	.96	verly large effect
MA 2	3.96	20	.00**	.66	verly large effect
MB 4	11.32	19	.00**	.93	verly large effect
MA 4	5.98	11	.00**	.87	verly large effect

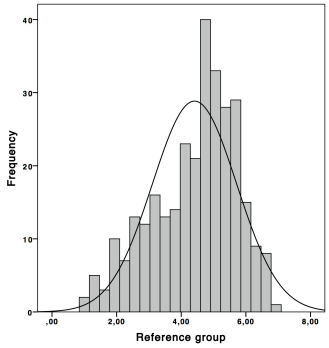
* *(r_F; calculated in accord with Field, 2009; p. 332)*

This result is clearly illustrated in the following histograms for all four groups. A comparison of the diagrams showing normal distribution (Fig. 1 – Fig. 6) illustrates the differences in the mean values as well as in the standard deviations derived from the complete scale. In groups MB 2, MA 2, MB 4, and MA 4 the standard deviation is clearly smaller than in the reference group, which indicates that there was less variance within the ratings of the students, which were also predominantly given in the positive part of the characteristic attributes provided in the rating scale (cf. Reitinger 2015a, p. 617).

HISTOGRAMS

Normal Distribution and Standard Deviation of the Reference Group

FIGURE 1. *Inquiry Learning of the Reference Group (cf. Table 18)*



Distribution of Group MB 2 and MA 2 (cf. Table 18)

FIGURE 2. *MB 2, Inquiry Learning*

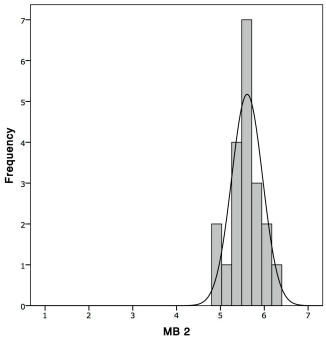
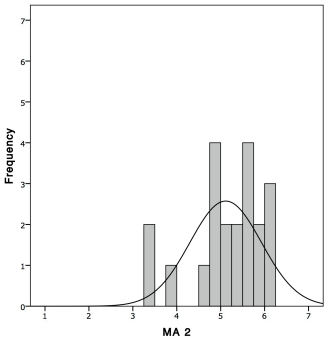


FIGURE 3. *MA 2, Inquiry Learning*



Distribution of Group MB 4 and MA 4 (cf. Table 18)

FIGURE 4. *MB 4, Inquiry Learning*

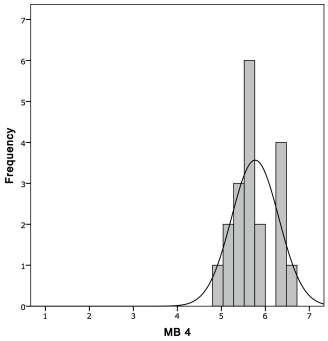
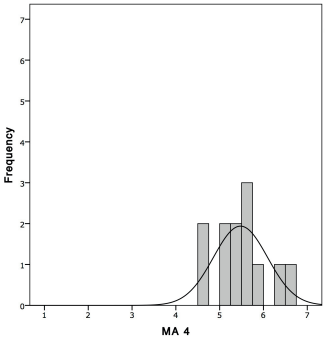


FIGURE 5. *MA 4, Inquiry Learning*



DISCUSSION OF THE RESULT: HYPOTHESIS 2

The application of the AuRELIA concept led to a highly significant result in all test groups with large-sized, resp. very large-sized effects concerning experiencing the criteria of Inquiry Learning. Thus, it could be shown by means of the scale CILI-β that student teachers who tried out AuRELIA in mathematics didactics met the criteria of Inquiry Learning according to Reitinger (2015b) to a large extent, and Hypothesis 2 was confirmed by the results of the study. However, the small sample size relativizes this difference. For the same reason, the results obtained by application of interference statistics should not be overgeneralized.

4 Conclusion

This article provided a brief introduction of the concept AuRELIA, a learning arrangement which facilitates self-determined Inquiry Learning, and described how student teachers became acquainted with and experienced the concept in a seminar about mathematics didactics. Subsequent studies to prove Hypotheses 1 and 2 showed that experiencing the learning setting brought about an increase in the self-efficacy of the student teachers concerning their own realization of the concept in a school class (H1). Likewise, it could be shown that the criteria of Inquiry Learning according to Reitinger evolved to a large extent in the phase of learning according to the AuRELIA concept (H2). It is hoped that student teachers will be able to draw on their individual learning experiences and knowledge gained concerning ways in which the concept can be organized in their attempts to conduct lessons according to the AuRELIA concept themselves.

OUTLOOK

As a next step, teacher trainees who experienced AuRELIA in mathematics didactics will be offered the possibility to conduct lessons in their teaching practice according to the AuRELIA concept. Studies have shown (Hauer, 2014) that experiencing this innovative concept of teaching can be considered relevant concerning the general self-efficacy, the special self-efficacy, the willingness to implement AuRELIA, the acceptance of the innovative method of teaching, and the development of didactic competences. Additionally, the AuRELIA concept will be discussed in the context of the development of differentiated posing of questions according to the WALK concept (Dinauer, 2001; Patry, 2001) as part of seminars covering various aspects of mathematics didactics.

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9 Autonomous Weeks: Inquiry Learning in Teacher Education from the Perspective of Student Teachers

Danièle Hollick

In this article, self-determined Inquriy Learning according to TILA (Reitinger, 2013) is discussed as one possibility to attain the *Shift from Teaching to Learning* in Higher Education. From the results of the case study on the *Autonomous Weeks*, where students experienced self-determined Inquriy Learning within two weeks, indications can be derived on how student-centered learning arrangements can be promisingly implemented in teacher education.

Keywords: AuRELIA, student - centered learning, learning in institutions

1 Introduction

The *Shift from Teaching to Learning* in Higher Education is the current policy forwarded by the European Commission to "enhance the quality of higher education while simultaneously catering for an increasingly diverse and numerous student body" (Mc Alleese et al., 2013, p. 5). Empirical studies refer to the need for student-centered learning arrangements in order to actively engage students in their learning processes and effective learning experiences (cf. Brown Wright, 2011). In contrast, Ayele, Shippers, & Ramos (2007, p. 120) state that the implementation of student-centered learning arrangements is considered as being more time consuming, difficult for a higher number of students, and not suited for all curricular standards. All these things taken together require careful consideration of institutional and organisational conditions when implementing student-centered learning arrangements. One way to meet these challenges is to take a closer look at the students' perspectives on student-centered learning arrangements in order to identify consequences for their implementation in higher teacher education. Hence, grounded in the concept of self-determined Inquiry Learning, the following case

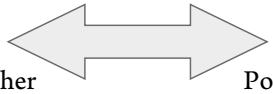
study focuses on the research question, "How do student teachers experience autonomous Inquiry Learning in the context of formal teacher training?" A previous study on self-determined learning in teacher education revealed the impact of *Autonomous Weeks* based on TILA (Reitinger & Hollick, 2014; Reitinger, 2013) on the motivation, on the attitudes towards self-determined human being, and the inquiry habit of mind of students.

The principal purpose of this research is to describe self-determined learning on an institutional level by focusing on student teachers' perspectives on autonomous Inquiry Learning. In this article, self-determined Inquiry Learning based on TILA (Reitinger, 2013) is defined as a learner-centered approach. Therefore, the focus is put on how students experience this approach in teacher training. The objective of this study is to take further steps to implement self-determined Inquiry Learning in tertiary education to guarantee optimal learning conditions and to foster gradual and full development of professional competences in teacher education.

2 Student-centered Teaching in Tertiary Teacher Education

Teaching and teaching methods applied in tertiary education have become a matter of debate in the course of the previous years. Up to now, teacher-centered modes of styles have been commonly used in tertiary education (Liu, Quiao, & Liu, n.d.). This rather traditional approach is centered around the tutor and is based on direct instructions. The students' participation is directed and controlled. Hence, one is faced with a paradoxical situation at teacher training colleges and universities. On the one hand, a learner-centered approach as a new learning culture has become one of the core issues in modern teacher education; on the other hand, a teacher-centered style is adopted, which provides students with very limited opportunity to experience student-centered learning in isolated projects few and far between based on concepts such as problem based learning or collaborative learning arrangements (cf. Conti, 2004). There seems to be a wide gap between practice and theory in teaching. Brown and Atkins (1990) describe a paradigmatic *Shift from Teaching to Learning* in which learning is seen as a constructive process as opposed to the instructional paradigm of "learning as a cumulative and linear process effected by teachers' instructions" (Fendler & Gläser-Zikuda, 2013; cited after Bar & Tagg, 2000; Wildt, 2005). However, in order to avoid a black-and-white description of either teacher- or student-centered learning, O'Neill and Mc Mahon (2005) offer a model in Table 1 describing the dualism on a continuum:

TABLE 1. *Student-centered and teacher-centered continuum (O'Neill & McMahon, 2005, p. 29)*

Teacher-centered Learning		**Student-centered Learning**
Low level of student choice		High level of student choice
Student passive		Student active
Power is primarily with teacher		Power primarily with the student

Weimer (2002; see also Blumberg, 2012; Brown Wright, 2011) defines the teacher-centered or instructor-centered approach and learner-centered approach along five dimensions: (1) function of content (application of content, learning independently, being actively engaged in learning), (2) role of instructors (creating a stimulating environment for learning, applying appropriate teaching and learning methods), (3) responsibility for learning (students assume responsibility for their learning, teachers guide and assist students) (4) purpose and process of assessment (integration of assessment and constructive feedback) and (5) balance of power (decision-making is shared between teacher and students). To define necessary steps when developing one's preferred teaching method from teacher-centered learning to student-centered learning, Blumberg (2012) points out the main characteristics of each step along those five dimensions. To single out one example, instead of providing the students with content for learning in isolation, the teacher organizes an arrangement in which the students interact and reflect "to make their own meaning of it" (ibid., p. 8).

Brown Wright (2011) analyzes pedagogical literature according to these five dimensions and provides some examples of successful student-centered teaching in teacher training. Referring to the dimension "function of content", she describes a model in music education in which the students are gradually guided to a higher level of learning on which they discuss and reflect the course content on a metacognitive level. In this model of student-centered learning, the students are offered the possibility of developing competences by conducting research, expressing themselves in writing and speaking, and interacting with the subject matter in groups to gain a deeper understanding of the content. Thus, students do not just acquire and apply content knowledge. They also learn more about their own learning strategies and develop abilities in problem-solving, in developing a differentiated view on issues, and in presenting results and drawing conclusions as a learning outcome.

Recent studies describe the successful transposition of the learner-centered approach in teacher training, for example in Blended Learning settings, by means of implementation E-portfolios as an integral part of teacher education (Karpa, Kempf, & Bosse, 2013), or in the context of self-determined Inquiry Learning (Hollick & Reitinger, 2014; Reitinger, 2013). It has been shown that student-centered learning arrangements support peer-learning, and foster the ability and enhance the process of personal reflection.

However, the strong and one-sided emphasis on student-centered learning has also been criticized for its sharp focus on the individual learner (O'Neill & McMahon, 2005, p. 33). The needs as well as the potential of the social context and interactions in institutional learning settings are said to have been neglected. The question of resources, the belief system of students, teachers, and heads of educational institutions, and the limited acquaintance with the term "student-centered learning" of the students have been determined to be barriers to the institutionalization of this approach (ibid.).

Self-determined Inquiry Learning based on the current theory TILA (Reitinger, 2013) is considered to be a step forward to student-centered learning in educational institutions. Considering *Trust* and *Safety* as two of the six principles of Inquiry Learning (see Chapters 1 and 2 this volume), the significance of the social context for self-determined learning is evident. *Method Affirmation* demanding agreement between students and teachers concerning the method of self-determined exploration and learning, *Critical Discourse* as well as *Conclusion-based Transfer* as three of the six criteria of TILA (Reitinger, 2013, p. 43–45, see also Chapter 1 in this anthology) are positioned in interaction and social contexts. This approach corresponds to the need for a certain belief system of learners as mentioned above.

3 Methodology

The decision to describe the experiences of student teachers taking part in the *Autonomous Weeks of Inquiry Learning* is based on TILA (Reitinger,2013) and the recent study on self-determined Inquiry Learning according to the *self-organized period of Inquriy Learning* of AuRELIA in teacher education (Hollick & Reitinger, 2014; Reitinger, 2013). Up to now, this study has shown the positive impact of self-determined learning on motivation and development of an inquiry habitus of students (Hollick & Reitinger, 2014). This study is carried out to gain an in-depth understanding of self-determined learning in teacher education by adding the perspectives of the participants on self-determined learning in the institutional context.

CONTEXT AND PARTICIPANTS

The context of this study is the realization of TILA (Reitinger, 2013) in formal teacher training. The implementation took place as a *self-organized period of Inquiry Learning* of TILA called *Autonomous Weeks of Inquiry Learning* which lasted for two weeks. Participation of students from the first, third, and fifth semester was on a voluntary basis and they were excused from all compulsory attendance in seminars and compulsory teaching practice. Every branch of the initial teacher training offered by the Private University College of Education, Linz, was represented: 76 students for primary school, lower secondary school and special needs school. The participating students took on different roles: 60 students from the 1st and 3rd semester took part as *explorers* who underwent the *Autonomous Weeks of Inquiry Learning* as learners according to TILA (Reitinger, 2013). 17 students from the 5th semester called *herOs* (Karolyi, 2012) acted as mentors who acquired and reflected on the AuRELIA concept (Reitinger, 2013, p. 87) within their teacher training. They assisted the explorers in their learning process by being in contact and working with them continuously in small groups or tandems. Lecturers and researchers from the teacher training college served as inquiry coaches to support the explorers in their inquiry work by giving inputs and knowledge as well as by moderating workshops

in the different phases of the *Autonomous Weeks of Inquiry Learning*. The following table shows the process of implementation in its single phases and sequences. The reference to the criteria and the relevance of the Principles of Inquiry Learning according to Reitinger (2013) are pointed out in the third column.

TABLE 2. *Implementation of the "Autonomous Weeks of self-determined Inquiry Learning" according to AuRELIA (Reitinger, 2013)*

Phase/ Description	Sequences	Reference to criteria/ relevance of principles
Emergence Group Constellation; Evaluation of interests of Discovery;	- Registration for "Autonomous Weeks of self-determined inquiry learning" (60 students of the 1st and 3rd semester, 17 students of the 5th semester as herOs) - personal meeting and exchanging of discovery interest - Evaluation of the individual research questions	- trust-based learning atmosphere to bring in the personal interest of discovery - areas for self - determined approach with being social integrated at the same time
Assumption Transformation of general questionings in reflected working hypothesis;	- Individual working phase for explorers to draft preliminary Hypothesis in the library or different workspaces - Workshop for reflecting the individual hypothesis with moderation	- experienced based hypothesizing on the basis of the principles personalisation and reliability-Support in the phase of construction by visualizing
Conception Assisted elaborating onstrategies of research	- Open Workshops assisted by Inquiry Coaches and herOs to generate the research design - Open Workshop to develope research designs - Workshop for reflecting the research design according to the viability (moderated by Inquiry Coaches)	- authentic exploration of viable paths of research - establishment of structure by transfer of responsibility
Inquiry/Exploration Phase of self-determined Exploration;	- 5 working days individually organized by the explorers with structural support(working spaces at the college, conversational support by Inquiry Coaches and herOs as well as Workshops) - Evening Event (fireside chat with an expert on educational sciences)with a critical approach and discussion about self-determined learning and orientation towards students' concern	- Support of self-regulation and orientation towards students' concern - safeness by presence of and exchange with lecturers of the Educational
Critical Phase	- Multidimensional reflection of the Exploration moderated and assisted by Inquiry Coaches)	- Engaging oneself with the critical discourse in a trust-based atmosphere
Conclusion-based transfer Assisted publication	- Presentation of the products of transfer (market place) - Exchange with visitors of the market place	- Communicating of the findings obtained - self-efficacy experience

The explorers voluntarily decided to what extent they would make use of the offer and services.

DATA SOURCE AND ANALYSIS

The research question "How do students experience self-determined inquiry learning in formal teacher education" is pursued in a qualitative study to gain insight in to autonomous self-determined learning in a formal learning context from the students' perspectives. The objective is to take further steps for implementing "Autonomous Weeks of self-determined Inquiry Learning" as a good and effective chance for student-centered teaching in higher teacher education at the Private University College of Education Linz.

The sampling strategy chosen is based on the critical case sampling as one type of purposive sampling (Patton, 2002; Kuzel, 1999). A small number of important cases is selected that are likely to "yield the most information and have the greatest impact on the development of knowledge" (Patton, 2002, p. 236). In this study, the important cases are represented by students from the 1st and 3rd semester of the branch of primary, compulsory and special education who are involved as explorers. According to Stake (1994, p. 237), this study can be considered as an intrinsic case study, which means the case facilitates understanding for implementing self-determined Inquiry Learning in teacher education.

Yin (2003) states that a case study design should be considered when: (a) the focus of the study is to answer "how" and "why" questions; (b) one cannot manipulate the behaviour of those involved in the study; (c) one wants to cover contextual conditions because they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context.

Open interviews were chosen as an appropriate technique. They were started by asking the students how they had experienced the *Autonomous Weeks*. The aim was to get as many aspects as possible from the students' point of view. All students were asked to volunteer in this study. Twelve out of 60 explorers were interviewed, 6 students from the 1st semester ($st_{1/01} - st_{1/06}$) and 6 from the 3rd ($st_{3/01} - st_{3/06}$) semester. To get an in-depth view of students' experiences, the interviewer reviewed the contents supplied by the interviewees and asked for more detailed narration.

The transcripts of the interviews were analyzed by using the method of framework analysis as the data analysis instrument by developing a theme based matrix based on the interview transcripts (Ritchie & Lewis, 2003). Thereby, cross-sectional descriptive data can be analysed and "different aspects of the phenomena under investigation" can be captured (Smith, 2011).

The interviews were transcribed, and five central categories were inductively deduced from the students' narrations of how they experienced the *Autonomous Weeks* as learners, as shown in Table 3:

TABLE 3. *Categories of experiences of the Autonomous Weeks*

	Categories
1	Metacognitive view on one's own learning attitude
2	Possibilities and challenges of one's own learning process
3	Learning Community
4	Differentiated perspective on education and learning
5	Institutional circumstances

These five categories form the basis for the analysis of all data of the interviews.

4 Results

It has to be noted that the study was carried out continuously in a special setting following the design of AuRELIA (Reitinger, 2013) within the two weeks. The specific circumstances make it difficult to transfer the results on other self-determined Inquiry Learning arrangements in higher education. To a varied extent, all explorers questioned focus on the following aspects of self-determined inquiry learning in the case of the *Autonomous Weeks* at the Private University College of Education, Linz:

METACOGNITIVE VIEW TO ONE'S OWN LEARNING ATTITUDE

All of the explorers describe their interest in experiencing a new learning arrangement ($st_{1/02}$, $st_{3/01}$, $st_{3/02}$, $st_{1/04}$, $st_{1/05}$, $st_{1/06}$, $st_{3/05}$, $st_{3/06}$) and a kind of flow experience as their motivation to continue with Inquiry Learning ($st_{1/01}$, $st_{3/01}$, $st_{1/03}$, $st_{3/03}$, $st_{3/04}$). One student calls this progress a "positive spiral" that leads her from one interesting question to another ($st_{1/02}$). While the growing interest causes some students to act, one was motivated by her first interactions with others:

> *"Richtig die Motivation ist gekommen, wie eben ich die erste Erasmus-Studentin am Gang getroffen habe, mir die Handynummer besorgt habe, mir einen Termin ausgemacht habe, dann mit ihr. Weil es wirklich so konkret war."*[1] ($st_{1/01}$)

According to the statements, also the exchange of the topics of interest among the participants increased the motivation of the explorers ($st_{1/05}$, $st_{1/06}$, $st_{3/05}$).
Strikingly the real motivation emerged after the students' decision to participate and the first meeting with the other participants where they exchanged their questions or topics they intend to work on and to learn about ($st_{1/01}$–$st_{1/06}$, $st_{3/01}$–$st_{3/06}$).

1 "The right motivation came when I met the first Erasmus student in the hall, asked for her phone number, and fixed an appointment with her. It was so real." (footnotes 1–7: author's translation)

Four students of the 1st semester ($st_{1/01}$, $st_{1/03}$, $st_{1/04}$, $st_{1/05}$) and one student of the 3rd semester ($st_{3/01}$) noticed that the participation in the *Autonomous Weeks* has led to strengthening of self-confidence and self-belief either through certain situations or through the possibility of self-determined Inquiry Learning in a formal setting. One student from the 1st semester refers to her experience in the phase of the "critical discourse" where her work was discussed in the group and she had to defend her work ($st_{1/05}$). She realized that others show an authentic interest in her work and listened to her reports attentively. Defending and arguing one's opinion within a group discussion is also for a further student an experience that increased her self-esteem ($st_{1/02}$). Another student states that for the next projects she will have the courage to start from the beginning with self-confidence:

> *"Also, wenn ich jetzt noch ein zweites Mal Autonome Wochen hätte oder generell einfach …, dann …, dass ich auch vielleicht am Anfang mich einfach darüber trauen sollte und gleich am Anfang sagen sollte, okay, ich fange da jetzt einfach an."*[2] ($st_{3/01}$)

All of the interviewee expressed a positive view on their learning during the *Autonomous Weeks* and underline this as an essential precondition for successful learning ($st_{1/01} – st_{1/06}$, $st_{3/01} – st_{3/06}$).

POSSIBILITIES FOR AND CHALLENGES TO ONE'S OWN LEARNING PROCESS

Self-determined Inquiry Learning is often mentioned in connection with time, topic ($st_{1/04}$) and the choice of learning activities. Some students state that the structure was helpful for one's own planning of the learning process ($st_{1/01}$, $st_{1/04}$, $st_{1/05}$) and serves as an orientation for one's own learning steps ($st_{1/01}$). It is described as a *"leichte Struktur"*[3] by one interviewee ($st_{3/04}$). Dealing with the subject without pressure ($st_{1/01}$, $st_{3/01}$, $st_{1/03}$, $st_{1/06}$, $st_{3/06}$) or without external as well as internal expectation of having to sit an exam ($st_{1/01}$, $st_{3/02}$, $st_{3/03}$) are related to the autonomous learning arrangement. One student emphasized that authentic exploration and an interest-orientated learning process are made possible because there were no instruction-centered lessons or predefined requirements ($st_{1/01}$).

> *"Und da bin ich nicht wirklich darauf eingegangen, was, wo ich ein Ergebnis oder irgendetwas habe, sondern einfach, was möchte ich wissen. Was interessiert mich?"*[4] ($st_{1/01}$)

2 "Therefore, if I had the 'Autonomous Weeks' a second time or in general simply ..., then ..., I would maybe dare right from the beginning and from the beginning I would say, okay let's get started."

3 "smooth structure" (in the sense of having a good work flow)

4 "I didn't show an interest in things just to have results or anything else but just asking what do I want to know. What am I interested in?"

While one interviewee describes the space of time for engaging oneself with the chosen theme ($st_{3/04}$), others indicate that at the beginning they felt unable to find subject areas and to develop their own hypotheses ($st_{1/01}$, $st_{1/03}$, $st_{3/04}$). Such different experiences are further mentionedin connection with the phase "Critical Discourse" and discussions the participants took part in ($st_{1/01}$, $st_{1/05}$, $st_{3/06}$). Some students describe them as important settings with a positive impact on their further learning process and interpret them as a possibility of getting different feedback for one's own work ($st_{3/06}$). On the other hand, students from the 1st semester indicate that they felt frustrated ($st_{1/01}$, $st_{1/05}$). They stated that it is difficult to get heard when one does not push oneself into the center of attention ($st_{1/01}$). A further reason is dealing with criticism in a way that does not discourage a person ($st_{1/05}$).

It seems that also the phase of Transfer was differently experienced. Some students evaluate this period as challenging in connection with presenting their work to others ($st_{3/01}$, $st_{3/03}$, $st_{1/04}$). One student said that she wondered if her work is of interest for others at all and took part just as a visitor ($st_{1/06}$). While experiencing the event of transfer, she noticed that she regreted not having presented her work.

Most of the students name the variety of learning settings they could frequent because of the open periods, such as different libraries ($st_{1/02}$, $st_{3/01}$, $st_{1/05}$), classrooms, and schools outside the college ($st_{3/02}$, $st_{1/03}$). Others tell about their new experiences with visiting experts ($st_{3/03}$, $st_{3/05}$) or teachers of schools and the teacher training college ($st_{1/02}$, $st_{3/02}$, $st_{1/03}$) and former teachers ($st_{3/01}$) as a part of their learning process. Two students report about their experiences with engaging their circle of acquaintances and unknown people for their investigations ($st_{3/06}$). With the support from participating teachers and peer-coaches some students mention that they obtained useful sources for their research using the Internet ($st_{1/02}$, $st_{3/02}$, $st_{3/04}$), books ($st_{3/06}$) and films ($st_{1/01}$). They relate this to the context of critical approach to media as scientific sources.

LEARNING COMMUNITY

The positive atmosphere that supports learning and personal development is mentioned by all questioned students ($st_{1/01} - st_{1/06}$, $st_{3/01} - st_{3/06}$), but characterized in a different way. For one it is the feeling of being accepted by the participating students and teachers even if it happens that one says something that turns out to be "nonsense" ($st_{3/04}$). Having different opinions and not being isolated by the group are also related to the acceptance orientated culture within the community of self-determined Inquiry Learners and Coaches ($st_{3/06}$). Three students describe their feeling of being integrated through the structure of this learning arrangement that offers help ($st_{1/02}$, $st_{1/03}$) and guarantees safety within all periods of the learning process ($st_{1/03}$, $st_{1/06}$). They report that, although the arrangement is quite open and participation is voluntary, they can orient themselves on the provided possibilities of getting feedback, support, and input. Related to this, one comes to the conclusion that perhaps the sense of security derives

from the factors self-determination and trust put in the participants ($st_{1/02}$). Students express their surprise how bgreat the trust they felt was within the community and of the institution ($st_{3/01}$, $st_{3/02}$, $st_{1/03}$, $st_{1/04}$, $st_{1/06}$). Despite initial doubt, students state that thanks to their experience in this community their attitudes towards self-determination have changed, and mutual trust is a key condition for learning and developing one's personality ($st_{3/02}$, $st_{1/03}$, $st_{3/06}$).

Nearly all students report about what can be associated with the category "experience of self-efficacy" ($st_{3/02}$, $st_{3/03}$, $st_{1/04}$, $st_{1/05}$, $st_{1/06}$, $st_{3/04}$, $st_{3/05}$, $st_{3/06}$): They express their surprise about the interests of others in one's own work as happening from the beginning of the *Autonomous Weeks*. In the interviews, situations are described in which authenticity was obvious to the interviewees, in particular when discussing about the cooperation with the Coaches and in the period of *Transfer* ($st_{3/02}$, $st_{1/04}$, $st_{3/04}$). Nearly all students characterized the coaching provided by the herOs and inquiry coaches as an invaluable support ($st_{1/01}$, $st_{1/02}$, $st_{3/01}$, $st_{3/02}$, $st_{1/03}$, $st_{1/05}$, $st_{1/06}$, $st_{3/04}$, $st_{3/05}$, $st_{3/06}$): The participants described the informal atmosphere within the community as beneficial and refer this circumstance to the way the coaches offered their support. They were on hand for the learner just when needed, but they were not obtrusive and did not overload the students with instructions.

Some students refer to the possibility of networking and getting to know other students and teachers of the college ($st_{1/02}$, $st_{1/03}$, $st_{1/04}$), and appraise this as having a sustainable impact on their further study and work as a teacher. The majority of the interviewed students state that the experience with peer-learning gives them new perspectives and encouragement for further learning ($st_{1/01}$, $st_{1/02}$, $st_{3/01}$, $st_{3/03}$, $st_{1/04}$, $st_{1/06}$, $st_{3/04}$, $st_{3/05}$, $st_{3/06}$).

DIFFERENTIATED PERSPECTIVE ON EDUCATION AND LEARNING

In general, all interviewees maintain that they have developed a new and wider perspective on institutional learning within these two weeks of self-determined inquiry learning ($st_{1/01} - st_{1/06}$, $st_{3/01} - st_{3/06}$). Most compare their experiences with their own school experiences as well as the current experiences with studying at the teacher education college ($st_{1/01}$, $st_{3/01}$, $st_{3/02}$, $st_{3/03}$, $st_{1/04}$, $st_{3/04}$, $st_{3/05}$). Others interpret their new understanding of learning as a sudden insight into what learning can be ($st_{1/02}$, $st_{1/05}$, $st_{1/06}$). Although reporting learning success and gaining deeper knowledge, some ask themselves if that was learning at all: *"Habe ich gelernt? Ist das Lernen?"*[5] ($st_{3/03}$, $st_{1/06}$, $st_{3/04}$). One calls her learning experiences *"entspanntes Lernen"*[6] ($st_{3/05}$). In addition to that, some students state that they now have a more expanded concept of learning than before. Learning means making mistakes and learning from them ($st_{1/06}$). Formal learning means to bridge formal

5 "Did I learn? Is that learning?"

6 "Relaxed learning"

learning with the living environments ($st_{1/04}$). Learning means to get a critical insight into issues and subjects ($st_{3/03}$), and learning means to have the courage to enter unknown fields ($st_{1/03}$). Some students state that real learning implies having enough time to spend on dealing with issues and to go deeper into the issue ($st_{3/02}$, $st_{3/06}$). In addition to that, to develope deeper knowledge, discussions and reflection in a group or learning community are necessary; learning is interpreted as a social act ($st_{3/02}$).

Besides talking about learning in general, most of the interviewees note that they have developed knowledge and abilities they could apply to their further studies: Related to their hypotheses developed for their inquiry learning, all state to have linked their chosen topic to the pedagogical field and acquired new, deep, and critical insights ($st_{1/01} - st_{1/06}$, $st_{3/01} - st_{3/06}$), such as reducing prejudice, checking one's preconception, and getting precise definitions of, for example, open learning or Inquiry Learning ($st_{3/06}$). In addition to this some stated that they have developed background knowledge about how research work takes place and about the care needed when carrying out surveys ($st_{3/02}$, $st_{1/04}$, $st_{3/05}$). Most described how they have developed skills needed for academic writing and have trained reflecting and arguing due to the participation in conversations, discussions, and presentation ($st_{1/01}$, $st_{3/01}$, $st_{1/03}$, $st_{1/06}$, $st_{3/04}$).

INSTITUTIONAL CIRCUMSTANCES

Four students refer to their experiences about the implementation of the "Autonomous Weeks of self-determined Inquiry Learning" next to the regular lessons ($st_{1/01}$, $st_{1/06}$, $st_{3/04}$, $st_{3/05}$). One appreciated that this was the first possibility to participate in student-centered learning arrangements which they just heard about theoretically in their lessons or experienced them in their school practice within their teacher training ($st_{3/04}$). With this opportunity they can understand paradigm from the point of view of learners not just teachers (ibid.). The interviewed calls this *"Ausstieg aus dem System"*[7] of instruction-centered learning (ibid.). Some criticize the attitudes towards *Autonomous Weeks* among a few professors, which were not openly communicated but noticeable in some side-comments about the absence of the participating students ($st_{3/01}$, $st_{3/03}$). The participants expressed their irritation because in the run-up to the *Autonomous Weeks* it was guaranteed that no disadvantages, such us additional work or making up absence would arise. Even the head of the teacher training college supported the *Autonomous Weeks* and appealed to the teachers to show consideration for the participating students. Some said that it may be too early for students from the 1st semester at the beginning of the teacher training because everything is new, and time for orientation in the daily student life is needed ($st_{1/03}$, $st_{3/05}$). Most determined that the change from self-determined Inquiry Learning to the regular lessons was difficult ($st_{3/01} - st_{3/06}$, $st_{1/03} - st_{1/06}$) because of the strictly organized schedule and the instruction-centered lessons and stringent requirements.

7 "Exit from the system"

5 Conclusion

Prior research work on the *Autonomous Weeks* in teacher education has documented the positive impact of self-determined learning on the motivation and the development of an inquiry habitus of students in teacher education. However, this study has not focused on the institutional context. In this study, data about the perspective of students on self-determined learning at an institutional level were collected. The results indicate a particular effect on self-determined learning in teacher education. These findings extend those of Reitinger & Hollick (2014) confirming that experiencing self-determination in institutional learning based on TILA (Reitinger, 2013) generates motivating effects on one's own learning. In addition, the affirmation of motivating effects noted in this study on the experience of the participating students was combined with a differentiated, reflexive and critical view on learning processes in school and higher education. This study, therefore, indicates that the benefits gained from self-determined Inquiry Learning, according the AuRELIA "self-organized period of Inquiry Learning" (Reitinger 2013), may drive the paradigm *shift from teaching to learning* in teacher education as well as in schools. Most notably, this is the first study on self-determined Inquiry Learning in teacher education concerning the integration of choice of learning issues and strategies, organization of study time as well as the place of learning, and having structural support at the same time. The results provide compelling reasons to implement self-determined Inquiry Learning in teacher education by taking into account the institutional circumstances and challenges. To implement *Autonomous Weeks of self-determined Inquiry Learning* according to TILA (Reitinger, 2013) in the regular teacher training, a wider study has to be carried out by interviewing participating teachers, the students in their role as mentors, and the head of the teacher training college. Further, data about the participation in the workshops, e.g., critical discourse as well as in the phase of transfer, should be collected. Further work should, therefore, include a mixed - method design to collect the data and achieve a coherent view of differentiated issues and aspects when implementing self-determined Inquiry Learning based on TILA (Reitinger, 2013) in higher teacher education.

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10 AuRELIA in Action: Inquiry Learning in Physics for Girls in Lower Secondary Education

Susanne Oyrer

This quasi-experimental study in the field of teaching physics is a practical example of AuRELIA as a modern, autonomy-supportive approach to physics lessons. Significant results are presented suggesting that AuRELIA is an extremely appropriate teaching concept for lower secondary school. It triggers intrinsic motivation, involvement in educational content in physics, and perceived self-determination of girls aged 11-14 years. While working within the framework of AuRELIA, girls conceptualized research questions and solution strategies in an autonomous, self-determined way. AuRELIA allows for individualized learner-centred education, which enables girls to do physics research in a contextual style, recognizing laws of physics in every-day life, thus, significantly raising the situational motivation level for physics lessons.

Keywords: self-determination, involvement, motivation

1 Introduction

Recent developments in the field of Austrian public education have led to a great interest as to how to conform with other European general school systems based on the results of PISA. Recommended individual learner-centered teaching approaches, on the one hand, and lately implemented standardization and state-mandated curricula, on the other hand, seem to be contradictory areas of interest within the field of education (see Savory, 2006, p. 17). However, hope is set on alternative instructional approaches in public education, a chance for the use of inquiry-oriented learning concepts, such as AuRELIA (see Chapter 2), in preference to traditional learning approaches in lower secondary school.

This article serves several purposes. On the one hand, it is a practical example as to how AuRELIA can be implemented in lower secondary school, complementing the theoretical background introduced in Chapter 2 in this book by Reitinger, Haberfellner & Keplinger. On the other hand, new results are presented, confirming the effectiveness of AuRELIA as an inquiry-oriented learning concept that triggers intrinsic motivation and involvement with educational content in physics at lower secondary level. Further, this case study intends to point out the importance of alternative instructional approaches, especially with respect to girls whose comprehension of physics apparently differs from that of boys (see Stadler, 2004; Engeln, 2004).

2 AuRELIA as an answer to the demand for a modern advanced teaching approach

According to the Austrian curriculum for physics classes (2012), pupils should not only gain knowledge but also achieve certain competences and skills, among which are the ability to recognize laws of physics in every-day life, to autonomously conceptualise and carry out experiments, and to interpret the findings, as well as to identify and solve problems by means of the pre-knowledge gained in physics classes. All of these competences are not likely to be achieved in teacher-centred lessons but cry out for a change in the teaching of science towards learner-centred active ways of learning.

In fact, the call for alternative ways of teaching has been urgently required ever since the constructivist mode of thought took on greater significance and gave rise to the conviction that information cannot be transferred 1:1 between the teacher and the learner (Roth, 2009, p. 88; Reitinger, 2013, p. 48). On the contrary, learners need to reconstruct the information by putting it into their own context of meaning, using their pre-knowledge.

Furthermore, neuroscience backs up constructivist approaches by discovering that we tend to retain information more easily if it is embedded in different parts of our brain during the learning process (Roth, 2009, p. 89; Klein & Öttinger, 2007, p. 53). The higher the degree of interconnectedness of different parts of the brain, the easier we can recall our memory for certain information (Klein & Öttinger, 2007, p. 53).

In addition, pupils learn and remember more easily if the learning process is accompanied by emotions or if an experience is added to the memory (Savory, 2006, p. 16). Similarly, conceptual knowledge is saved less sustainably and retrieved from memory with more difficulty, while procedural knowledge, such as carrying out an experiment or setting one's own parameters for certain tasks, is likely to be saved in long-term memory (Klein & Öttinger, 2007, p. 57).

The above mentioned transdisciplinary approaches of advanced didactics are fully met in the AuRELIA concept. Conclusive evidence has been reported earlier in this book by Reitinger, Haberfellner & Keplinger (see Chapter 2) in that this teaching approach "has a positive influence on self-efficacy, motivation and inquiry habit of mind",

among others, in lower secondary school (ibid.). In a case study conducted in 2015 (see Oyrer & Reitinger, 2015), the participants (girls and boys of lower secondary school aged about 13 years) stated that they consider their contribution to the outcomes of their studies to be important and that they had become more courageous in carrying out research in physics. The study suggests that transparency allowed by the self-determined learning approach of AuRELIA plays a key role in recognizing as to how knowledge acquisition works in the field of natural sciences and how to gain specialist competences and skills.

The six principles of the AuRELIA concept facilitate transparency in terms of what is studied why and how. While working on their topic, students coincidentally find answers to the following questions: what is the aim of the studies, how are research issues and hypotheses developed in natural sciences, which research methods are being used, how can a complex scientific question be transformed into smaller projects or questions. Clearly, further arguments could be added to this list, such as the pupils' reflection on their performance, which eventually makes transparent the factors of effectiveness, of productive collaboration, and of useful group decisions (see Oyrer & Reitinger, 2015).

Through working with the concept AuRELIA, it eventually becomes evident to the pupils that modern knowledge of natural sciences is but the result of generating and answering research issues, of data acquisition and of the pursuit of empirical cognition in the past. The previously mentioned results of earlier studies (Reitinger, 2012; Oyrer, Ressl, & Reitinger, 2012; Oyrer & Reitinger, 2015) are basic to the study at hand that deals with the positive influence of the concept AuRELIA on the involvement, the increase of intrinsic motivation, and the perceived self-determination of 13 year old girls in physics classes.

3 Interest and motivation as a basis for involvement in physics classes

The knowledge of the theoretical background of motivation and interest is basic to the understanding of teenage girls and their relationship to physics classes. Hence, relevant aspects of interest and motivation will be dealt with in the following sections.

We may call it a person's action of interest whenever a person's action is self-determined, meaning that there is no difference between what the person wants to do, and what they have to do (Deci & Ryan, 2002, p. 3). According to Deci & Ryan (ibid.), it is the felt autonomy to engage oneself in a matter that accompanies the quality of intrinsic motivation of an action conducted by interest.

While interest is characterised by the undivided attention to, or the cognitive concern of a person for another person or an action (Mitchell, 1993, p. 426), motivation can be described as the willingness of a person to deal with a matter in a persistent and intense way (Hasselhorn & Gold, 2009, p. 103). In their Theory of Self-determination, Deci & Ryan (2002, pp. 3–9) state that intrinsically motivated behavior is always self-deter-

mined. An intrinsically motivated person makes decisions as to their actions throughout a period of time in order to achieve a certain goal; motivation is like a process requiring the person's mental energy.
If a person's goals of action are beyond those inherent in the activity itself, Deci and Ryan (1985) define it as "extrinsic motivation" and propose to distinguish between external and internal motivation. An externally motivated person completes an action in order to either avoid sanctions or obtain rewards, whereas an internally motivated person values an action as being chosen by themselves. "Yet, the motivation is still extrinsic because the activity is not performed for itself but as a means to an end" (Guay, Vallerand, & Blanchard, 2000, p. 177). In their Theory of self-determination, Deci and Ryan (1985) postulate that the level of self-determination decreases from intrinsically to internal and external motivation to finally reach its lowest point in amotivation.
According to Deci and Ryan (2002, pp. 3–9), there is a hierarchical order of different kinds of motivation:
(1) General level: attitude to life, habitual ways of thinking;
(2) Contextual level: depending on the context; e.g., in piano lessons;
(3) Situational level: concerning a special situation;

Applied to physics lessons, this could mean that if a teacher succeeds in triggering situational motivation in their students during interesting physics lessons ("this lesson was fascinating"), the students may develop contextual motivation ("physics is cool"). Ideally, this positive attitude towards physics could lead to the general motivation of a student resulting in the rediscovery of a general curiosity in natural sciences. However, the purpose of this study remains to analyse the effect of the AuRELIA teaching approach on a situational level, regarding the motivational state, involvement, and perceived self-determination and autonomy offered in physics lessons.

3.1 INTEREST AND MOTIVATION OF TEENAGE GIRLS IN PHYSICS

Physics is the least fancied subject in school especially when it comes to girls of the age between 12–14 years (Milberg & Röbbecke, 2009, p. 48). At the same time, physics as a Natural Science is considered highly relevant and pivotal in that age group.

While the interest in physics is similar for girls and boys of younger age, girls are less interested in physics than boys by the age of 12. In fact, girls seem to develop a fundamental objection to and basic rejection of physics, which eventually may result in having less access to future relevant competences and occupations.

For girls, the context in which a physical topic is taught becomes more important than for boys (Zwiorek, 2010, p. 73). According to a study of Häussler et al (1998, cited in Müller, 2010, p. 108) girls take the greatest interest in physics when applied to different areas of medical application. Girls and boys both showed an interest in physics concerning humans and nature, while it was mostly the boys who indicated interest

in physics and technology. For girls, physics becomes more interesting in the context of physics and medicine, physics and the human body, or physics and sport (Müller 2010, p. 109). For example, 80% of interviewed girls were interested in the functioning of a ventricular assist device in a study by Müller (2010, p. 109), while only 40% of the female interviewees were interested in the functioning of a pump when used for oil production. In contrast, there was no difference in the interest of the interviewed boys for both applications. Stadler (2004) states that girls need to put a concept into a broader world view in order to understand it, whereas boys appear to take pleasure in the internal coherence within the physics concepts learned and view physics as valuable in itself.

Another phenomenon that deserves particular attention is the fact that girls have less self-confidence and less trust in their abilities and achievements concerning physics compared to boys (Zwiorek, 2010, p. 75), which results in less interest in physics before they even have had their first physics lesson in school. Furthermore, girls systematically underestimate their capabilities in physics and mathematics, whereas boys tend to overestimate their abilities in these fields.

When girls perform well, teachers tend to unknowingly communicate the message that girls were diligent but untalented, whereas boys who perform badly are told that they just did not make enough effort or take enough time to study the topic (Zwiorek, 2010, p. 77). Nine times out of ten, girls have difficulty in constructing a positive self-concept. Moreover, female pupils suffer from the lack of female role models in physics, and they experience little incentives to deal with physical or technical topics, eventually accumulating less pre-existing physical knowledge than boys before they get in contact with physics in school.

Engeln (2004, p. 59) was able to prove that changing the context of physical topics boosts the girls' trust in their abilities concerning physics. Savory & Duffy (1995) suggest enhancing a learner's motivation by leaving responsibility for the solution to the problem with the learner, an approach that seems highly recommendable for girl's physics education. Moreover, Engeln's studies (2004) show that the consideration of the student's interests and pre-knowledge leads to a prolongation of memory-retention of the educational content.

In the following sections, the current investigation will to confirm the positive effect of an interest-guided, inquiry-oriented learning environment, namely AuRELIA, on the involvement, motivation, and perceived self-determination of girls of lower secondary school.

4 Object of investigation

Based on the Theory of Self-determination (Deci & Ryan, 2002, pp. 3–9) the purpose of this study is to analyse the effect of the AuRELIA teaching approach on the situational state of motivation of girls at lower secondary level and their involvement in

physics lessons in response to self-determination and autonomy offered and warranted by the teacher. Reeve (2004, p. 194) adopted these considerations, and noted three fundamentals underlying the perception of self-determination in students:

(1) Internal locus of causality reflects high self-determination (Deci & Ryan, 1985)
The internal locus of causaltiy is high if individuals believe that personal force initiated and regulated their behaviour (internal locus of causality), whereas it is low if perceived externally, initiated and regulated by the environment.
(2) Sense of volition (Reeve, 2004, p. 194)
The sense of volition is high if an individual feels the unpressured willingness to engage in an activity. He or she feels free to do so.
(3) Perception of choice (Reeve, 2004, p. 194)
The perception of choice is high if an individual has the opportunity to choose what to do.

When students perceive self-determination, they are also more likely to engage in an activity, which in turn results in a higher level of involvement in the activity. Secondly, it is probable that these students develop the feeling of motivation (Reeve, 2004, p. 194).

In light of these considerations, the following questions of investigation were defined for the study at hand:

(1) Does the AuRELIA teaching approach facilitate self-determination? Do students believe that they can work autonomously during AuRELIA physics lessons? Do they feel they can pursue their own interests, work without pressure, and make a choice as to what they want to learn?
(2) Is AuRELIA an appropriate concept to enhance the engagement and involvement of students? Are pupils attentive, do they participate, do they show interest, enjoyment, effort, and persistence during the lessons?
(3) Does the AuRELIA teaching-approach promote intrinsic motivation or identified regulation? Do pupils show enthusiasm, can they find answers as to why they are working on certain tasks, do they accept the merits and see the utility of the tasks during physics lessons?

Additionally, the study intends to give a practical example of the inquiry-oriented learning concept AuRELIA (Authentic Reflective Exploratory and Interaction Arrangement). Is this teaching concept, which is compatible with the Theory of Inquiry Learning Arrangements TILA (Reitinger, Haberfellner, & Keplinger; see Chapter 1 this volume), applicable to teenage girls at lower secondary school?

5 Project design

The AuRELIA concept was implemented in two classes (6th and 8th standard) in a lower secondary school in an Austrian city in roughly the same period of the summer term within the framework of the lessons. All participants were female. Research was based on the following design (cf. Figure 1):

FIGURE 1. *Research design*

Reference Phase 1 was characterized by regular physics lessons with teacher-centred teaching and intermittent demonstration experiments. Participants were then asked to complete Questionnaire 1 retrospectively. Questionnaire 1 is referred to as Post-test 1. Reference Phase 2 was a period of inquiry-based physics lessons applying the AuRELIA concept. Retrospectively again (post-interventional), Questionnaire 2 was completed by the pupils and is referred to as Post-test 2, the point of time of completion being after the AuRELIA treatment.

Fifty-minutes-classes were held twice a week according to the regular schedule in Year 8 (class "4e"). Standard 6 (2b) had one regular lesson per week. In total, class 4e had 10 and class 2b had 9 teaching units in physics in a period of 5 and 7 weeks respectively.

TABLE 1. *Classes with AuRELIA treatment in an Austrian grammar school in the district of Upper Austria*

location	class	participating girls	standard
grammar school in Upper Austria	2b	20	6
	4e	23	8

Moreover, the decision was made by the teacher not to mark the student's outcomes of their work. This choice was based on the findings of Deci & Ryan (1985) that intrinsic motivation is more likely to occur in the absence of rewards. Guay, Vallerand & Blanchard (2000, p. 179, 204) argue that rewards represent a controlling factor that undermines the pleasure derived from an activity and that it may have a negative influence on both intrinsic and internal motivation. Later, after the students had proudly presented their results in front of the class, it was a point of discussion brought up by the students whether or not there should be marks for all the demanding work they had done. To them it seemed that getting an A would show the appreciation for the competent job they had done. Finally, the agreement was reached as to cherish the original structure of the project. However, the students of both classes wished to discuss the grading previous to future projects.

For the purpose of giving the reader a practical example how AuRELIA can be implemented in lower secondary school. Table 2 describes the course of action of the AuRELIA-based lessons, complementing the theoretical background introduced earlier

by Reitinger, Haberfellner & Keplinger (see Chapter 2 this volume). In Table 2, the seven steps comprising AuRELIA (Emergence, Speculation, Conception, Investigation, Discovery, Critical Phase, and Transfer; see Reitinger, Haberfellner, & Keplinger, Chapter 2 this volume) are related to the six Principles of Inquiry Learning (Trust, Self-determination, Safety, Clearness, Structuring, and Personalization; see Reitinger, Haberfellner, & Keplinger, Chapter 1 this volume) that were considered in the preparation of each special step of AuRELIA-based lessons and are matched with the actual activities of the lessons.

6 Performance of AuRELIA – a practical example

The teacher started the project by asking the pupils for feedback about the physics lessons of the last 3 weeks, which had been characterized by teacher-centred teaching and intermittent demonstration experiments. The teacher also informed the pupils that she was doing scientific research at the University College of Education as to how pupils learn physics and how much they like or dislike physics lessons at school. Before any further information about the possible carrying out of the AuRELIA project, the class completed Questionnaire 1 (Post-test 1), retrospectively considering the recent 2 weeks of physics lessons. The teacher then pointed out what AuRELIA was about. In class 4e (Year 8) she introduced the major topic of the project (Future technology 2050). In class 2b (Year 6) pupils were allowed to choose any topic of physicochemical relevance. The teacher emphasized the importance of the pupils' free will to participate in the project. It was also mentioned that the results would not be graded. On the contrary, the pupils should work in a self-determined, autonomous way, finding a research question they were interested in, while the teacher would be on hand to support the pupils with organisational or academic advice or help they might need. The pupils were very keen on starting the project, and it was jointly decided to start in the next lesson. Hereafter, AuRELIA was introduced as described in Table 2 (see next page).

7 Examples of pupils' research

All groups were able to find detailed answers to their questions and hypotheses to a greater or lesser extent. The results were presented to the class in Phase 5 (discovery). Results of some groups are exemplarily listed below:
Resarch questions of Class 2b (Year 6):
(1) Buoyancy - why do some solids swim, while others don't?
(2) What is the origin of a thunderstorm?
(3) Why and how do stars explode?
(4) Why do earthquakes occur?
(5) Why do volcanos erupt?
(6) What is the origin of the polar lights?

TABLE 2. *Phases of the AuRELIA project matched to course of action and main principles in each phase*

Phase	Course of action	Main principles of AuRELIA considered in this phase
Phase 1: ***Emergence:*** *encouragement of personal interests integrating the learner´s wants concerning content and method*	Teacher and students agree on starting AuRELIA under the title "Future technology 2050" (4e) or on any problem with physicochemical background. Teacher projects stunning and/or striking pictures about future technology on screen; e.g. wind turbines, a baby with a remote control in hands, solar energy, the Universe, a robot. Pupils start developing their own interest, start finding partners and defining their interests more precisely.	**trust:** teacher needs to trust that pupils are interested and will succeed in developing a research question.
		self-determination: teacher changes her role into a coach rather than an instructor. The 2b-project allows for a large range of topics. The 4e-project "Future technology 2050" is also meant to be a large frame.
		safety: teacher remains on hand for questions
Phase 2: ***Speculation:*** *specification of the topics; open research questions are transformed into definite working assumptions and hypotheses*	Pupils search the internet and the library for information to their topics. Some plan experiments, others want to stick to analyses of literature. Main problem of almost all the groups: pupils just define topics instead of asking an underlying question. They need to know about the topic in order to be able to ask meaningful questions and find their own hypotheses.	**clearness:** in this phase, the teacher needs to be very clear about the working tasks, and the exact procedure: choose a topic, do some research in order to phrase a research question, suggest a hypothesis
		personalisation: groups work highly self-determined and define their individual interest.
		structure: Pupils should be guided through the steps mentioned above (clearness).
Phase 3: ***Conception:*** *Supervised elaboration of research strategies*	Teacher explains that group members need to decide as to how to handle their further research: where/how will they find information? Work packages: who will do what, when, how, where? Some groups decide to meet at home and do the experiments there; they decide to get it on camera and present it in school.	**structure:** worksheets help the groups as guidelines through the process of research.
		trust: teacher trusts in the groups that their intrinsic motivation will work their way through this phase
Phase 4: ***Investigation:*** *exploration; experiments, literature, gathering of information*	Pupils work autonomously on the answers to their questions. Some make experiments	**self-determination:** on demand, teacher helps as a coach
		safety: Pupils are told to ask teacher for supervision when it comes to experiments.
		personalization: Groups work on their ideas, each group in a different way. Additionally, some groups ask for advice; others hardly ask any questions.
Phase 5: ***Discovery:*** *results are being evaluated and interpreted. Presentations of the results, hypotheses and findings*	Learners sort all collected information, check their hypotheses, decide where they need more information, prepare presentations.	**structure and self-determination:** pupils decide what is important, what is presentable or noteworthy. They themselves structure their work, results and further procedure.
Phase 6: ***Critical Phase:*** *discussion of results, reflecting on the procedure that leads to the results*	Pupils and teacher sit together in a circle reflecting on the experienced processes. Posters help to structure the discussion.	**structure:** Posters help to structure the discussion and to accumulate and visualize what is said.
Phase 7: ***Transfer:*** *inquiry-finalizing actions*	Some of the students want to present their results at the parents´ evening.	**personalization:** Pupils are not forced to present their results.

Research questions of class 4e (Year 8):
(1) How does a hybrid car function and why is there only a limited number nowadays?
(2) Traffic of the future: how will people travel in 2050? (Spaceliner, Hyperleeps)
(3) School system – what will equipment for schoolchildren look like in 2050?
(4) How will mind-controlled instruments and objects change peoples' lives?
(5) What will humanoid robots look like and what will they be able to do?

8 Design of the questionnaire

Building on the findings of Deci and Ryan (1985) outlined in section 3 of this article, the questionnaire was designed to shed light on the capability of AuRELIA to promote self-determination, enhance intrinsic or internal motivation, and trigger involvement in students of lower secondary level during physics lessons; it is meant to answer the research questions discussed in Point 4 of this article. The following three approved, reliable, and theory-based questionnaires were applied to the study at hand: perception of self-determination (Reeve, 2004), PII Personal Involvement Inventory testing cognitive and affective involvement (Zaichkowsky, 1994), and the SIMS Situational Motivation Scale (Guay, Vallerand & Blanchard, 2000, p. 210) investigating different types of motivation.

Building on the three qualities within the experience of self-determination defined by Reeve (2004, p. 194), namely *choice*, perceived *locus of causality* and *volition*, nine out of twelve items developed by Reeve (2004, p. 198) were chosen and translated into German for the questionnaire of this study; thereby each quality was represented by 3 items tested on a fourfold scale, covering degrees of agreement (1 – "stimme gar nicht zu"; transl.: "I strongly disagree" – to 4 – "stimme voll zu"; transl.: "I fully agree"). In the following, an example is given for each of the above qualities:

Choice: *"I felt that I had control to decide what to do and whether to do it."*[1]
Perceived locus of causality: *"I was pursuing my own goals, goals that were important to me."*[2]
Volition: *"While doing this task, I felt a relaxed sense of personal freedom."*[3]

Considering that a student's perceived self-determination is closely associated with a student's involvement during learning (Reeve, 2004, p. 195; see section 4 this article), a measure for an individual's involvement was searched for the questionnaire and was eventually quantified by the revised PII Personal Involvement Inventory developed by Zaichkowsky (1994). This measure consists of ten items, five of which are designed to

1 Footnotes 1–9 present the respective German translations.
"Ich hatte das Gefühl, dass ich Kontrolle darüber hatte zu entscheiden, was ich tun wollte und ob ich es tun wollte."
2 "Ich verfolgte meine eigenen Ziele; Ziele, die mir wichtig waren."
3 "Während dieser Unterrichtsphase hatte ich das Gefühl der Lockerheit und Freiheit."

cover the cognitive or utilitarian aspects, e.g., unimportant-important, worthless-valuable[4], and the other five the affective or emotional aspects of involvement, e.g., unappealing-appealing, unexciting-exciting[5]. In this manner, a large range of personal relevance of a subject, namely physics, was analysed.

Motivation was investigated with regard to the different types of motivation making use of the SIMS Situational Motivation Scale (Guay, Vallerand & Blanchard, 2000, p. 210). The main underlying question of all the items of the Scale is why the student was engaged in the various tasks within physics lessons. The retrospective, post-interventional items represent answers to this question and reflect the type of motivation ranging from intrinsic motivation, e.g., *"Because I think that this activity is interesting"*[6], identified regulation (internal motivation) (e.g. *"Because I think that this activity is good for me"*[7]), to external regulation (external motivation), e.g., *"Because I believe it is something I have to do"*[8], and amotivation, e.g., *"I do this activity but I am not sure if it is worth it"*[9]. For each type of motivation two items were chosen for the questionnaire and were assigned to a seven-fold array of possible ratings (1 = "not at all true" / 7 = "very true").

The pupils' involvement, perceived self-determination, and motivation in a lesson may not only be influenced by the characteristics of the lesson or pedagogue's teaching approach but also by certain antecedents such as the characteristics of the pupil, the family situation, not to mention family problems or simply the attitude towards a certain school subject. Therefore, the PII (Personal Involvement Inventory), SIMS (Situational Motivation Scale), and the items concerning self-determination suggested by Reeve (2004) all measure the situational state of a pupils' involvement, self-determination and motivation rather than a stable trait (Zaichkowsky 1994, p. 59; Reeve, 2004, p. 196; Guay, Vallerand & Blanchard, 2000, p. 207).

9 Results

A mixed between-within subjects analysis of variance (between-within subjects ANOVA; Pallant, 2011, p. 250) was conducted to assess the following:

(1) Within each class: Is there an impact of the AuRELIA teaching approach across time (pre and post treatment)? Is there a rise in the participants' scores on self-determination, involvement and intrinsic motivation and a decline of extrinsic motivation or amotivation resulting from the AuRELIA teaching approach?

4 "unwichtig-wichtig, wertlos-wertvoll"
5 "nicht reizvoll-reizvoll, nicht aufregend-spannend"
6 "Weil ich sie (die Unterrichtsinhalte) interessant fand"
7 "Weil ich dachte sie (die Unterrichtsinhalte) wären gut für mich."
8 "Weil es etwas ist, was ich tun muss."
9 "Ich setze mich mit den Unterrichtsinhalten auseinander, aber ich glaube es lohnt sich nicht."

(2) Between the classes: Is there a significant difference between the two classes over time (2b, 4e)? In other words, are there class-specific factors in lower secondary education that influence the effect of the AuRELIA teaching approach in terms of self-determination, involvement or motivation?

9.1 SELF-DETERMINATION

Studies have shown (Reeve 2004, p. 197) that an individual's perception of self-determination is reflected in his or her perceived locus of causality, volition, and perceived choice. In the present study, these three qualities were tested before (Post-test1) and after (Post-test2) the application of the AuRELIA teaching period (treatment) in order to verify TILA learning theory as described earlier in Chapter 1 of this volume.

Multivariate tests for all three categories showed highly significant main effects for time. Exact data for *Pillai-Spur*, *F*, *p*, and *partial eta squared* are given in Table 3, revealing that both classes show a significant increase in all three qualities of self-determination in physics lessons as a result of the inquiry-based teaching period AuRELIA.

TABLE 3. *All three qualities of self-determination show significant, high effects of time applying the guidelines proposed by Cohen (1988, pp. 284–287).*

	Pillai-Spur	***F***	***p***	***eta squared***
choice	0.475	37.05	<0.001	0.475
volition	0.416	29.16	<0.001	0.416
locus of causality	0.394	26.66	<0.001	0.394

As the Mauchly-Test of sphericity did not produce data of significance, sphericity cannot be definitely proven. However, Greenhouse-Geisser analyses are significant for all three categories (choice: $p < 0.001$, *eta squared* = 0.48; volition: $p < 0.001$, *eta squared* = 0.42; causality: $p < 0.001$, *eta squared* = 0.39) and additionally within-subject analyses of each category are highly significant (all three categories $p < 0.001$) and clearly reveal an increase of mean-values for perceived self-determination over time with a substantial main effect for time (choice *eta squared* = 0.48, volition *eta squared* = 0.0.42, causality *eta squared* = 0.0.39). Pair-by-pair comparison of time measurement shows significance (choice: $p < 0.001$; volition: $p < 0.001$; cause: $p < 0.001$), again indicating the clear change of mean values for all three categories of self-determination with time. Mean values for all participants and for each class respectively are shown in Table 4.

TABLE 4. *Mean values for the 3 qualities of self-determination (choice, volition, and locus of causality) before (post-test1) and after AuRELIA-treatment (post-test2).*

	post-test 1 mean value	standard deviation	post-test 2 mean value	standard deviation	N
choice 2b	2.38	0.59	3.11	0,53	20
choice 4e	2.46	0.58	3.19	0.62	23
volition 2b	2.75	0.60	3.37	0.51	20
volition 4e	2.74	0.50	3.33	0.60	23
causality 2b	2.53	0.64	3.08	0.66	20
causality 4e	2.31	0.58	3.02	0.56	23

There was no significant interaction between the classes (2b, 4e) concerning perceived self-determination. This is indicated by non-significant multivariate tests of MZP*class with values for choice ($F(1/41) = 0.001$, $p = 0.97$, *partial eta squared* < 0.001), for volition ($F(1/41) = 0.01$, $p = 0.92$, *partial eta squared* < 0.0001), and perceived locus of causality ($F\,(1/41) = 0.43$, $p = 0.52$, *partial eta squared* < 0.01).

While testing the between-subjects effects (classes 2b, 4e), the main effect comparing the two classes in their increase in perceived self-determination was not significant for any of the 3 categories (choice: $F(1/41) = 0.32$, $p = 0.57$, *partial eta squared* = 0.008; volition: $F(1/41) = 0.30$, $p = 0.86$, *partial eta squared* = 0.001; causality: $F(1/41) = 0.90$, $p = 0.35$, *partial eta squared* = 0.02).

Therefore, tests of between-subjects effects suggest that the positive effects of the inquiry-based teaching concept AuRELIA are not dependent on factors lying within the class with regard to self-determination of the participants.

9.2 INVOLVEMENT

There was a substantial main effect for time (pre, post treatment) in both classes, *Pillai-Spur* = 0.442, $F\,(1/41) = 32.46$, $p < 0.001$, *partial eta squared* = 0.442, with both classes showing an increase in the extent of emotional and cognitive involvement in physics lessons after applying the concept AuRELIA. This effect is also easily evident in Figure 2 (value for involvement vs time). The highly significant rise in mean values for involvement between post-test1and Post-test2 is found for total mean values (Post-test 1: 4.14, Post-test 2: 5.07) for the total of 43 participants, as well as for the values of each class (2b Post-test 1: 3.82, 2b Post-test 2: 4.98; 4e Post-test 1: 4.42, 4e Post-test 2: 5.16).

There was no significant interaction between the classes (2b, 4e), $F\,(1/41) = 1.517$, $p = 0.225$, *partial eta squared* = 0.036. Testing the between-subjects effects (classes 2b, 4e), the main effect comparing the two classes in their increase in the felt involvement again was not significant, $F\,(1/41) = 1.957$, $p = 0.169$, *partial eta squared* = 0.046 (using guidelines proposed by Cohen (1988, pp. 284–287). This suggests that the positive ef-

fects of the inquiry-based teaching concept AuRELIA are not dependent on factors lying within the class with regard to the involvement of the participants.

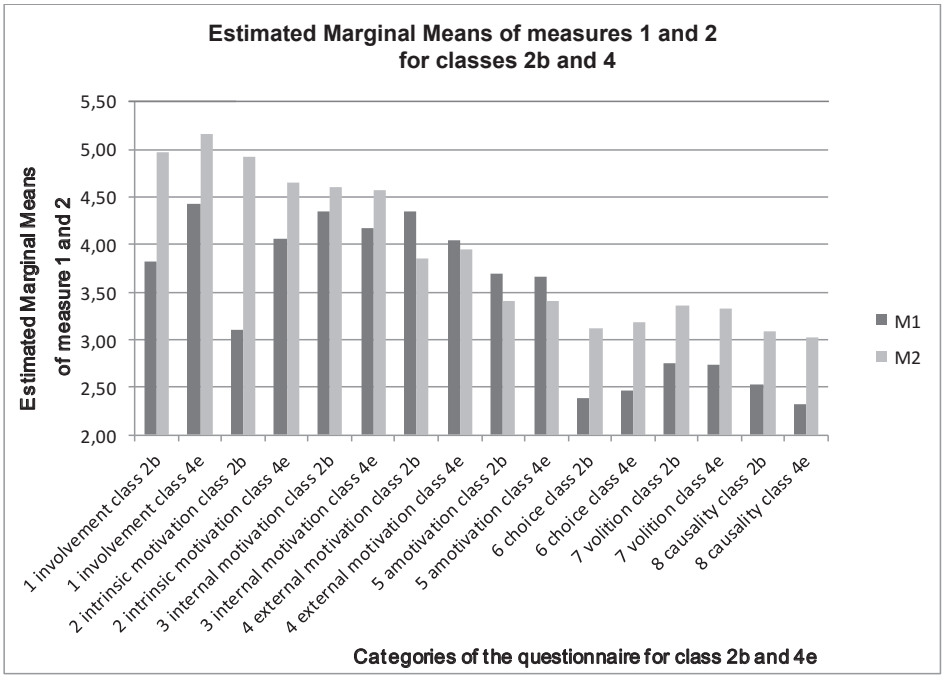
9.3 MOTIVATION

There was a noticeable difference in the mean Post-test 1 values for intrinsic motivation of class 2b and 4e (2b 3.20, 4e 4.065) suggesting that the level of motivation of the girls aged about 11-12 years was higher than of girls aged 13–14 years (see Figure 2). Nevertheless, this difference is insignificant, showing that factors of the class do not interfere with the the effect of AuRELIA. In Post test 2, values for the two classes converge after the treatment with AuRELIA (2b 4.93, 4e 4.65), excellently complementing the conclusion drawn from the above data, that the effect of AuRELIA is independent of the initial motivational situation of a class.

Multivariate tests (time*group) further confirm these data with *Pillai-Spur* = 0.138, $F(1/41) = 6.651$, $p = 0.014$, *partial eta squared* = 0.138. There was a substantial main effect for time (pre, post treatment with AuRELIA) in both classes, *Pillai-Spur* = 0.378, $F(1/41) = 24.902$, $p < .001$, *partial eta squared* =0.378, with both classes showing an increase in the extent of intrinsic motivation in physics lessons as a result of AuRELIA.
Testing the between-subjects effect (classes 2b, 4e), the main effect comparing the two classes in their increase in the intrinsic motivation was not significant, $F(1/41) = 6.561$, $p = 0.014$, *partial eta squared* = 0.138 again suggesting that effects of AuRELIA are independent of class factors.
For internal motivation mean values show an increase with time. After the AuRELIA treatment, mean values slightly rise both for all the participants (pre 4.26; post 4.58) as well as for each class (2b: pre 4.35, post 4.50; 4e: pre 4.17, post 4.57), but no significance is achieved for multivariate tests (*Pillai-Spur* = 0.035, $F(1/41) = 1.470$, $p = 0.232$, *partial eta squared* = 0.035), nor for inner subject effects ($p = 0.232$, *partial eta squared* = 0.035). Pair-by-pair comparison of time measurement shows insignificance ($p = 0.232$); similarly, the effect for time is small and insignificant (*partial eta squared* = 0.035) using guidelines proposed by Cohen (1988, pp. 284–287).
A clear though insignificant decrease of mean values for external motivation and amotivation is shown in Figure 2. This decrease is found both for all the participants (external motivation Post-test 1: 4.17; Post-test 2: 3.91; amotivation Post-test 1: 3.69; Post-test 2: 3.41) as well as for each class (external motivation 2b Post-test 1: 4,33, 2b Post-test 2: 3.85 and 4e Post-test 1: 4.04, 4e Post-test 2: 3.96; amotivation 2b Post-test 1: 3.70, 2b Post-test 2: 3.40 and 4e Post-test 1: 3.67, 4e Post-test 2: 3.41). Moreover, the main effect for time (before and after AuRELIA) in both classes was merely small (eta squared = 0,015) using guidelines proposed by Cohen (1988, pp. 284–287). Figure 2 summarizes the estimated marginal means of all categories of the questionnaire: involvement (Zaichkowsky, 1994), SIMS (Situational Motivation Scale by Guay, Vallerand & Blanchard, 2000), and the three qualities of perceived self-determination (Reeve, 2004).

While involvement, intrinsic motivation, internal motivation and self-determination increase with time, external motivation and amotivation have decreased after the AuRELIA teaching period. Regardless of class-internal factors, both classes show a significant increase in all three surveyed qualities namely involvement, perceived motivation, and perceived self-determination in physics lessons as a result of the inquiry-based teaching period AuRELIA.

FIGURE 2. *Estimated marginal means of all categories of the questionnaire before and after AuRELIA (M1,M2): 1 involvement (Zaichkowsky, 1994); 2–5 SIMS (Situational Motivation Scale by Guay, Vallerand, & Blanchard, 2000); 6–8 three qualities of perceived self-determination (Reeve, 2004).*



10 Conclusion

The present study was designed as a practical example of the concept AuRELIA in order to complement the theoretical background introduced earlier in this book by Reitinger, Haberfellner, & Keplinger (see Chapter 1). An outline of the physics lessons in the course of the AuRELIA treatment shows that the 6 principles of inquiry learning (see Chapter 2 in this volume) can be implemented within the narrow bounds of the schedule of lessons in lower secondary school (grammar school). Furthermore, it gives an example as to how to go about such a project in an autonomy-supportive way.

Secondly, the didactic relevance of the theoretical learning approach TILA (Reitinger, Haberfellner, & Keplinger, Chapter 1 in this volume) is clearly supported for lower

secondary school by the current results of the practical quasi-experimental study. Mixed between-within subjects analysis of variance (between-within subjects ANOVA; Pallant, 2011, p. 250) clearly confirm the effectiveness of AuRELIA as an inquiry-oriented learning concept that facilitates intrinsic motivation, perceived self-determination, and involvement.

A significant impact of the AuRELIA teaching approach was proven across time. Participants' scores on perceived self-determination, involvement, and intrinsic motivation clearly rise, whereas there is only a slight and insignificant increase in internal motivation and a small decline in extrinsic motivation and amotivation after the application of inquiry-based teaching concept AuRELIA. There is no significant difference between the two classes over time (2b, 4e), suggesting that class-specific factors such as the initial state of motivation, involvement, or perceived self-determination have no impact on the effect of the AuRELIA teaching approach. The study proves AuRELIA to be successfully applicable in physics classes of lower secondary level of grammar school.

The third aim of this research was to point out the importance of alternative instructional approaches, especially with respect to girls, whose comprehension of physics apparently differs from that of boys in that they need to put a concept into a broader context in order to understand it (Stadler, 2004; Engeln, 2004). The results of the study highly suggest that AuRELIA is an effective teaching concept for girls. AuRELIA facilitates girls' perceived self-determination, supporting their self-confidence by letting them experience pursuing their own interests, working without pressure, and making a choice as to what they want to learn. AuRELIA proved to be an appropriate concept to enhance the engagement and involvement of girls during physics lessons, which means that they are more attentive, participate to a higher level, and show interest, enjoyment, effort, and persistence during the lessons.

Furthermore, AuRELIA promotes intrinsic motivation, opening new perspectives for physics lessons. If teachers are able to repeatedly motivate girls at the age of 12-14 years on a situational level, girls might take a positive attitude towards physics lessons on a contextual level.

In light of this study, AuRELIA appears to be an extremely appropriate teaching concept for lower secondary school regarding a modern approach to physics lessons and to the Austrian curriculum for physics classes (2012). It has been shown that by teaching in an autonomy supportive way, such as according to the AuRELIA concept, girls feel free to do physics research in a contextual style, recognizing laws of physics in every-day life, autonomously conceptualising research questions and solving strategies. While working within the framework of AuRELIA, girls proved to be totally capable of carrying out experiments by themselves and of interpreting their findings, as well as identifying and solving problems by means of their pre-knowledge complemented by research activities.

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Part III

Relating TILA to Other Theoretical Frameworks

11 Inquiry Learning Arrangements from the Perspective of Critical Multiplism and Related Concepts

Jean-Luc Patry

Reitinger's *Theory of Inquiry Learning Arrangements* (TILA) is discussed within the framework of Critical Multiplism. This framework refers to the necessity to consider multiple approaches when conceiving and testing theories. These approaches need to be selected systematically and to be critically justified on a theoretical basis. Besides methodology, which is not addressed, multiplism is applied to object theories that are the main target of research. TILA is an integration of several theories. On the meta-theoretical level, multiplism in TILA consists, among others, in using both descriptive as well as prescriptive statements. This paper then shows that and how TILA can be interpreted as constructivist, with a particular focus on viability checks, a new element in constructivism. Finally, based on these concepts, the question is addressed whether and how TILA can be taught to (student) teachers using the key elements of TILA. The discussion deals, among others, with the possibility to use TILA within broader frameworks.

Keywords: constructivism, critical multiplism, multiple theories, teaching for TILA, viability check

1 Introduction

Since the beginning of scientific inquiries into teaching, a great number of didactical tools have been developed. Many of them are independent from each other, but others form what Schurz (1998) calls a "paradigm cluster" (*"Paradigmenbündel"*; p. 19), i.e., a set of more or less loosely connected paradigms. It seems that inquiry learning theories form such a paradigm cluster since many approaches have been developed more or less independently under this name which have the focus in inquiry in common but which vary greatly (Furtak et al., 2011), e.g., dealing with individual or with group inquiries,

in different disciplines (e.g., Dekkers, 1978; Farrell, Moog, & Spencer, 1999; Leonard, 1983; Oliver-Hoyo, Allen & Anderson, 2004; Rutherford, 1964; Tamir, 1983; Welch, Klopfer, Aikenhead, & Robinson, 1981; Zeichner & Teitelbaum, 1982), often in combination with other approaches such as values education (Patry, Weinberger, Weyringer & Nussbaumer, 2013). According to Furtak et al. (2011), however, researchers disagree about the features that define inquiry learning (p. 301). As a corollary, the theoretical underpinnings of the respective teaching approaches are often weak and in any case inconsistent, which leads to substantial problems in conceiving teaching and doing research in this field.

Reitinger's (2013; see also several chapters in this volume) approaches belong to this paradigm cluster and are among those with the most explicit framework relating theory to practice through a series of theoretically justified criteria (TILA: "Theory of Inquiry Learning Arrangements "; see Reitinger, 2013; 2015; and the contributions in this volume), whose systematic operationalizations (e.g., AuRELIA: "Authentic Reflective Explocatory Learning and Interaction Arrangement", and CrEEd: "Criteria-based Explorations in Education", see contributions in this volume) satisfy the requirement formulated by Furtak et al. (2011) for treatment validity: Indeed, the studies done by Reitinger and colleagues follow quite narrowly the respective principles, albeit within the necessary freedom to adapt to the specific topic, sample, and other conditions.

TILA, AuRELIA and CrEEd are based on many different basic theories, including a normative framework referring, among others, to Benner's (2011) and Klafki's (1999) *Bildungstheorien* which address autonomy and responsibility. This is seen as an example of critical multiplism (see Patry, 2013) on the object-theoretical level as well as on the meta-theoretical level. In the present paper, the aim is to use the concept of critical multiplism as a tool for the analysis and possibly enhancement of TILA. The aim is also to discuss TILA using the present author's own extensive research programs.

2 Critical multiplism on all levels

Critical multiplism (Cook, 1985; Shadish, 1986; Patry, 1989) has evolved from the framework of Donald T. Campbell (see Overman, 1988). Originally conceived as a methodological approach (e.g., Campbell & Fiske, 1959), he expanded this framework to theory (e.g., Campbell, 1969, particularly in the last two sections, "Unifying phenomenology and behaviorism" and "A behavior-phenomenological analysis of Aristotle's Lover and Coward") and to epistemology (meta-theory, e.g., Campbell, 1988).

The core principle of critical multiplism with respect to methods has been stated by Hetherington (1997, Slide 18; see Table 1). He distinguishes two dimensions: thoughtless vs. throughtful and single vs. multiple methods. Thoughtless research is considered poor science, whereas single approaches are seen as rigid and inappropriate. The only appropriate methods are thoughtful *and* multiple, i.e., critical multiplism.

Thoughtful and hence critical mean here that (1) the multiplism is systematic without being rigid; (2) they are justified, i.e., they are supported by reasonable arguments; (3) they require a theoretical underpinning (cf. Patry, 2013, pp. 51–52).
As demonstrated by Campbell in the papers referred to above, these core principles can be extended from methodology to object theory and meta-theory.

TABLE 1. *A taxonomy of methods (following Hetherington, 1997, slide 18)*

	Thoughtless	**Thoughtful**
Single method	Mindless monism Poor science Rear-end validity	Rigid monism Newtonian science Max-min-con
Multiple methods	Mindless multiplism Poor science Anything goes	Critical multiplism

Object theory is the theory that addresses the object; a sound theoretical base for an intervention method such as teaching (in the present case: inquiry based teaching) is required for generalization (application of the teaching tool to circumstances different from the one investigated in a particular research) and for appropriate application which must be adapted to the particular conditions: The theory provides the framework how to apply it (see, for instance, Patry, 2012a). In inquiry learning, the objects are, in any case, teaching and learning, and more concretely in TILA: interest, method affirmation, hypothesizing, exploration, discourse, transfer. Applying critical multiplism to object theory means that one single theory is not sufficient to address a specific object.

One justification for using multiple theories lies in the argument that in practice (such as teaching) several theories are necessary to account for the complexity of the circumstances. Another justification refers to the fact that in social sciences the statistical variance accounted for by variables referring to single theories (e.g., in multiple regression analyses: R^2) is almost always very low, usually not higher than 40% but frequently much lower: Lance and James (1999, p. 409), for instance, report a typical variance accounted for of less than 25%; Mischel (1968) found that in social behavior less than 10% of the variance is explained, based on correlations between, for instance, personality questionnaire results and behavioral observations of the same behavior; etc. The hope is that by combining theories, such as using variables from different theories as predictors in a multiple regression analysis, the variance accounted for (R^2) can be increased. These two justifications are probably related since one can argue that the neglect of relevant theories (first argument) lowers the variance accounted for (second argument).

The scientific discourse is still dominated by the opposition of theories ("if my theory is right, your theory, which is different, must be wrong") in the tradition of Kuhn

(1962) – provided that theories are addressed at all. However, co-existence (two or more theories are acknowledged as being relevant, but no relationship is established), co-operation (a relationship between compatible theories is established) or even complementarity of theories (two or more seemingly incommensurable theories are integrated in a common framework; Bohr, 1937[1]) seem much more appropriate (Patry, 2014a). How these concepts of co-existence, co-operation, and complementarity are to be conceived in particular cases will have to be considered case by case. The claim is that TILA is such a conception.

Meta-theory is the theory about theory (or about theories). The most prominent meta-theory is epistemology, but this is by no means the only one. Critical multiplism on this level means that different meta-theoretical approaches are considered. In the present case, the epistemological approach of post-positivism (Phillips & Burbules, 2000) is espoused with a special focus on warranted assertibility (ibid, p. 31; Putnam, 1990; see also Patry, 2008; the term has been coined by Dewey) and viability checks (Patry, 2014b; see below).

Warranted assertibility refers to the experience that classical epistemological frameworks such as critical rationalism (e.g., Popper, 1934) or analytical philosophy (e.g., Weingartner, 1971) are only partly satisfactory in the social (and other) sciences because they cannot take into consideration all conditions as would be necessary. This means that there is no single best approach. Instead, according to the concept of warranted assertibility, one should use the *best arguments possible* to support scientific statements, using the approaches that are most appropriate using good norms and standards. Putnam (1990), in response to the issue that there is no single best approach, argues that our norms and standards for justifying statements "are historical products" and "evolve in time", that they "always reflect our interests and values" and "are capable of reform. There are better and worse norms and standards" (p. 21). However, the criteria of "better" and "worse", in turn, are subjects to norms and standards. We have than the Munchausen trilemma (Albert, 1991, pp. 13–18) referring to the famous liar Baron Munchhausen who claimed to have pulled himself out of the swamp by his own hair. There is *either* an infinite regress (the criteria need to be judged on new, higher-order criteria, which need to be justified again, and so on), *or* a circular argumentation (Munchausen's "solution"), *or* arbitrary termination of the procedure. Since the first two solutions are inacceptable, only the third can be considered. Although critical multiplism does not eliminate this problem, it might attenuate it: If several of the arguments converge on

1 "The apparently incompatible sorts of information about the behavior of the object under examination which we get by different experimental arrangements can clearly not be brought into connection with each other in the usual way, but may, as equally essential for an exhaustive account of all experience, be regarded as 'complementary' to each other." (Bohr, 1937, p. 291) However, with this I do not want to draw any conclusion from quantum theory as addressed by Bohr to social science (see Reich & Patry, 1997).

one statement, the warranted assertibility is judged higher than if only one arguments speaks in its favor.

This is in clear opposition to throwing away previous epistemologies because of their flaws and replacing them with other ones. The new ones may presumably not have these flaws but definitely have other shortcomings, although these usually remain unacknowledged. For instance, Guba and Lincoln (2000) rightly criticized some features of traditional research and tried to replace all of it, thus getting rid of some problems but creating anew many others. Instead, the weaknesses of the different approaches are acknowledged, and taking them into account, the justification is done in the best way possible . Guba & Lincoln's criticism should be taken seriously, and attempts should be made to take it into consideration without giving up the positive principles. This means that, instead of bold and simple catchphrases, rational arguments are provided. This is the essence of *critical multiplism*.

In addition, from a meta-theoretical standpoint, one can address both descriptive *and* normative statements, provided that they are argued for appropriately (Zecha, 1984) This is in striking opposition to the claim that research in education (*Erziehungswissenschaft*) must not contain any normative statements (Brezinka, 1978), a stance that according to Zecha is not tenable (see also Patry, 2006). Normative statements are also an integral part of TILA, as Reitinger (2013) insists in the need to use a normative *Bildungstheorie* (Benner, 2011, and Klafki, 1999), as mentioned above.

Overall, critical multiplists acknowledge the limits of research on all levels and try to do their best, which means using different approaches which are rationally underpinned. This means that propositions are argued for but that counterarguments are considered as well.

3 Constructivism

Constructivism (see Section 3.1 below) is another important rational for critical multiplism. While in TILA publications constructivism is only mentioned marginally (Reitinger, 2015; see also the contributions in this volume), except for pointing to the viability check (see Section 3.2 below), it is obvious that constructivist concepts underlie TILA. For instance, TILA satisfies all four constructivism criteria provided by Baviskar et al. (2009), namely eliciting prior knowledge, creating cognitive dissonance, application of knowledge with feedback, and reflection on learning.

3.1 CONCEPT

One can find many different concepts of constructivism in the literature (see, for instance, Davis & Sumara, 2002; Phillips, 1995). It is not the place here to account for all the different approaches labelled "constructivism", rather to present briefly a position in

this regard, which can be regarded as a moderate position as opposed to Glasersfeld's radical constructivism (e.g., 1997).

Very simply said, constructivism says that what we perceive is not the reality but rather a construction, i.e., an interpretation of the signals provided by our senses based on our subjective theories (for details, see Gastager, Patry & Gollackner, 2011). Constructivism is, first of all, an epistemological perspective (e.g., Kant, quoted from Phillips, 1995, p. 6), responding to the question "What can I know?". Secondly, it is a theory of learning, responding to the question "How can I learn?". It is not primarily a theory of teaching (Baviskar, Hartle & Whitney, 2009, p. 542; Kotzee, 2010), i.e, it does not respond to the question "How can I (as teacher) foster learning?". Only through the integration of other theories (see above, critical multiplism on the object theoretical level) can it become a theory of teaching. However, as a theory of learning it has a substantial impact on a theory of teaching. Therefore, it is necessary, first, to present the underlying assumptions (epistemology). Then, it would be necessary to show how the integration of other theories lead to a theory of constructivist teaching. This will be addressed only with regard to one topic: viability checks.

What can I know? Simply stated, constructivists stipulate that knowledge of any kind is constructed by our cognition, not an actual representation of reality, whatever this might be (see, for instance, Confrey, quoted from Kotzee, 2010, p. 178). The claim is that we have no direct access to reality but that our perception, which would be our most direct connection with reality, depends on our pre-conceptions. We can perceive only what fits into our cognitive framework, which means that we distort everything that "meets the eye" (or our other senses).

The first questions are whether there is a reality, and if so, how humans have access to it. Capitalizing on the pragmatic realism of Hilary Putnam (2008; see also González García & Rivas Monroy, 2008), the following theses are proposed as basis for a constructivist stance (for a more detailed account, see Patry, Weinberger, Weyringer, & Nussbaumer, 2011).

(1) Whether there is a real world or not, and if so, whether there is one or there are several, is irrelevant since we have no possibility to test them.

(2) In everyday life as well as in science, we have theories, which can be subjective in the sense of lay theories, i.e., non-scientific, *that* there is a real world and *how* this looks. These theories are our constructions. We interpret these subjective theories very broadly, including restrictions due to our perception apparatus (for instance, we cannot see certain colors like ultraviolet), our information processing structures (e.g., particular sensibility for certain features of the signals provided by our senses), innate cognitive structures (as described, for instance, in *Gestalt* psychology), and acquired cognitive structures (e.g., as described by Piaget, 1976, or by Vosniadou & Skopeliti, 2014).

(3) It is not assumed that these theories represent reality appropriately. However, it is the premise is that the theories have been successful so far, i.e., they have been viable in the sense discussed above, and we have been able to act successfully based on them. Had they not been viable, they would have been replaced long ago in the evolution of our species, or mankind would not have survived. There are people whose subjective theories are partly viable at best (e.g., schizophrenics). These people have difficulties in coping with everyday life.
(4) The subjective theories used might differ from situation to situation. This is due, among other things, to the different goals in different situations, which lead to different viability criterions.
(5) The viability of a subjective theory is temporary and may change due to learning (assimilation and accommodation in the sense of Piaget, 1976; conceptual change in the sense of Vosniadou & Skopeliti, 2014). Learning is here conceived as a change in the subjective theory.

According to this concept, hence, learning depends on the viability criterion that is applied and on whether the new theory that is either offered from sources outside of the person or that is invented by the learner is understood. It can be integrated into the learner's system of subjective theories or can lead to accommodation or conceptual change, and it is viable with respect to the criteria which are actualized in the current situation. It might be mentioned here that according to the argumentation above when discussing warranted assertibility, there is not one single criterion. Which one to choose needs justification, that is, as Brewster (personal communication) suggested, its viability needs to be established; note that here, again, a Munchhausen trilemma arises.

Inquiry learning complies fully with the five principles above. The teacher's task is, then, to provide opportunities for this to happen, i.e., to establish inquiry learning arrangements. It might be mentioned here that the principles above are based on several theories, thus demonstrating the appropriateness of critical multiplism on the level of theories. The viability criterion varies from one situation to another. Multiple yet justified approaches are needed both on the level of the theories and on the level of methods. This shows that critical multiplism at least on the methods and theories levels are applicable in constructivist learning as well.

3.2 VIABILITY CHECK

The viability check is a concept that takes the critique seriously that constructivism is a theory of learning and not of teaching. According to the principles discussed above, viability of a concept is a precondition for its integration in one's system of subjective theories, i.e., for learning. This means that it is crucial that the learners check the viability of such concepts and that the teachers provide such opportunities. This is in agreement

with the third criterion for constructivism formulated by Baviskar et al. (2009), namely application of knowledge *with feedback*.

In traditional teaching, it is usually the teacher who defines the problem to be solved. He or she also defines the criterion for the viability of the concepts that might be proposed by the students. From the point of view of the students, then, there is only one dominant viability criterion: the teacher's satisfaction with the proposition, i.e., typically with the answers of the students. In the best case, the students adhere to the criterion that is applicable from the teacher's standpoint as well. In Inquiry Learning, they decide themselves about the criterion to apply, which means that they are really *interested* in the problem and its solution and are self-determined to find viable solutions, which Reitinger (2013) calls *method affirmation*. In this case, they *hypothesize* about the viability of the concepts they have developed through *exploration*. This set of conditions is a precondition for transfer, but *transfer* is much more complex than usually assumed (see, for instance, Patry, 1999). The concepts marked in italics above are criteria for inquiry learning according to Reitinger (2013; see also Reitinger, Haberfellner, and Keplinger, in this volume).

Reitinger's sixth criterion is called *critical discourse* and refers explicitly to the concept of viability check, which contributes to the warranted assertibility mentioned above. While warranted assertibility is fully compatible with TILA, it seems worthwhile to examine what the application of these principles might mean for improving the concept of Inquiry Learning. In particular, in viability checks, the problems of finding the appropriate criteria as discussed above need to be addressed. One can distinguish at least six types of direct viability checks in learning:

(1) *Experience*. One applies a particular concept in a practical situation and is successful or fails. For instance, one can only learn to ride a bike by doing it and recognizing when and how to keep one's equilibrium and when or how not. Relevant natural consequences of one's actions show whether the underlying concept is viable or not. Thus, from the teacher's standpoint, it is important for learning to let the learners experience the natural consequences of their actions, provided that there is no overriding reason, e.g., that the consequences are too dangerous. In science learning, doing experiments or gaining other relevant evidence, including, for instance, computer simulations, is an important type of viability check through experience.

(2) *Argumentative viability check*. Arguments are provided to support the concept. It is important that also arguments against the concept are considered. This refers to the warranted assertibility discussed above.

(3) *Social viability check*. The peers are one of the most important sources of critique. Their feedback, hopefully supported by warranted assertibility, i.e., an argumentative viability check, can be accepted or declined, again, with argumentative justification.

(4) *Simulation*. The learner imagines what will happen if he or she acts according to his or her new concept. For instance, teachers plan their teaching and anticipate what could happen and how they would react in this specific critical cases.

(5) *Substitute viability check.* Models are a powerful source of information about the viability of actions (Bandura, 1977). Model learning consists in observing someone performing a relevant viability check instead of doing it oneself. Such models are particularly powerful if one experiences the viability of the respective action oneself. This is the case, for instance, for punishment. Someone who has been punished in his or her education knows that this can change behavior quickly and might use punishment him- or herself, even if the influence is not sustainable because a quick impact is a more important viability criterion than sustainability.
(6) *Communicated viability check.* Someone who is seen as competent by the learner states which concepts are viable and possibly why, i.e., an argumentative viability check. In school, often the teacher conveys which solution is the "right", i.e., viable one through lectures or books. This is the way viable concepts are disseminated in science since it would not be possible and economical that every study is done again and again for a viability check through one's own experience. Although teachers' lectures are often criticized from a constructivist standpoint, they might be necessary for economic reasons. However, they need to be done appropriately, i.e., taking into account the criteria of constructivism as addressed, for instance, in TILA.

Further, at least two types of retrospective viability checks, i.e., *after* the viability of a concept has been decided, can be distinguished:
(7) *Reflection* (Weinberger, 2006). After a problem has been solved, the learner reflects how the solution was found and whether it is plausible. In mathematics teaching, for instance, the learners can try out another path to solve a problem and check whether they arrive at the same result.
(8) *Feedback by peers* (Weyringer, 2008). The retrospective reflection is done in groups, i.e., the peers become mutual agents of retrospective viability checks.

One cannot say that one or the other type of viability check is better on principle. However, it seems likely that viability checks which are somehow linked with the argumentative type are appropriate in many cases, particularly in cognitive learning and that experience is sustainable particularly for procedural concepts. However, it is not possible in all situations for teachers to provide such opportunities. On the other hand, one can assume that more can be done than typically achieved in school.

Inquiry learning provides opportunities for all eight types of viability checks. It is the teacher's task, either, to provide opportunities for the learners to practice viability checks of different types or to accept if a learner uses an unexpected type of viability check. Hopefully, the learner will learn under what conditions which type is appropriate (super-ordinary viability check).

Weinberger (2006) has shown that learning using a type of Inquiry Learning, namely Values *and* Knowledge Education (V*a*KE; Patry et al., 2013), can be improved

by systematically using viability checks. This means that it is appropriate, from a constructivist point of view, to induce students to perform such checks. This might be appropriate in TILA as well. These *systematic* viability checks go beyond group discussions and should encourage the learner to provide arguments for his or her stance, for instance, in written form.

4 Teaching for TILA

TILA and the corollary tools, AURELIA and CrEEd, are an exemplary application of critical multiplism on the theoretical level. The question then becomes whether the underlying theories are conveyed to the potential users of the tool. This is necessary because TILA, AURELIA and CrEEd are frameworks to be adapted to the different conditions in which they should be applied. This means that these tools are not cookbooks to be followed blindly but need some kind of translations to fit the particular needs (for more reasons why such a translation is required for application, see Patry, 2012a). For this translation to lead to an intervention which is likely to be effective, however, it must be performed in the spirit of the theoretical framework. Therefore the teachers need to become familiar with the underlying theories. This is more the case since the teacher might be confronted with surprising reactions by the students or with unexpected events, to which they must react in agreement with the spirit mentioned above.

The question then becomes whether the teachers can be taught these theories. Experience shows that teachers are reluctant to acquire and use theories (Patry, 2005). Applying the criteria for TILA, then, becomes partly difficult.

Because scientific theories can be helpful when deciding how to act in practical situations, it is crucial that the teachers understand the reason why it is necessary to learn about theories, otherwise, the *interest* will be minimal. Professionalism means that the practitioner capitalizes on any available viable concept, and since scientific theories are claimed to be particularly viable, it would be irresponsible not to integrate them into one's system of subjective theories. In order to apply the theories appropriately, they need also to understand the role of theories in practical action. In particular, they must recognize that there cannot be a direct impact of theories on action. Instead scientific theories provide action options, but it is the teacher's responsibility to decide whether a particular theory is applicable and, if so, beneficial in a specific practical situation (Patry, 2012a). Learning about theories refers to the communicated viability check since the students learn not only presumably viable theories but also how the viability check was performed in the original study, e.g., through exemplary experiments. This means, according to the argumentation above about warranted assertibility, that the students must also learn about the importance of critical multiplism on the theoretical level and decide themselves, based on the criteria of their choice, about the viability of the theories proposed to them.

The same applies for *method affirmation*. Hopefully, this will then lead to the teachers looking for more theories that might be useful for their practice, namely, critical multiplism on the theoretical level.

With respect to *experience-based hypothesizing*, an additional issue comes into play. Since learning about theories means integrating scientific theories into one's system of subjective theories, the question becomes whether scientific theories are compatible with subjective ones. Accommodation seems particularly difficult in this respect; as Messner and Reusser (2000, p. 157) stated that "Teachers teach as they are taught and not as they are taught to teach", i.e., typically they rely on their experience (see the first type of viability checks) and not on the communicated concepts. Hypothesizing then will likely be based on actual subjective theories and not on scientific ones. In contrast to most learning topics, this problem is enhanced by the fact that everyone regards him- or herself as an expert in education since we all have experienced education, both having been educated and having practiced education.

Authentic exploration seems difficult because theories cannot be experienced directly. It is important that teachers experience at least prototypically that theories can provide them with valuable information for their practice. Once they have made this experience, one can assume that exploration is more likely. In agreement with TILA, it is important that each teacher finds his or her own way of dealing with theories.

Critical discourse then becomes crucial. The theories we use in practice are usually tacit, i.e., we rarely or never speak about them. Since teachers are very insecure with respect to their subjective theories, which is due to the problems related with the gap between theory and practice (see above), they tend to perceive a lack of warranted assertibility in their theories. As professionals, however, they believe they are required to use good theories, and society strengthens this belief. As a consequence, they are particularly sensitive to criticism. To account for this, it is even more important than with other contents that discourse is performed in a socially acceptable form, i.e., that appropriate discussion rules are agreed upon and enforced, otherwise reactance might result. This shows that additional theories, here the theory of reactance (Brehm, 1966) are necessary).

Conclusion-based transfer is then the final viability criterion through application of the principles of TILA in appropriate adaptations in concrete situations. These adaptations depend on many features such as situations, goals, time constraints, etc. This adaptation process is addressed in the theory of tact (Patry, 2012a).

One can ask here whether TILA can be conveyed to (prospective) teachers through TILA. The remarks above show that this is not fully possible since there are substantial obstacles. In generalization to the application of TILA, one can conclude that TILA cannot be used for all possible subject matters. However, it can be combined with other teaching tools. To apply critical multiplism to this issue means that this combination needs justification otherwise it cannot be regarded as *critical*.

5 Discussion

Critical multiplism on the different levels is a general framework that seems appropriate in the current situation of social research, particularly within a constructivist research context. The aim of the present paper was to give some insight into the issues that might arise here under particular consideration of TILA. The focus was on the multiplism of theories and, to a lesser degree, on meta-theoretical multiplism. The methodological perspective, i.e., the one from which critical multiplism originated in the Campbellian tradition (Campbell & Fiske, 1959), would require a discussion in itself, which would show that, again, multiple theories on the object theoretical level are required (see Patry, 2011), and these should be compatible with the object theoretic theories under investigation (e.g., TILA). It is suggested, then, that the research done in the TILA research program should use methodical critical multiplism to enhance the warranted assertibility of the respective statements.

While critical multiplism has mainly been discussed in methodology, the present chapter shows clearly how important it is on the theoretical level. In this regard, much more research about the interaction between theories needs to be done. This can best be done with concrete examples, as performed here with TILA. The question is, however, whether and how the experiences with theory multiplism made with TILA can be generalized to other topics. Similar insights were already achieved for the topics Values *and* Knowledge Education (V*a*KE; Patry, 2012b) and situation specificity (Patry, 2013). This shows that the principles discussed above not only apply to TILA but have a more general validity. However, in agreement with the reflections above with respect to TILA, the general principles of critical multiplism on theoretical level need to be applied specifically and critically to each of the domains of interest.

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12 Inquiry Learning Arrangements and Expansive Learning: A Tentative Dialogue

Investigating TILA from a Cultural-Historical Perspective

Martin Kramer

Any word is a theory.
To name an object is to apply a concept to it.
Admittedly, by means of the word we wish to comprehend the object.
But each name, each application of the word, this embryo of science,
is a critique of the word, a blurring of its form, an extension of its meaning.
Vygotsky, 1997, p. 251

This chapter examines the Theory of Inquiry Learning Arrangements from a cultural-historical perspective, respectively from the point of view of Engeström's *Theory of Expansive Learning*, which is built on the grounds of *Cultural-Historical Activity Theory*. Possible theoretical approximations as well as persisting conceptional differences are highlighted and discussed. Although they are built on different paradigms it is suggested that both approaches are basically complementary, ready for a fruitful dialogue.

Keywords: inquiry learning, expansive learning, cultural-historical activity theory

1 Introduction

With its *Definitional*, *Action-orchestrating*, and *Organizational Frame Constructs*, the *Theory of Inquiry Learning Arrangements* (Reitinger, 2013; TILA) presents itself as an organic whole, a theory that takes into account manifold aspects of how learning can and should be arranged in an inviting, meaningful and effective way that is both consistent with the inquisitive nature of human beings and at the same time also fosters it. It seems, however, to be a worthwhile undertaking to examine these theoretical constructs from an outside position in order to highlight similarities with and differences to other approaches theorizing on learning and to investigate their general compatibility.

In the present account, such an attempt shall be made in a dialogical manner, acknowledging the fact that any such examination, or juxtaposition of theories, also puts them in dialogue, and as such cannot possibly stay without effect, reminding us of Watzlawick's first pragmatic axiom of human communication (Watzlawick et al., 2011, p. 29): *One cannot not communicate*.

This chapter looks at TILA from a *distinctive* outside position, a position that highlights the fact that every learning is embedded in a rich cultural and historical background, that any novel idea is rooted in countless other novel ideas that have been developed and applied before, and that, while shaping human culture through our unique inquisitive behavior, we are at the same time being shaped by it. Besides an apparent epistemological outcome, any kind of learning also has an ontological effect that is not to be neglected: It changes the very person a learner *is* (Packer & Goicoechea, 2000; Stetsenko & Ho, 2015).

The learning theory chosen to investigate TILA acknowledges this cultural and historical background and also takes into account the ontological aspect of learning: The *Theory of Expansive Learning* (EL) is situated within the framework of Cultural-Historical Activity Theory (CHAT). Outlined in the legacy of Vygotsky and A. N. Leont'ev, it was developed by Engeström (1987). Its main goal being the development of transformative agency, "agency understood as volitional actions that transform the world we inhabit" (Sannino, 2015, p. 1), it has been successfully applied in educational and organizational settings and as such seems well-suited for a fruitful dialogue with TILA.

The following sections elucidate the peculiarity of such a cultural-historical perspective and give a short account of the Theory of Expansive Learning before putting both theories in contrasting juxtaposition, which allows the discussion of their general compatibility and the possible application of one theoretical framework in light of the respective other, thus opening up a tentative dialogue.

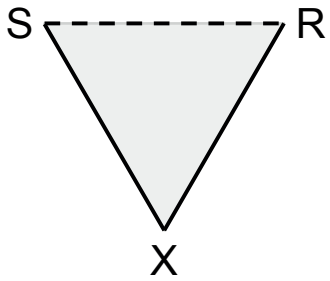
2 A cultural-historical perspective

This section focuses on some of the basic characteristics of a position of a learning theory that deserves the descriptors *cultural* and *historical*. This means that learning is situated within and at the same time transforms a certain cultural and historical context.

LEARNING NEVER TAKES PLACE IN A VACUUM. It grows out of and takes place on a rich cultural and historical background. Every tool carries with it a long tradition of human endeavor. By using it – by enacting specific human culture – it also helps to create culture, and at the same time it is being shaped and further developed. This is obvious when we look at a hammer, at its historical development, and at its multiple shapes for specific uses, but it equally applies to other cultural artifacts, most notably *language*. Vygotksy (1978, p. 45) described the mediated act: We are no longer directly connected to

a world without culture and history, merely responding to outward stimuli (stimulus → response). On the contrary, the objective world is revealed to us, and we in turn master the world through cultural artifacts, as diagrammed below:

FIGURE 1. *The mediated act (Vygotsky, 1978, p. 40)*



Furthermore, we create and use cultural artifacts not only to change the world, but also to change our own behavior, the famous knot in the handkerchief being a well-known illustration (Vygotsky, 1978, p. 51), the whole endeavor of formal education, of formally being introduced into specific human culture, being the full-blown consequence: "For the young child, to think means to recall; but for the adolescent, to recall means to think" (ibid.). By tying a knot in the handkerchief in order to be reminded of something, *remembering* is transformed into an external activity, i.e., an external object is utilized for the deliberate construction of memory. For Vygotsky, this very fact demonstrates the fundamental characteristic of the higher forms of behavior when he states, "In the elementary form something is remembered; in the higher form humans remember something" (ibid.). While in the first case simultaneously occuring stimuli create a temporary link, in the latter case such a temporary link is actively created through a deliberate combination of stimuli:

> "The very essence of human memory consists in the fact that human beings actively remember with the help of signs. It may be said that the basic characteristic of human behavior in general is that humans personally influence their relations with the environment and through that environment personally change their behavior, subjugating it to their control." (Vygotsky, 1978, p. 51)

Vygotsky addresses this purposeful introduction of a cultural artifact as stimulus to change one's own behavior as *double stimulation* (Vygotsky, 1978, p. 74), the first stimulus being the problematic situation, the task that needs to be solved, and the second stimulus being the cultural artifact that is chosen by the learner in order to master the situation.

LEARNING IS AN INVITATION into both a social and meaningful world. A learner's innate learning disposition and willingness to learn – in other words, the learner's *readiness for taking in human culture* (Zinchenko, 2012, p. 73) – is complemented by an objective world that presents itself as personally meaningful to the learner and *wants to be discovered*. George Mallory's famous answer may serve as an illustration: When being asked by a reporter of the New York Times why, after not having succeeded twice, he wanted to take yet another attempt at climbing Mount Everest in 1924, he simply replied, "Because it's there" ("Climbing Mount Everest is Work for Supermen", 1923). Within an object-oriented activity, like the successful ascent of a mountain, the object reveals its motivating power to the subject. It becomes meaningful to the subject, in fact, subject and object *constitute* each other to some extent (Packer, 2011, p. 10). Both subject and object become *transformed* in the activity: While proving to be fatal, Mallory's final attempt (whose failure or success from the point of view of reaching the summit still remains an open question) meant a change in the perception of Mount Everest, and it also had an effect on the organization of further, more successful attempts (from the point of view of returning home safely), as well as on the further development and refinement of expedition tools based on the experiences of those pioneers.

At the same time, learning means an invitation and initiation into a social world. The cultural-historical position holds that we are not merely shaped by social or cultural influences, as this would amount to a *weak* definition of a social self. In contrast, a *strong* definition of the social self maintains that the very capability to learn *at all* is socially constituted: Beyond our beliefs and behavior being fundamentally influenced by the social circumstances of our lives, "our very capacities to think and act are themselves socially constituted" (Bakhurst & Sypnowich, 1995, p. 5). In other words, rather than being merely *shaped* by society, the human mind is *made* in society.

This becoming of the social self, however, does not amount to a "gradual animation of a statue" (Zinchenko, 2012, p. 63). On the contrary, Zinchenko postulates a certain pre-experiential readiness and willingness to accept culture, a "set of intrinsic conditions that allow development to occur", enabling a child to absorb culture (Zinchenko, 2012, p. 73). Thus, the world is first social and then meaningful to us:

> "Penetration of the word into the child's soul is a mysterious process, as enigmatic as the soul itself. Michael Bakhtin said that soul is a gift his spirit gives to another person. From the excess of her love and generosity of spirit, mother gifts her soul to her baby. This gift is mediated by her voice, her nurturance and her words. Love is eloquent and articulate. Both the voice and the word become meaningful events in the baby's life." (Zinchenko, 2012, p. 69)

EVERY LEARNING ALSO ENTAILS AN ONTOLOGICAL ASPECT. Besides obvious epistemological goals, to gain new knowledge about the objective world, any learning also encompasses a distinctive ontological aspect. It transforms the very person a learner *is*. This can already be concluded from what has been stated so far, but it is worth highlighting separately: In becoming subjects of a new activity, such as becoming school children by entering the specific activity of formal schooling, children undergo a transformation process that not only changes the way they acquire factual knowledge but also transforms their very personality, i.e., learning *entails broader changes in being* (Packer & Goicoechea, 2000, p. 227; cf. also Packer & Greco-Brooks, 1999). The acquisition and mastery of new cultural tools, such as written language, is accompanied by new rules, both written and unwritten, and specific roles that, by growing into them, alter the whole personality. Time and place get structured in a totally new way: Instead of being able to run around freely, one has to learn to sit still and work between acoustic signals that designate specific work and leisure times[1].

The same applies, of course, to other activities, as entering as well as maintaining any object-oriented activity, not just a specific learning activity, encompasses learning and transformation: Becoming a school teacher entails a whole spectrum of transformation in being, in growing into a new form of social practice. It includes becoming acculturated into a specific, historically grown setting, becoming part of a (typically quite heterogeneous) team of teachers, acquiring distinctive rules and roles. In short, it shapes and transforms the very person that teacher is.

LEARNING TAKES PLACE IN SPECIFIC LEARNING SPACES. This refers more to a temporal than a spatial dimension and addresses the relation between certain developmental steps and possible effective learning. Vygotsky (1978, p. 79; see also Daniels, 2009, p. 26), after discussing (and rejecting) positions in which (a) development and learning take place independently from each other, (b) are basically one and the same thing, or (c) are a combination of both points of view, proposes a radically new approach that he calls the *zone of proximal development* (ZPD) which is renownedly defined as

> "the distance between the actual developmental level as defined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." (Vygotsky, 1978, p. 86)

Instead of concentrating on an actual developmental stage (or, rather, shortcomings and deficits according to a developmental stage that would be expected at a certain age), on intellectual functions that have already matured and define a current status quo, it is more

1 For a brilliant illustration, refer to Roger McGough's poem *First day at school.*

promising for Vygotsky to look for "functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state" (ibid.). He calls such functions *buds* or *flowers* of development rather than its *fruits*. Such a view focuses rather on a possible future instead of a problematic present, as Engeström (2015, p. xiii) quotes Bronfenbrenner (1997, pp. 527–528), who recalls a famous remark made by A. N. Leont'ev: "It seems to me that American researchers are constantly seeking to explain how the child came to be what he is; we in the USSR are trying to discover how he can become what he not yet is." As Griffin and Cole (1984, p. 62) put it, the ZPD is the *dialogue between the learner and his/her future*. However, the ZPD is not limited to the individual learner. Rather, it encompasses possible developmental steps of a given social practice, in other words, it could be defined as the dialogue between a given activity and its possible future form. Engeström (2015, p. 138) thus reformulates the ZPD this way:

> "It is the distance between the present everyday actions of the individuals and the historically new form of the societal activity that can be collectively generated as a solution to the double bind potentially embedded in the everyday actions."

After highlighting some essential characteristics of learning within a cultural-historical paradigm, let us now turn to the Theory of Expansive Learning as a specific learning theory that has been developed on the grounds of these cultural-historical premises.

3 Expansive Learning in a nutshell

Engeström's (1987; 2015) Theory of Expansive Learning (EL) is developed out of an activity-theoretical framework that has, amongst others, most notably been set up by Vygotsky and his colleagues and students. EL has hence also been addressed as *third generation of cultural-historical activity theory*, Vygotsky's work being understood as first generation, and especially A. N. Leont'ev theory of activity as its second generation (cf., for example, Sawchuck & Stetsenko, 2008, p. 342). In the following brief account, the most basic tenets of EL are highlighted, namely the object-oriented activity as unit of analysis, i.e., the activity system, contradictions within a given activity as motors for transformation, the specific interventionist methodology that triggers a cycle of expansive learning, and the notion of transformative agency as the outcome of an expansive learning process.

AN OBJECT-ORIENTED ACTIVITY AS UNIT OF ANALYSIS

Within the CHAT tradition, the most basic category that serves as a unit of analysis for understanding human practice is object-oriented human activity. A. N. Leont'ev (1978) distinguishes between the hierarchical levels of operations (governed by conditions),

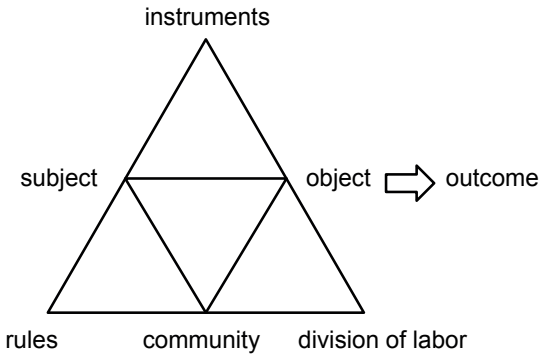
actions (governed by goals), and activity (governed by a motive), activity thus being made up of actions serving specific goals which even may seem contradictory to the whole activity and in turn consist of automatized sequences of motion. Leont'ev's famous example is that of a hunting activity (Leont'ev, 1981, p. 210): The *action* of the drivers of startling the game seems to be contradictory to the collective hunting *activity*, but is an essential part of it.

Engeström (2015, p. 59) describes the evolution of the human form of activity out of the animal form of activity, which is constituted by the relations between individual members of a species and their natural environment (individual survival – doing alone), between the individual and other members of the species (social life – being together), and between the population and the natural environment (collective survival – doing together): Emerging cultural artifacts (tool making; rituals and rules; division of labor) that *rupture* the original triangular relation between individual, environment, and population, mark the transition between animal and human form of activity:

> "The breakthrough into human cultural evolution – into the specifically human form of activity – requires that what used to be *separate ruptures* or emerging mediators become *unified determining factors*. At the same time, what used to be ecological and natural becomes economical and historical." (Engeström, 2015, p. 61, accentuation in original)

Thus, human activity is characterized by cultural artifacts that mediate and constitute the relation between subject, object, and community and can generally be described in a triangular model, as follows:

FIGURE 2. *A general system of object-oriented human activity (Engeström, 2015, p. 63)*



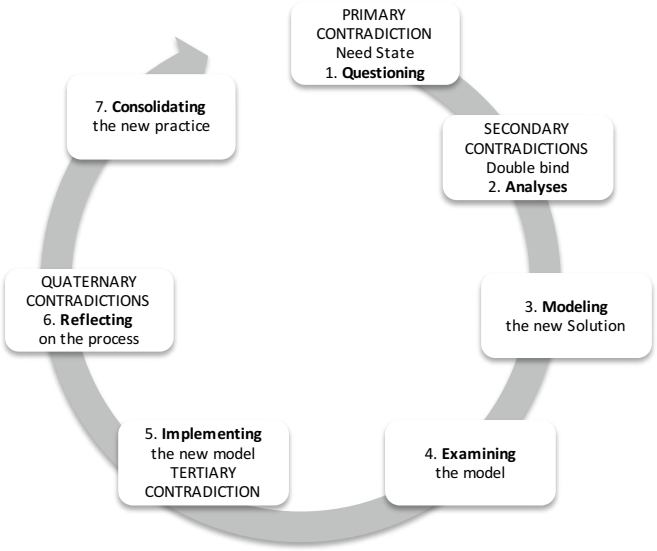
Empirical and historical analyses of the constituents of a particular activity system and their relation to each other reveal systemic tensions and contradictions, the overcoming and resolution of which is the task of an expansive learning process, ultimately leading to a historically new and expanded form of the activity.

CONTRADICTIONS thus serve as a motor for transformation. Engeström (2015, p. 66) distinguishes four levels of contradictions: Primary contradictions reveal the double nature between use and exchange value *within* each constituent component of a given activity system, e.g., the personal use value of formal education vs. the market value of the educated person. Secondary contradictions arise between its constituents, e.g., through the introduction of new tools, rules, or new roles. Tertiary contradictions become visible *between* the object/motive of the given activity and its possible future, culturally more advanced, form, e.g., the transition of an old school form into a new one. Finally, quaternary contradictions appear between the given activity and neighboring activity systems, e.g., the accumulation of roles that a subject is assigned to in different activities. Sometimes contradictions may not seem obvious. Potential contradictions between an unsatisfactory or boring present and a more promising future activity, in other words: *possibilities* (cf. Postholm, 2015, p. 49), may also serve as triggers for transformation.

THE CYCLE OF EXPANSIVE LEARNING

Engeström (2015, p. 149) describes expansive learning as a cyclic process consisting of a sequence of learning actions that aim at resolving primary to quaternary contradictions. These encompass states of questioning and analyzing a given practice, and of modeling, examining, reflecting, implementing, and consolidating/generalizing a new, culturally more advanced practice. Expansive learning is depicted as movement within the zone of proximal development that first needs to be charted and then serves as fertile ground for modeling, testing and implementing the new form of activity, as is illustrated in Figure 3.

FIGURE 3. *Cycle of expansive learning with corresponding contradictions (Engeström, 2015, p. 150)*



An expansive learning process is typically triggered and fostered by formative interventionist methodology. Intervention in this process does not mean pushing learners towards a desired outcome, but rather providing them with material that they can (but not necessarily need to) employ as second stimuli to change the activity under scrutiny:

> "[T]he end results of learning are not predetermined by the interventionists or researchers. The outcomes are designed by the participants as they work out expansive solutions to developmental contradictions in their activity systems." (Virkkunen & Newnhamn, 2013, p. xvii)

TRANSFORMATIVE AGENCY is the outcome of an expansive learning process. Virkkunen (2006, p. 49) defines it as "breaking away from the given frame of action and taking the initiative to transform it". Generally, agency becomes visible in actions, and it unfolds and develops in collective activity, directly connected to the activity's inherent motives and contradictions.

Transformatory agency is especially concerned with the contradictions, challenging the current status, and looking for new possibilities. Agentive actions are initiated by individuals, but they become meaningful, and pick up and maintain momentum only in the interplay between individual and community. Agency, thus, is a collective endeavor (cf. Haapasaari, Engeström & Kerosuo, 2014, p. 4).

4 A contrasting juxtaposition

From what has been outlined so far, we can now put TILA and EL in contrasting juxtaposition in order to analyze in what respect the former has the potential to serve as a compatible framework for supporting the latter. In particular, the unit of analysis, the conditions that trigger and foster learning processes, the learning steps, and the outcome of the learning processes are contrasted and discussed. Table 1 summarizes these points and provides a brief overview.

TABLE 1. *Contrasting different aspects of TILA and EL*

	Theory of Inquiry Learning Arrangements	**Theory of Expansive Learning**
unit of analysis	individual learner Criteria, Principles, and Dimensions of Inquiry Learning: Definitional, Action-orchestrating, and Organizational Frame Constructs	collective activity system ZPD as distance between individual actions and historically new form of collective activity (cf. Engeström, 2015, p. 138)
learning triggered by	innate cognitive-emotional structure of an individual; but also by contradictory contents or unexpected learning environments; curiosity as trait (Kashdan, 2010)	systemic contradictions within a given activity system; contradictions also seen as possibilities (Postholm, 2015, p. 49); learning as socially constituted

	Theory of Inquiry Learning Arrangements	Theory of Expansive Learning
learning fostered by	setting up learning arrangements that meet the learner's basic psychological needs (Deci & Ryan, 2000); other team members encouraging the learner to express their focus on learners' concerns (Seyfried, 2002)	formative interventions: providing material that serves as second stimulus; help with historical and empirical analyses
learning steps	Neither TILA's principles nor its criteria are organized as consecutive steps. The more the respective principles and criteria can be applied the better.	cycle of expansive learning consists of specific learning actions (Questioning – Analyzing – Modeling – Examining – Implementing – Reflecting – Consolidating and Generalizing the new practice)
outcome	building knowledge about the objective world; no previously fixed outcome	systemic change; transformation of activity system (epistemological and ontological change); transformative agency; no previously fixed outcome

WHAT ARE THE UNITS OF ANALYSIS?

TILA is a construct of criteria *for* as well as principles and dimensions *of* an Inquiry Learning process that together make up TILA's *Definitional, Action-Orchestrating,* and *Organizational Frame Constructs* which are tailored for the individual learner and the inquiry learning process, thus putting the focus on what *constitutes* an authentic inquiry learning experience, what *fosters* it, and how it can be *organized*. Centered around the individual learner and the learning experience, these arrangements together make up the basic unit of analysis.

The cultural-historical position takes *collective human activity* as its central unit of analysis. Rather than focusing primarily on the learner and taking care of arranging everything in order to provide an authentic inquiry learning environment, it takes a broader, systemic approach and seeks to trigger and foster transformation of all constituents of the activity system. It is not the *arrangement* around the learner, but the *re-arrangement* and *transformation* of the whole activity that marks the cultural-historical point of view. This transformation, however, always includes an aspect of personal learning.

Greeno and Engeström (2014, p. 135) contrast cognitive and situative learning perspectives. Traditional cognitive psychology focuses on the individual learner. Other people or materials are, if at all, merely considered as a context for that learning process. A situative learning perspective, on the other hand, specifically takes this context into account. Both perspectives, however, are not incompatible. Rather, they can be seen as complementary, as the authors suggest (ibid.).

While TILA clearly pays attention to the contexts of learning, it does not per se start from a situative position. Adding such a complementary perspective might prove to be fruitful and contribute to a broader understanding of the learning process.

WHAT TRIGGERS AND FOSTERS THE LEARNING PROCESS?

For TILA, the innate cognitive-emotional structure of an individual is the main predisposition for an emerging learning process, i.e., the first criterion of the theory's *Definitional Frame Construct*. This innate predisposition is, amongst others, fostered by the principle of self-determination, especially by taking into account the learner's basic psychological needs put forward in Self-Determination Theory (Deci & Ryan, 2000; SDT). TILA holds that a *General Discovery Interest* may emerge *directly by itself* or otherwise be provoked and sustained from the outside by conversations or experiments.

From a cultural-historical perspective, the cognitive-emotional structure is not innate but socially created (or, rather, *co-created*), although this has been a matter of long debate (cf., for example, Backhurst et al., 1995; Levitin, 1982; Stetsenko & Arievitch, 2004). Zinchenko (2012, p. 73) claims a "pre-experiential readiness and willingness to accept the gifts [of culture]", and D. Leontiev (2012, pp. 22–23) interprets SDT's basic psychological needs for competence, relatedness, and autonomy as metanecessities on the levels of biological, social, and personal existence:

> "I distinguish[ed] three levels of human functioning, or, one may say, of being-in-the-world: the level of biological existence where we function as biological units, the level of social existence where we function as elements of social units, and the level of personal existence where we function as autonomous self-conscious agents. Each of these levels is characterized by objective metanecessities underlying all the varieties of motivational structures and mechanisms developing on this level: the actualization of potentialities and relating to the environment on the level of biological existence, integration with social systems on the level of social existence, and self-determination on the level of personal existence." (D. Leontiev, 2012, p. 23)

The basic psychological needs – understood as existential metanecessities – may thus function as key principles for understanding the mechanisms that trigger and foster learning processes, no matter if being looked at from a cognitive or situative perspective. While they emerge from the individual, they orient the individual towards the Other: the objective world, the others, and the Self. From the activity-theoretical point of view, however, it is essential that these general and abstract need forms become concrete needs by finding and becoming attached to concrete objects (i.e., by becoming objectified, cf. f.e. Kaptelinin & Nardi, 2006, p. 59) that, by being culturally mediated, are already laden with meaning. This process of objectification reveals the motivational side of the objects.

CONTRADICTIONS play roles as triggers for learning activities in both theoretical approaches. However, while *contradictory contents* may serve as an initiator to raise a General Discovery Interest in TILA, contradictions, as "historically evolving tensions

that can be detected and dealt with in real activity systems" (Engeström & Sannino, 2010, p. 4), play a crucial role for Expansive Learning.

HOW IS LEARNING ORGANIZED?

While in TILA the criteria, principles, and categories do not organize learning steps in any particular order, EL's cycle of expansive learning proposes an order of learning actions. For the analysis of expansive learning processes in a library, Engeström et al. (2012, p. 90) discuss a minimal criterion for expansive cyclicity. For their analysis, the authors agree on the *appearance of at least four different expansive learning actions in a meaningful order within a session or within an object-bound cross-session cycle* (ibid.).

There is, however, a learning concept that has been developed as application of the TILA framework: AuRELIA (Authentic Reflective Exploratory Learning and Interaction Arrangement; Reitinger 2011) has been introduced as a self-determined stepwise concept for Inquiry Learning, however, potentially revealing gaps and loops (Oyrer, Ressl & Reitinger, 2012, p. 29).

The sequences of learning steps, as outlined in this AuRELIA concept (Reitinger, 2013, p. 88; Reitinger & Hollick, 2014, p. 60), or learning actions, as laid out in the cycle of expansive learning (Engeström, Rantavuori & Kerosuo, 2012, p. 85) reveal some similarity between both approaches. They can roughly be mapped to one another, which, however, does not mean that the conceptual differences between both approaches are to be neglected. Table 2 juxtaposes both approaches.

TABLE 2. *Learning steps vs. learning actions in TILA and EL*

AuRELIA concept	cycle of expansive learning
Emergence of personal meaningful discovery interest Speculation (connecting to previous knowledge)	Questioning; Need State
Conception (planning the investigation)	Analyzing (historical; actual-empirical)
Investigation	Modeling a solution
Discovery (testing the speculations; presenting findings)	Examining, Implementing and Testing
Critical Phase (reflection on the outcome)	Reflecting
Transfer	Consolidating & Generalizing

TILA's Organizational Frame Construct OPeRA (Reitinger, 2013, p. 73), consisting of outline, performance, reflection and (process) analysis, assigns the latter a meta position. The same applies to EL: The whole learning process builds on a profound historical and actual-empirical analysis that follows Davydov's principle of ascending from the abstract to the concrete, which Engeström and Sannino (2010, p. 5) depict as a "method of grasping the essence of an object by tracing and reproducing theoretically the logic of its development, of its historical formation through the emergence and resolution of its inner contradictions". In this process, an abstract *germ cell*, a simple explanatory

relationship based on a new theoretical idea, carefully and gradually becomes enriched and develops into a complex object, and ultimately into a new form of practice.

WHAT IS THE OUTCOME OF THE LEARNING PROCESS?

The outcome of a learning process is the building up of knowledge and the ability to apply this knowledge reasonably and responsibly. It is both knowledge about the present world and about possible future worlds (cf. Bruner, 1996). Engeström (2007, p. 271) distinguishes between two types of knowledge, *stabilization* and *possibility* knowledge. Stabilization knowledge is "constructed to freeze and simplify a constantly shifting or otherwise bewildering reality", and as such is necessary. It perceives a problem as a closed phenomenon, usually in the form of fixed categories or narratives. Possibility knowledge, on the other hand, emerges "when objects are represented in fields with the help of which one can depict meanings in movement and transformation". Transitions of positions in a field are traced. Thus, knowledge becomes destabilized and is put in movement. This necessarily opens up new possibilities, depicting possibility knowledge as "agentive knowledge, the instrumentality of agency at work" (ibid.).
Both types of knowledge are needed. While *stabilization knowledge* is essential for transmitting and preserving culture, *possibility knowledge* is indispensable for its creation and transformation. Expansive Learning puts the focus on *possibility knowledge*, on what is *not yet there*. Inquiry Learning is open to both aspects.

5 Conclusion

From what has been explicated above, the Theory of Inquiry Learning Arrangements presents itself as a compatible framework that can be considered as applicable from a socio-cultural perspective, respectively the Theory of Expansive Learning. On the other hand, expansive learning, looked at as a specific inquiry learning process, could benefit from TILA's frame constructs much the same way as the AuRELIA concept utilizes and benefits from them. On approaching TILA from a cultural-historical perspective the following can be summarized:

- The individual and autonomous learner does not exist, as he or she is part of the world, or, as Postholm (2015, p. 44) puts it, "Neither the external world nor the human being in isolation is responsible for developing knowledge; rather they interact."
- Learning arrangements are always embedded in culture and history and, therefore, cannot be seen and understood outside this context.
- Factual learning is complemented by social learning and development of a personality: Learning takes place in each of the dimensions of the learning activity. The epistemological side of learning is always accompanied by an ontological perspective, by a transformation in personality.

- Knowledge acquired through Inquiry Learning needs to be brought to life and responsibly applied in social practice. As such, it changes social practice. By also taking into account possible, in fact, inescapable, consequences on social practice, TILA contributes to an understanding of learning that is rather built on responsibility than on feasibility.
- The concepts of double stimulation (cultural artifacts provided for and employed by the learners in order to be able to analyze the problem and model a solution) and the zone of proximal development (spaces that open in a collaborative and supportive learning environment) are compatible with an inquiry learning approach and, therefore, recommendable for a TILA learning setting.

On the other hand, if expansive learning is understood and looked at as a specific inquiry learning process, TILA's proposed Definitional, Action-Orchestrating, and Organizational Frame Constructs, the criteria and principles of Inquiry Learning as well as the dimensions of its realization, can contribute to the emergence of transformative agency as defined above, helping the learners to understand the learning activity as something that they actively construct and shape, and enabling them to even *go beyond* it and transform themselves, and social practice.

Both the Theory of Inquiry Learning Arrangements and the Theory of Expansive Learning offer distinctive perspectives on human learning, the first highlighting its innate, individual and inquisitive aspects, the latter the social and cultural ones. Although they represent different viewpoints, both approaches complement each other, and it is not only possible but, in fact, quite feasible to utilize inquiry learning arrangements for expansive learning settings and vice versa, thus putting into focus both the individual learner and the evolving new collective activity, both stability and possibility knowledge, investigating both vertical and horizontal dimensions of learning, and seeking to advance both empirical and theoretical knowledge.

In an attempt to "locate the Theory of Expansive Learning more adequately in the conceptual field of learning theories" (Engeström & Sannino, 2010, p. 2), the authors employ four dimensions that they pose as questions (ibid.):

- Is the learner to be understood primarily as an individual or as a community?
- Is learning primarily a process that transmits and preserves culture or a process that transforms and creates culture?
- Is learning primarily a process of vertical improvement along some uniform scales of competence or horizontal movement, exchange and hybridization between different cultural contexts and standards of competence?
- Is learning primarily a process of acquiring and creating empirical knowledge and concepts or a process that leads to the formation of theoretical knowledge and concepts?

The Theory of Expansive Learning obviously "puts the primacy on communities as learners, on transformation and creation of culture, on horizontal movement and hybridization, and on the formation of theoretical concepts" (ibid.). TILA, by contrast, puts the primacy on the individual learner, which does not question the basic compatibility of both approaches. The question of transmitting and preserving or transforming and creating culture, however, cannot be answered so easily. Inquiry Learning entails both discovering knowledge that has been found before, but also discovering hitherto untrodden paths and mapping uncharted land, thus creating culture. The concept of the zone of proximal development is compatible with TILA and, thus, worth considering applying it in Inquiry Learning settings. From the point of answering the third question posed by Engeström and Sannino, it can be stated that TILA concentrates more on what has been described as vertical improvement, as *movement from incompetence to competence* (ibid.), but it is not closed to horizontal, expansive development, either. Finally, while the creation of empirical knowledge is certainly a desired outcome, the formation of theoretical knowledge and concepts is undeniably part of true inquiry learning.

In the introductory quote, Vygotsky (1997, p. 251) depicts *any word* as theory – as an idea about how the world is, and our wish to comprehend it. This especially applies to words that depict a distinctive theory. Both "inquiry" and "expansivity" signify (in the etymological sense of the word – yet another theory) and reveal significant aspects of the nature of human learning. Hence, it may well prove feasible and fruitful to approach and analyze a given learning activity from both perspectives.

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13 Inquiry Based Science Education and Teacher Professional Development

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Inquiry Based Science Education has been shown to foster both understanding of scientific concepts as well as an understanding of how scientists work when solving problems. Besides the raising popularity of Inquiry Learning a current unified view of precisely how inquiry should be defined does not exist. The article tries to compare current conceptions of Inquiry Based Science Education (IBSE) with Reitingers (2013) Theory of Inquiry Learning Arrangements (TILA) and discusses the implications of Continuous Professional Development focusing on Inquiry Based Science Education (IBSE) on teaching practice in the primary science classroom.

Keywords: inquiry based science education, primary science, continuous professional development

1 Introduction

Inquiry has been a central term in the rhetoric of science education reforms around the globe over the last two decades. One goal of these reforms is promoting positive attitudes towards science and learning science. The importance of this promotion is emphasized by the mounting evidence of a decline in young peoples' interest in science studies and careers in industrialized countries (OECD, 2006). Motivating students to study science is a worthy aim, however, the primary goal of science education must not be to produce the next generation of scientists but to offer an education that develops students' basic understanding both of the major ideas which science offers and the way it produces reliable knowledge. The aim of science education should be educating students in and about science (Osborne & Dillon, 2009). To achieve this goal, we need to refocus science teaching on meaningful learning and conceptual understanding of scientific ideas rather than teaching and learning isolated fragments of theoretical knowledge.

Inquiry Based Science Education, if carried out effectively, is an efficient way to facilitate conceptual understanding and deepen the understanding of the nature of scientific inquiry. Learning with understanding differs from remembering facts, such as the names of the planets in the solar system, which particular objects float or sink, or the photosynthesis equation (Harlen, Artigue, Dillon, & Lena, 2012). Facts alone are insufficient to develop understanding. Understanding means that students can explain why there are four seasons in Austria, why things do or do not float, why plants cannot grow in the dark, and which evidence supports these concepts. A review of 138 studies focused on the outcome of Inquiry Based Science Education has shown that students who have the opportunity to engage in active thinking and being subsequently asked to draw conclusions from data are more likely to understand the inherent scientific content than in traditional teacher-centered lessons (Minner, Levy, & Century, 2010).

Inquiry Based Science Education and Inquiry Based Education in general require students to become more independent learners. Teachers must allow students to develop their own ideas taking into account that these ideas can also be incorrect at first. Teachers used to teaching science by giving information from text books need the chance to experience, understand, and value Inquiry Based Learning if they are to develop the confidence and skills to implement Inquiry Based Education in their classroom (Harlen & Allende, 2009). To achieve a change in teaching practices, Professional Development is still seen as the most effective way.

In the first part of this article current conceptions of Inquiry Based Science Education (IBSE) are compared with Reitingers (2013) Theory of Inquiry Learning Arrangements (TILA). The second part focuses on Teacher Professional Development in Inquiry Based Primary Science Education.

2 Inquiry Based Science Education (IBSE) and the Theory of Inquiry Learning Arrangements (TILA)

It is difficult to exactly trace the first appearance of Inquiry Based Learning and Instruction. John Dewey, Jean Piaget, and Lev Vygotsky anticipated in their work about the nature of learning and teaching many aspects of IBSE, such as the need to motivate students in hands-on activities and the opportunities for students to engage in active thinking and drawing conclusions from data they gathered on their own. In 1910, John Dewey criticizes that "science has been taught too much as an accumulation of ready-made materials with which students are to be made familiar and not enough as a method of thinking" (Dewey 1910, p. 122). Dewey placed inquiry at the center of his educational philosophy. For him, learning was best approached by engaging student communities in an inquiry process (Dewey, 1933).

While Inquiry Based Learning is not especially new in science education, it has been increasingly engrossed in reform documents over the last 20 years. In 1996 the

US National Science Education Standards declared that "inquiry is central to science learning" (NRC 1996, p. 2). In 2007, the European Commission demanded a "reversal of school science-teaching pedagogy from mainly deductive to inquiry-based methods" (EC 2007, p. 2). In 2015, one can find the term inquiry in almost any curriculum in industrialized countries, from primary to higher education.

Aside from its raising popularity, we still do not have a current unified view of precisely how inquiry should be defined. Some researchers assess its definition as "the most confusing thing about inquiry" (Colburn 2000, p. 42). Part of this confusion lies in the fact that inquiry often simultaneously refers to the learning of both scientific concepts and the skills scientists use to solve problems of the natural world (Magee & Meier, 2011). Abd-El-Khalick et al. (2004) distinguish between "inquiry as means" and "inquiry as ends". The former sees inquiry as an instructional approach intended to help students develop understanding of science content, the latter refers to inquiry as an instructional outcome. Students learn to inquire in the context of science content and develop epistemological understandings about the nature of science and the development of scientific knowledge, as well as relevant inquiry skills, e.g., identifying problems, generating research questions, designing and conducting investigations, and drawing evidence-based conclusions.

One definition that is often referred to within the science education research community is the one given by the US National Research Council. It defines inquiry

> "… as a multifaceted activity that involves making observations; posing questions; examining books, and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results." (NRC 1996, p. 23)

The NRC also defines essential features of classroom inquiry and gives variations in the amount of learner self-direction, as illustrated in Table 1.

TABLE 1. *Essential features of classroom inquiry and their variations in the NRC concept (NRC 2000)*

Essential Feature	**Variations**			
Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner clarifies questions provided by teacher, materials, or other source	Learner engages in questions provided by teacher, materials, or other source
Learner gives priority to evidence in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze

Essential Feature	Variations			
Learner formulates explanations from evidence	Learner formulates explanations after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanations	Learner provided with evidence and shown how to use evidence to formulate explanation
Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to use sharpen communication	Learner given steps and procedure for communication

Within the EU Seventh Framework Programme (FP 7) funded project "Primary Science Network" the University of Teacher Education (Pädagogische Hochschule) Vienna coordinated Continuous Professional Development activities focusing on Inquiry Based Science Education in primary schools for 60 Austrian teachers over a period of two years. Within the project, a framework for Inquiry Based Science teaching and learning at primary level was defined. In this framework, learners

- engage actively in the learning process with emphasis on observations and experiences as sources of evidence;
- tackle authentic and problem based learning activities where the correctness of an answer is evaluated only with respect to the available evidence and getting to a correct answer may not be the main priority;
- practice and develop the skills of systematic observation, questioning, planning and recording to obtain evidence;
- participate in collaborative group work, interact in a social context, construct discursive argumentation and communicate with others as the main process of learning;
- develop autonomy and self-regulation through experience (Gatt & Scheersoi, 2014, p. 2).

Within this framework the teacher scaffolds and guides learning by being a role model of an inquiring learner. The teacher does not perform, in the eyes of the children, as the sole bearer of expert knowledge. Instead, the main role of the teacher is to provide possibilities to negotiate ideas and to highlight criteria for formulating classroom knowledge (Gatt & Scheersoi, 2014).

Whereas the various definitions of inquiry in the science education research community are strongly linked to the processes of inquiry undertaken by natural scientists, Reitinger (2013) made an attempt to conflate the earlier roots of Inquiry Learning coined by Dewey with recent findings from motivational psychology (Ryan & Deci, 2004), as well as arguments derived from the European *Bildungstheorie* (Klafki, 1999)

in his Theory of Inquiry Learning Arrangements (TILA). According to Reitinger (2013) Inquiry Learning is characterized by six criteria: (1) General Discovery Interest, (2) Method Affirmation, (3) Experience-based Hypothesizing, (4) Authentic Exploration, (5) Critical Discourse and (6) Conclusion-based Transfer. One can find a detailed description of the TILA framework in this volume (see Chapter 1).

Table 2 shows a comparison of the three mentioned frameworks focusing on Inquiry Learning. All frameworks were initially developed for science classes, but can easily be adapted to other subjects. The comparison of the frameworks shows significant overlap, however, some aspects can only be found in one or two of the frameworks. According to the TILA, Inquiry Learning is underpinned by two dispositions which foster the act of questioning, namely General Discovery Interest and Method Affirmation. The NRC framework does not mention preconditions that lead to the formulation of research questions.

TABLE 2. *Comparison of different frameworks dealing with classroom inquiry*

NRC Framework	Pri-Sci-Net Framework	TILA Framework
	Learner engages actively in the learning process	General Discovery Interest
	Learner develops autonomy and self-regulation	Method Affirmation
Learner engages in scientifically oriented questions		Experience-based Hypothesizing
Learner gives priority to evidence in responding to questions	Learner tackles authentic and problem based learning activities where the correctness of an answer is evaluated only with respect to the available evidence	Authentic Exploration
	Learner practices and develops the skills of systematic observation, questioning, planning and recording to obtain evidence	
Learner formulates explanations from evidence	Learner constructs discursive argumentation	Critical Discourse
Learner connects explanations to scientific knowledge		
Learner communicates and justifies explanations	Learner participates in collaborative group work, interacts in a social context, constructs discursive argumentation and communicates with others as the main process of learning	Conclusion-based Transfer
	Teacher scaffolds and guides learning by providing a role model of an inquiring learner. Teacher facilitates negotiation of ideas and highlights criteria for formulating classroom knowledge.	

Both the NRC and the Pri-Sci-Net framework see Inquiry Based Learning as evidence-based learning, but they differ in the aim of the inquiry process. In the Pri-Sci-Net framework "the correctness of an answer is evaluated only with respect to the available evidence and getting to a correct answer may not be the main priority" (Gatt & Scheersoi, 2014, p. 2), whereas in the NRC framework the "learner connects explanations to scientific knowledge". The question inevitably arises, what if the students' findings con-

tradict the current scientific view on a given topic? The NRC framework gives different variations on how to connect students' explanations to scientific knowledge. It assumes that students' investigations cannot contradict scientific knowledge. TILA is not very specific on how to connect students' findings to current scientific knowledge on the topic. Concerning the role of the teacher, only the Pri-Sci-Net framework is specific and defines the teacher as a role model for an inquiring learner, who scaffolds the learning process and sums up classroom knowledge.

Three different definitions of Inquiry Learning were chosen and overlaps were found but also different aspects in these definitions. Looking at other curricula or reform documents would probably have yielded more definitions, more overlaps and more different aspects. Not all, but many of these definitions do have a strong theoretical foundation (Abd-El-Khalick et al., 2004). Sometimes the basis is more epistemological and refers strongly to the philosophy of science. Sometimes the foundation refers to educational theories.

From a scientific point of view, a unified definition of Inquiry Learning by means of clearly defined criteria would ease the access for empirical work in the field. Current meta-analyses on the effects of Inquiry Learning (Hattie, 2010, Minner et al., 2009) are difficult to interpret because it is not clear what different studies meant when they evaluated Inquiry Learning.

However, restrictive definitions with the idea that an endeavor can only be classified as Inquiry Learning if all the criteria of the definitions are met have little value for educational settings because these are highly situated and contextual. One wonderful example of Inquiry Learning I recently saw in preschool education is the research conducted by the young learners on snails and their favorite food. The research question, "What is the favorite food of snails?", was posed by the kindergarten teacher. The children developed an experimental setting to find out if snails prefer lettuce, cucumber, grass, or dried leaves. On the basis of their observation, they came to the conclusion that snails' favorite food is lettuce. This might not be scientifically correct, and one could criticize that the chosen research design is not suitable to answer the posed research question. One could also criticize that the posed research question is probably too unspecific. However, one could also focus on a group of young learners that developed an experimental setting on their own, were enthusiastic when they came to kindergarten the next morning to observe what happened over night, and reported to their parents what they found out in kindergarten. In the lesson described many aspects of the presented definitions were met, but not necessarily all of them. However, who could argue that this is not Inquiry Learning?

If we want to integrate Inquiry Learning into daily classroom routines, we need to have a clear understanding what Inquiry Learning is. Based on this understanding we can define curricular goals and develop pedagogical tools and professional development sessions for in-service and pre-service teachers.

However, having a clear understanding of Inquiry Learning does not mean that we have to follow a unified definition of Inquiry Learning. Instead of thinking of a generalized definition of Inquiry Learning in science and assuming it will allow achieving multiple goals, i.e., developing understanding of scientific concepts, helping students to acquire integrated inquiry skills, learning about the nature of science, it might be more useful to think of several dimensions of Inquiry Learning that are intimately linked with measurable instructional outcomes.

Inquiry Learning is seen as evidence-based learning where one can use different methods of investigation to find evidence for defensible conclusions. When planning Teacher Professional Development sessions on Inquiry Learning in science several dimensions of Inquiry Learning can come to mind. One dimension can be *Conceptual Understanding*. How must inquiry lessons be structured to allow better understanding of a given topic? Another dimension can be *Inquiry Skills*, e.g., how can a teacher support the systematic collection of data and fair testing? A third dimension can be the *Nature of Science*, e.g., how can a teacher support the epistemological understanding about how scientists work?

To achieve Inquiry Based Science learning teachers themselves must be aware of how science works and what the characteristics of scientific investigations are. This can only be facilitated if the nature of science is made explicit in the pre-service and in-service training of teachers (Sadler, Burgin, McKinney, & Ponjuan 2010; Capps & Crawford, 2013).

3 From Theory to Classroom Culture: Continuous Professional Development on Inquiry Based Science Education at Primary Level

Teacher Professional Development (PD) is seen as the most powerful tool to change teaching practices. Alternative methods, such as policies to support ambitious instructional reforms, have been found to have little impact on basic classroom routines (Suppovitz & Turner, 2000).

Within the EU FP7 project Primary Science Network (www.prisci.net) the University of Teacher Education Vienna and its Educational Competence Center for Science and Mathematics designed, implemented and evaluated Continuous Professional Development (CPD) sessions on IBSE over a period of two years for 60 primary school teachers.

Usually teacher trainings in Austria only span one or two afternoons. Evaluation of various projects on the dissemination of IBSE shows that short term teacher trainings do not necessarily lead to a change in classroom routines. Harlen and Allende (2009) concluded in their evaluation of various Professional Development (PD) programs on IBSE that

> "when teachers learn to use new materials and pedagogy, their needs are similar to those of any learners, particularly the need to communicate with

> and have feedback from others and to have time for reflection. These are more likely to be provided, and teachers take ownership of their learning, when professional development sessions take place intermittently over a period of time, with opportunities between sessions for teachers to practice what they have learned in their own classrooms and to share experiences with others." (Harlen & Allende, 2009, p. 25)

Suppovitz and Turner (2000) identified six critical components of Professional Development in science education. If PD includes most or all these six components they call it *high quality professional development*. In the developed PD sessions on Inquiry Learning, five of the six mentioned components were included. One component, namely showing teachers how to connect their work to specific standards for student performance, was neglected because there are no standard tests in science at primary level in Austria. Yet, we added another crucial component when it comes to PD in IBSE. We included a workshop focusing specifically on the Nature of Science into our trainings. The following six criteria were met in the Pri-Sci-Net PD sessions:

1. High quality Professional Development must immerse participants in inquiry, questioning, and experimentation and, therefore, model inquiry forms of teaching. In each of our eight workshops teachers had the possibility to experience Inquiry Learning.
2. Professional Development must be both intensive and persistent. We organized eight workshops (40 hours) over a period of two years. If this is intensive enough could be discussed. Austrian primary school teachers would definitely argue that eight workshops on primary science education are intensive. In addition to the 40 hours, the participants engaged in a number of in-class tasks, i.e., testing materials, interviewing children about their pre-instructional concepts.
3. PD must engage teachers in concrete teaching tasks and allow personal experiences. Teachers were asked to put into practice what we discussed in the workshops between the training sessions and discuss their experiences with the other participants.
4. PD must focus on subject-matter knowledge and deepen teachers' IBSE skills. Many primary school teachers feel insecure in science and lack the confidence in science teaching. Therefore, the developed PD program engaged teachers in learning core concepts of primary science, e.g., magnetism, state of matter, floating and sinking through inquiry at their own level, providing them with first-hand experience of using inquiry skills, as well as a deeper understanding of the phenomena they studied. We also provided the needed background knowledge, possible students' conceptions, as well as possible age-adequate explanations.
5. Primary school teachers normally lack authentic research experience. Therefore, we added a workshop focusing on the nature of science explicitly to support teachers in

learning about inquiry. Therefore, teachers had opportunities for learning through inquiry and learning about inquiry.

6. Staff development cannot be separated from school development. In the workshops, we provided and discussed development tools that support schools in reforms towards a "culture of inquiry" in science teaching at their school. These SQA (Schulqualität Allgemeinbildung) guidelines can be found at www.science2school.at.

EVALUATION OF THE PD COURSES

Sixty teachers started the two year training, among this group 42 teachers took part in all eight workshops. The course was evaluated with a pre and posttest design with questionnaires and interviews. Teachers' concepts of Inquiry Learning and their science teaching self-efficacy beliefs were already published (Bertsch, 2014). In this article, some results of the post-questionnaire will be discussed.

Figure 1 shows the impact of the PD course on teacher knowledge and self-confidence. 91% of the participants strongly agree that the PD course improved their understanding of Inquiry Based Science Education, while 76% of the teachers reported a strong influence on their content knowledge of relevant primary science topics. More than 85% strongly agree that the PD course improved their self-confidence in science teaching.

FIGURE 1. *Impact of PD within the Pri-Sci-Net project on teacher knowledge and self-confidence (n=42)*

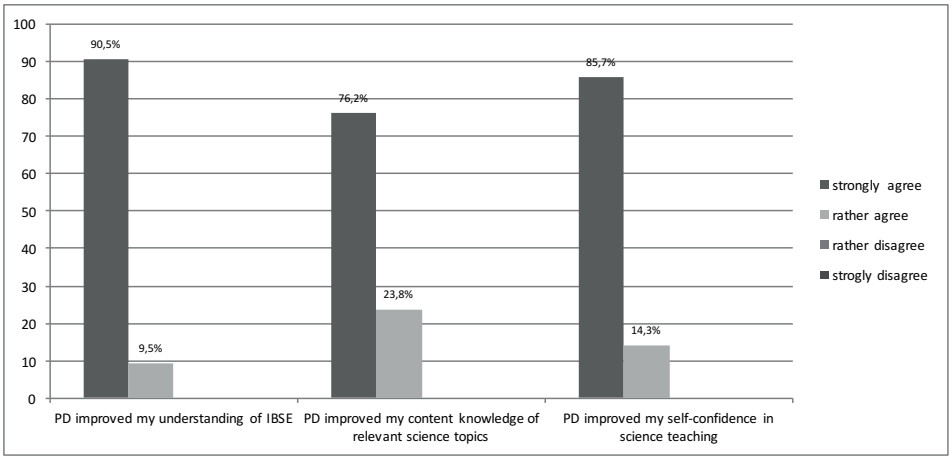
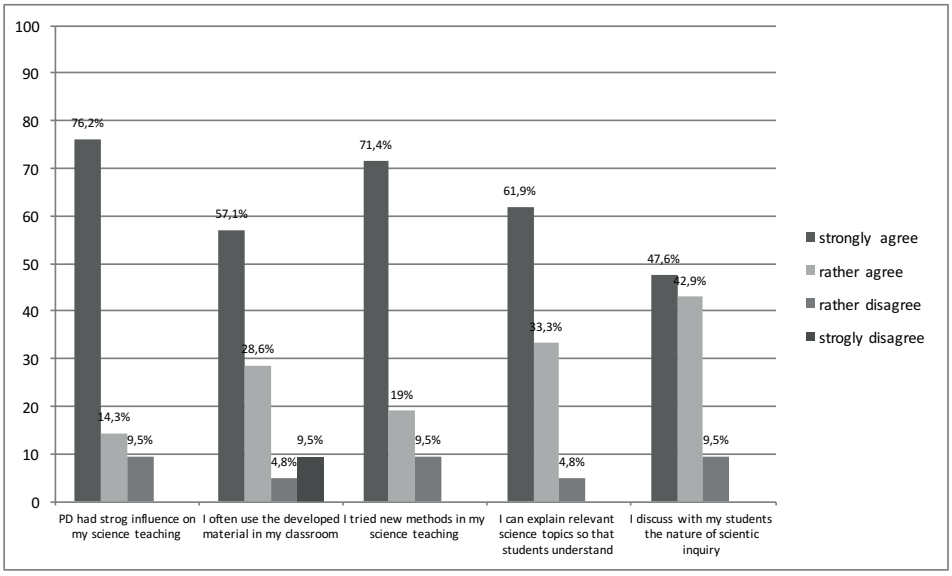


Figure 2 shows the impact of the PD course on primary science classroom routine. 76% of the participants reported that the PD had a strong influence on their science teaching, while 57 % strongly agree that they often use the material that was developed during the PD sessions in their classroom. 71% reported that they worked with new methods in their science classrooms, and 62% strongly agree that they can teach relevant science topics in a way that their students develop conceptual understanding.

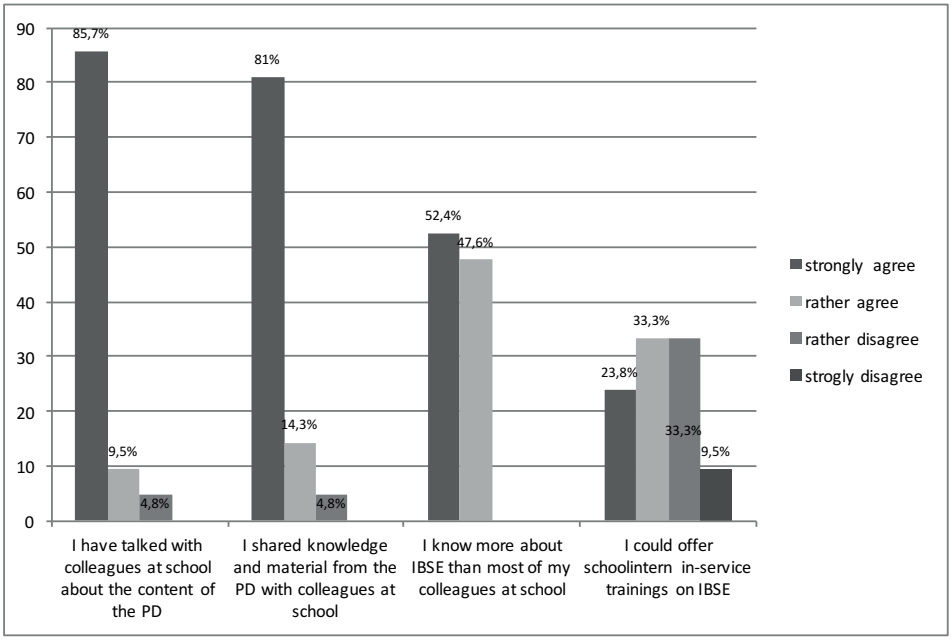
In the literature it is suggested that PD on IBSE should contain opportunities for learning through inquiry and learning about inquiry. Therefore, one workshop on the Nature of Science was added. Teachers were very enthusiastic about this workshop and in the interviews they mentioned that this workshop had a strong influence on their own understanding about inquiry. However, only 48% of the teachers strongly agree that they discuss the nature of scientific inquiry with their students. The material used in this workshop was developed for 8-10 year old children. As many of the participants also teach younger students this could explain the lower transfer of the material into classroom routine.

FIGURE 2. *Impact of PD within the Pri-Sci-Net project on science teaching (n=42)*



Successful PD should empower teachers not only to use new methods in their teaching but also to promote new learning methods at their schools. Figure 3 shows how knowledge acquired during the PD course was disseminated at their schools. At the end of the PD course, 86% of the participants said that they had discussed content of the workshops with colleagues at school, 81% had shared knowledge and materials. 52% strongly and 48% rather agree that they know more about IBSE than most of their colleagues at school. However, only 24% strongly agree that they are able to offer in-school trainings on IBSE for their colleagues.

FIGURE 3. *In-school dissemination of knowledge acquired within the Pri-Sci-Net project PD courses (n=42)*



4 Conclusion

Inquiry Based Science Education has been shown to foster both understanding of scientific concepts as well as understanding of how scientists work when solving problems. Besides the raising popularity of Inquiry Learning, a current unified view of precisely how inquiry should be defined does not exist. In this article three different frameworks defining Inquiry Learning were compared. Even if a unified definition of Inquiry Learning by means of clearly defined criteria would ease the access for empirical work in the field, the author comes to the conclusion that a too restrictive definition of Inquiry Learning would be of little value for the dissemination of Inquiry Learning in highly situated and contextual educational settings. Instead of thinking of a generalized definition of Inquiry Learning in science, it might be more useful to think of several dimensions of Inquiry Learning that are intimately linked with measurable instructional outcomes. Based on this assumption, Professional Development sessions on Inquiry Learning in science were planned, implemented, and evaluated. The PD focused on Inquiry Learning in Primary Science and emphasis was placed on increasing teachers' content knowledge and developing Inquiry Learning skills, opportunities for "learning through inquiry" and "learning about inquiry", and methods and principles of Inquiry Learning in the primary science classroom. The two year training improved participant's knowledge of Inquiry Based Science Education and their self-confidence in science teaching. It also had a strong influence on teachers' content knowledge of relevant

primary science topics. Teachers reported a strong influence of the training on their science teaching practices.

The major determinant of any education system is the quality of its teachers. If we want a reversal of school science-teaching pedagogy from mainly deductive to inquiry-based methods investment in long-term Professional Development is crucial. Changing teacher pedagogy cannot be done through short, one-off courses, which currently dominate Professional Development for teachers in Austria.

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14 Introducing Musical Inquiry Learning (MIL) according to TILA

Albin Waid

This article introduces Musical Inquiry Learning (MIL) as a result of conflating the theory-based process of reframing music education at the Private University College of Education of the Diocese of Linz with the Theory of Inquiry Learning Arrangements (TILA). Seven core principles of reframing music education are introduced, discussed in their interrelations with TILA and restructured according to its Definitional and Action-orchestrating Frame Constructs. As a result, Musical Inquiry Learning (MIL) is evaluated as a proper means to apply TILA in the context of music education to change current education practices and paradigms.

Keywords: educational psychology, education paradigms, teacher training, music education, inquiry learning

1 Introduction

The Theory of Inquiry Learning Arrangements (TILA) as put forward by Reitinger (2013a, 2013b, 2014a, 2014b, 2015) offers a consistent system of theoretical foundation, action-orchestrating guidelines and a precise structure of how Inquiry Learning can be organized in the classroom. This evidence-based theory of Inquiry Learning has already been empirically validated by Reitinger (2014a, 2014b) and is now ready to be transferred to various educational settings.

This article describes the process of reframing music education at the Private University College of Education of the Diocese of Linz according to seven core principles which have been drawn from various sources (Bucay, 2011; Hüther, 2011; Robinson, 2011; Rosenberg, 2004; Schnarch, 2011). In its transdisciplinary approach, this process can be seen as analogous to the development of the Theory of Inquiry Learning Arrangements

as promoted by Reitinger (2013a, 2013b, 2014a, 2014b, 2015). From this starting point, both approaches, which point to a change in education paradigms, will be compared and interrelated with each other in a systematic way in order to discuss their complementarity as suggested by Patry (2005) in the context of Critical Multiplism.

After a brief introduction to the context of the reframing process, the seven core principles are presented and depicted with their theoretical foundation. As a next step, their interrelations with the Theory of Inquiry Learning Arrangements (TILA) will be discussed in more detail by screening, restructuring, and renaming the core principles according to TILA. As a result of this conflation, the construct of Musical Inquiry Learning will be introduced together with further implications for its application and future development.

2 The Context of the Reframing Process

Music education, even in a country like Austria with a rich musical tradition, is facing some serious challenges (Aichinger, 1999; Broschart, 2003; Waid, 2010a). Especially young adults who join teacher education in order to become primary school teachers often lack musical experience and knowledge due to poor musical education during upper secondary school where music is a supplementary subject. Together with limited beliefs regarding their own musical aptitude, music as a core subject tends to provoke fear in students. Needless to say, this phenomenon inhibits the creative processes which are meant to be stimulated. Thus, the necessity for music educators arises to face creativity inhibiting practices with a general reframing of music education by putting a strong emphasis on inviting, encouraging, and inspiring young people (Hüther, 2011).

In this context, one main challenge for music educators seems to lie within the balance of individual growth and the fulfillment of general requirements regarding musical proficiency. Therefore, in line with Reitinger (2013a), an approach that emphasizes individual coaching is postulated. At the same time, the two variables individual growth and meeting general requirements may also be seen as compatible, similar to the concepts of autonomy and structure which sometimes have been perceived as incompatible (Reitinger, 2013a, p. 54). Individual coaching also incorporates allegiance to the truth. Only if all participants truly accept where they stand, can they take a next step into a more promising future by catering for the needs of students as well as for those of educators (Rosenberg, 2011).

In addition, we have to provide students with tokens of confidence and joy. In other words, we assume that only if students experience the joy of music, will they be able to pass this experience on to their prospective pupils. Thus, the reframing process of music education focuses on providing joyful musical experience rather than sheer knowledge.

More precisely, also experience and knowledge need not be perceived as antagonists. Quite on the contrary, knowledge will emerge from experience. This may also have some

important implications for music educators dealing with students specializing in music education for secondary schools and the current development of establishing a joint music education program between music universities and university colleges of teacher education in Austria. The reframing process of music education introduced in this article by the means of Musical Inquiry Learning (MIL) could serve as a common ground in order to meet the needs of students, inquiry coaches, and prospective pupils as well. As this cannot be dealt with in more detail here, the seven core principles of reframing music education at the Private University College of Education of the Diocese of Linz are outlined in the next section.

3 Seven Core Principles and Their Theoretical Foundation

The principles introduced in this chapter structure the reframing process and serve as general guidelines for music educators who want to primarily encourage their students to cope with their fears and experience the joy of music both together with fellow students and prospective pupils.

3.1 ABSENCE OF FEAR-INDUCING HABITS

According to Riemann (1961), angst is an inevitable part of life. Thus, the total absence of fear can be regarded as an illusion (Riemann, 1961, p. 7). As stated above, students may experience music education as fear-laden, not necessarily driven by their actual learning experience but rather induced by past experiences or a general lack of experience. Taking fear in all its facets for granted, we can start to develop strategies to help students face their fears. As a first step, let us step back from fear-inducing habits like authority qua office and other games that people play. To achieve this, the concept of differentiation as put forward by Schnarch (2011) may be helpful. For him, human growth can be measured with the degree of differentiation comprising four crucible points of balance: (1) Solid Flexible Self, (2) Quiet Mind & Calm Heart, (3) Grounded Responding, and (4) Meaningful Endurance (Schnarch, 2011, p. 72, pp. 98–100). Moreover, anchored in the absence of fear-inducing habits, a trust-based learning environment (Seyfried, 2009) may be seen as a prerequisite for addressing fear that emerges in the context of music education.

3.2 SKILL ORIENTATION

Skill orientation can be seen as a rather critical point in the context of reframing music education as students may believe that they lack musical skills. Some of them may not even be able to imagine that they will be able to develop these skills because of deep-rooted beliefs inhibiting their musical development. However, Robinson (2011) and Hüther (2011) proclaim that education needs to focus on students' abilities rather than their weaknesses. Robinson (2009) points out that many celebrities graduat-

ed from school without having found their element by then. Thus, also education and schooling might need a reframing according to findings of positive psychology and education (Burow, 2011, 2014; Robinson, 2009, pp. 49–79). In the context of music education for initial training with primary school teachers, Skill Orientation means to start from a point where students have competence. In other words, it is crucially important for musical inquiry coaches to open their senses for latent competence and talents, such as a quick-witted mind, a strong point in coordination, rhythmical expertise, or listening experience. With this in mind, musical preferences and *audiobiographies* of students are most likely to be catered for (Waid, 2015). The term audiobiography refers to the listening biographies of individuals that influence and constitute actual listening experience and behaviour (Waid, 2015). It comprises chronological, topographical and situational listening experience developing from prenatal hearing to the present moment (Waid, 2015). In the context of Skill Orientation, this variety and personal history of listening experience offer substantial material to draw on (see also 3.6).

3.3 EXPERIENCE-DRIVEN MUSICAL LEARNING

As stated above, the reframing of music education focuses on an approach that is experience-driven. Moreover, it is about the experience of joy when listening to or making music. It may sound massively exaggerated or even pathetic, but we firmly believe that a revolution in music education can only be achieved by the power of love and joy. This means that students develop feelings of love based on the experience of joy. In other words, they learn to see, feel, and reflect upon music as a strong resource. Starting to focus on the process of experiencing music within a group itself, assessing musical proficiency on a grading scale may have counter-productive effects. This is why all members of the department of music education agreed to transform this grading scale into a more promising way of formative assessment when developing the reframing of music education at the Private University College of Education of the Diocese of Linz. To the international reader this may sound rather anachronistic considering the fact that many international institutions of music education have started to focus on the process and its contemplation instead of grading students on the basis of general requirements. This could be, so to speak, the beginning of a revolution. In a more moderate way, formative and summative assessment may also be compatible as suggested by Patry and Weinberger (2010) by introducing WALK (W' Assessment of Latent Knowledge). Their approach offers a tool for summative assessment by having students generate W-questions meeting the specific requirements of assessment in the context of constructivist teaching (Patry & Weinberger, 2010, p. 220). In the context of Experience-driven Musical Learning, WALK could bridge the gap between experience and knowledge as the emergence of questions can be nurtured by experience and, moreover, boost students' General Discovery Interest (see 5.1).

3.4 SELF-ORGANIZED LEARNING

This principle draws on a constructivist perspective on learning, viewing human beings as autopoietic systems. Referring to Bandura's concept of self-efficacy (Bandura, 1997), Self-organized Learning strengthens students' individual abilities and enhances their learning motivation by achieving a maximum level of self-determination and self-regulation. Thus, students can design their own learning processes. They choose their own learning activities and work at their personal pace. Therefore, Self-organized Learning opposes mental overload (and underload) by surmounting the concept of synchronicity in learning communities. This has important implications for the self-image of music educators. To support Self-organized Learning, we sculpture a learning environment in which students can experience something new. This means that students can choose from a variety of musical activities, styles, and pieces that educators have to offer. Moreover, students are encouraged to cultivate their creativity by meaningful activities, such as writing their own songs. Educators draw upon their own experience when supporting students by delivering prompts and techniques, mainly on demand, to support the emergence of safety (Reitinger, 2013a, pp. 51–52).

3.5 BENIGN CLARITY

Two extreme positions in human interaction can be identified: rigidity concerning personal concepts of life and belief in the direct application of those to others on the one hand, and abandoning personal preferences and principles in order to cater for somebody else's needs on the other. Corresponding to Schnarch's concept of Differentiation (2011), Benign Clarity overcomes these two non-beneficial extremes by suggesting a more moderate way of balancing one's own needs with the needs of other people. This also correlates with Rosenberg's model of Life-enriching Education (Rosenberg, 2004). For the reframing process of music education, Benign Clarity stands for addressing students' needs and being clear about one's own needs at the same time. Besides achieving clarity for themselves, music educators also communicate these needs in a crisp and open way to their students. Instead of ignoring questions, problems, and important facts, they will be addressed openly, in order to make better use of existing resources, such as energy that has been blocked by fear. Benign Clarity can, therefore, be defined as an organic synthesis of being kind and frank instead of being exclusively polite or rude. This can be achieved by simply accepting, acknowledging, and recognizing people's needs on the basis of Empathic Listening (Covey, 2013) together with a strong inner presence (Almaas, 2010). While making clear who one is, what one stands for, and what is important to a person, opening up heart and ears for students' needs, for what moves them, who and where they are, and what they care for achieves Life-enriching Education for all people involved regardless of their position or function in the education process (Rosenberg, 2004). In this context, the model of Motivational Interviewing as put forward by Miller & Rollnick (2012), including aspects of both client-centered

counseling and behavioral implications, can be mentioned as well as a further reference for potential musical inquiry coaches. Motivational Interviewing has been designed to help people change by applying the techniques of engaging (Miller & Rollnick, 2012, pp. 37–90), focusing (Miller & Rollnick, 2012, pp. 91-154), evoking (Miller & Rollnick, 2012, pp. 155–254), and planning (Miller & Rollnick, 2012, pp. 255–302) during collaborative conversations. Therefore, this conversation style can also be used in the context of Musical Inquiry Learning in order to help students establish a playing routine (similar to the writing schedule suggested by Silvia, 2007) and to commit to change.

3.6 NAVIGATING DEVELOPMENT

When introducing structural changes to academic institutions, one can be confronted with the reproach of arbitrariness. How can we not grade and at the same time be certain about musical achievements of our students? Instead of gravitating towards extreme positions like grading and not grading, the fruitful combination of formative and summative assessment as developed by Patry and Weinberger (2010) with their WALK concept can be seen as an appropriate assessment tool in the context of Musical Inquiry Learning. At first, staff members were tempted to call the principle introduced here Cooperative Objective Agreement. As this would again relate to pre-determined objectives and, therefore, contradict the paradigm of self-determined Inquiry Learning (Reitinger, 2013a, pp. 47–51), the term *Entwicklungskompass* was introduced instead, which can be translated literally as Developmental Compass. By fostering Navigating Development, a broader translation which we consider to be more appropriate, music educators mainly provide a frame in which development and learning emerge, rather than exposing students to standards that have to be achieved by everyone by a certain time. Thus, Navigating Development ensures that students will be provided with the space they need to develop their own musical ability and proficiency at their personal pace. Goal orientation also plays an important role, but as opposed to unidirectional learning interactions, where educators set the goals for their students, these goals emerge in the process of Navigating Development at different times.

However, how can we start this navigation? In the context of music education we suggest exploring the audiobiographies of individuals (Waid, 2015) in order to find out what roles music plays in their everyday lives. Talking about previous experiences from early childhood to school can give clear hints about individualized educational interventions and can assist the process of finding out where exactly to start from. Together with this initial talk, methods of documentation can yield a higher commitment and continuity to the musical learning process. Performances, diaries, portfolios and jam sessions together with a reasonable use of media offer a rich variety of contemporary documentation tools. Navigating Development, therefore, strengthens the students' role as equal partners on a par with their music educators. As a result, we believe that

students are far more likely to meet their prospective pupils on an equal footing after experiencing a flat hierarchy and Navigating Development during teacher training.

3.7 POTENTIALENTFALTUNG

Hüther (2011, 2015) focuses in his works on the concept of *Potentialentfaltung*. Corresponding to Robinson (2009, 2011) regarding the necessity of discovering talents and passions, he also wants to inspire people to improve the quality of their relationships in order to achieve a transformation of communities and societies (Hüther, 2015). Thus, Potentialentfaltung suggests a process of collective growth in relationships and the establishment of individualized communities (Hüther, 2011, 2015). For the reframing process of music education discussed in this chapter, an orientation towards Potentialentfaltung presupposes that there are hidden talents in every human being and that education may help to unfold these talents and transform aptitudes into abilities (Robinson, 2013, pp. 33–55). This means that, contrary to the popular belief that music is an exclusive aptitude, every human being (apart from those suffering from amusia; Sacks, 2008, pp. 168–180) can experience and profit from musical training provided that students are offered self-organized, joyful, and experience-driven musical learning settings.

Hüther (2011, 2015) distinguishes two uniquely human dispositions as joy of discovery and the pleasure of creating. As music educators, we support the rediscovery of these two dispositions and their development. We offer our students trust (Reitinger, 2013a, pp. 46–47) and true presence (Almaas, 2010). When we do our best, chances are high that students will resonate accordingly. This will lead to a more promising future in music education, marked by joy, awareness, and loving openness. To sum up, Potentialentfaltung can be viewed as both the starting point and the aim or overall result of implementing the core principles introduced in this chapter. As a next step, we will take a close look at the Theory of Inquiry Learning Arrangements (TILA) and its potential interrelations with the reframing process stated above.

4 Interrelations with the Theory of Inquiry Learning Arrangements (TILA)

The core principles introduced in the current treatise have been derived from various sources. Thus, this cannot be regarded as a conflation of two consistent theoretical frameworks. Quite the contrary, the interrelations between the Theory of Inquiry Learning and the reframing process of music education need to be discussed in order to realize Inquiry Learning also in the context of music education. These interrelations are mutual. The core principles of reframing music education may help the criteria, principles, and phases of Inquiry Learning to evolve and vice versa. In order to reach a reasonable degree of certainty concerning their corresponding elements, they have to be interrelated by systematic comparison. Moreover, the model of frame constructs constituting the Theory of Inquiry Learning may be used to clarify and restructure the core principles mentioned

above. As a next step, reference is made to the Definitional and the Action-orchestrating Frame Constructs developed by Reitinger (2013a, pp. 20–45, pp. 46–62). Some generic references to the core principles introduced above will also be included. These frame constructs are used to discuss a restructuring process of the core principles shown above. Furthermore, the implementation of Musical Inquiry Learning by meeting the Criteria of Inquiry Learning will be described. Finally, the Organizational Frame Construct of Inquiry Learning will also be integrated as an aid for music educators when realizing Musical Inquiry Learning together with their students.

4.1 THE DEFINITIONAL FRAME CONSTRUCT

In the Definitional Frame Construct, Reitinger (2013a) introduces six criteria which characterize Inquiry Learning processes: (1) General Discovery Interest, (2) Method Affirmation, (3) Experience-based Hypothesizing, (4) Authentic Exploration, (5) Critical Discourse and (6) Conclusion-based Transfer. Moreover, he subdivides these criteria into inquiry-related dispositions (1 + 2) and action domains (3 – 6; Reitinger, 2013a, pp. 41–45). The disposition General Discovery Interest corresponds with the notion of curiosity as a positive force as described by Zehetner (2015). However, regarding musical development, this general interest may be obstructed because of past experience and counter-productive beliefs as stated above. As a first interrelation on the level of the Definitional Frame Construct, the core principles of reframing music education support the emergence of curiosity (General Discovery Interest) as described by Reitinger (2013a, p. 43). General Discovery Interest, as defined in TILA, cannot be presupposed. Quite the contrary, in line with the comprehensive model of fostering curiosity developed by Zehetner (2015, p. 166), curiosity can emerge and be nurtured during fruitful communication and interaction in the classroom by giving credit to four factors: (1) teacher personality, (2) structured instruction, (3) variety of methods, and (4) differentiation according to learner personalities (Zehetner, 2015, pp. 171–182). Acknowledging both the genetic origin and openness as a crucial personality trait, this model also accentuates the importance of situational determinants (Zehetner, 2015, p. 183) in the emergence of curiosity. Therefore, students' individual base levels regarding self-efficacy, self-organization, and self-determination need to be explored thoroughly in the context of Musical Inquiry Learning (MIL). The interrelation between the Definitional Frame Construct and the core principles of reframing music education will be dealt with in more detail when introducing MIL.

4.2 THE ACTION-ORCHESTRATING FRAME CONSTRUCT

In the Action-Orchestrating Frame Construct, Reitinger (2013a, pp. 46-62) defines six theory-based pedagogical principles: (1) Trust, (2) Self-determination, (3) Safety, (4) Clearness, (5) Structuring and (6) Personalization. Corresponding with Seyfried (2010, p. 33) and Reitinger (2013a, p. 46–47), the core principles of reframing music

education help to establish trust between inquiry learners and coaches. Moreover, all six pedagogical principles can be seen as compatible with the core principles stated above. However, one main difference between the core principles and the Theory of Inquiry Learning Arrangements can be identified. They are located at different levels of theoretical differentiation. Whereas Reitinger (2013) has defined three different frame constructs, the core principles of reframing music education are apparently located on one level. Therefore, they demonstrate mainly aspects of communication and interaction, which can be linked to the Definitional and the Action-Orchestrating Frame Constructs without providing a frame for their organizational implementation. A conflation between the core principles of reframing music education and the Theory of Inquiry Learning Arrangements (TILA) seems to be meaningful and necessary as follows: (1) The Definitional and the Action-orchestrating Frame Constructs can be used as a model for restructuring the core principles of reframing music education, explicating criteria and principles as achieved by Reitinger (2013); (2) The implementation of Musical Inquiry Learning can be discussed according to the Criteria of Inquiry Learning; (3) The Organizational Frame Construct can be used in addition to help educators, thus, enabling Inquiry Learning in the field of music education and beyond.

4.3 SCREENING THE CORE PRINCIPLES OF REFRAMING MUSIC EDUCATION

When taking a close look at Reitinger's Definitional and Action-Orchestrating Frame Constructs, one will soon spot the conceptual differences. Whereas the Criteria of Inquiry Learning consist of two inquiry-related dispositions and four action domains (Reitinger 2013a, pp. 41–42), the principles of Inquiry Learning merely focus on the role of the inquiry coach and basic human needs that have to be met when supporting inquiry learners in their explorations. Thus, also the core principles of reframing music education will be screened with regard to their implications for (1) dispositions, (2) action domains and (3) the role of musical inquiry coaches. By this screening a new structure for the reframing process of music education may emerge – as a basis for implementing Musical Inquiry Learning according to the Theory of Inquiry Learning Arrangements (TILA).

The core principles of reframing music education can be screened regarding their nature of either representing dispositions themselves or rather relating to dispositions. Within the Theory of Inquiry Learning Arrangements (TILA), Reitinger (2013a, p. 41–42) defines General Discovery Interest and Method Affirmation as inquiry-related dispositions. However, Method Affirmation as described by Reitinger (2013a, p. 25) can also be seen as a criterion merely relating to the method dispositions of inquiry learners. As mentioned above, General Discovery Interest can be fostered by suitable educational settings and interactions. Looking at the seven core principles of reframing music education with regard to their dispositional character, one has to acknowledge that many of them relate to the dispositions of both inquiry learn-

ers and coaches. At the same time, their main focus lies, and this corresponds well with the Action-Orchestrating Frame Construct as put forward by Reitinger (2013a, pp. 46–62), on the role of musical inquiry coaches and their behavior in the education process. The core principle of Navigating Development, however, corresponds closely with Reitinger's criterion Method Affirmation (Reitinger, 2013a, p. 25), as both strongly relate to inquiry learners' dispositions and proclaim a democratic process of negotiation as introduced by Rosenberg (2004) with his model of life-enriching education. Thus, it can be argued that the criterion Method Affirmation will also be met by the compatible core principle of Navigating Development.

Reitinger's Definitional Frame Construct comprises "four inquiry-related fields of action" (see Chapter 1 in this volume). This has been neglected so far in the process of reframing music education. Thus, these fields of action will be used to specify the implementation of Musical Inquiry Learning in the next section.

As mentioned above, the core principles of reframing music education correspond very well to the Action-Orchestrating Frame Construct of Reitinger's Theory of Inquiry Learning Arrangements (TILA). To be more specific, (1) Absence of Fear-inducing Habits, (2) Skill Orientation and (3) Benign Clarity directly address the respective inquiry coaches and their desirable behavior in the process. The core principles of Experience-driven Musical Learning, Self-organized Musical Learning and Potentialentfaltung also relate to this behavior, but rather focus on the nature of the Musical Inquiry Learning process and, with Potentialentfaltung, the overall aim in the endeavor. Again, this will be discussed in more detail in the context of implementing Musical Inquiry Learning.

The screening of the core principles of MIL according to the Definitional and Action-Orchestrating Frame Constructs of TILA has revealed the following: (1) The core principles of reframing music education mainly correspond with the Action-orchestrating Frame Construct of Inquiry Learning and (2) the core principles of reframing music education and the Principles of Inquiry Learning can, therefore, be compared very well regarding their implications, compatibility, and interrelations. Therefore, the focus now will be to compare the two classes of principles and return to integrating the Definitional Frame Construct for restructuring the core principles of reframing music education later on.

4.4 COMPETING PRINCIPLES

As shown above, the principles of reframing music education can be seen on the same theoretical level as the principles of Inquiry Learning as put forward by Reitinger (2013a, pp. 46–62). In addition, Reitinger (2013) describes these principles as "action-orchestrating". In other words, educators can use principles as guidelines to support Inquiry Learning endeavors (Reitinger, 2013a, p. 60). In the following section, the similarities of and differences between the two groups of principles are discussed.

Self-organized Learning corresponds with Self-determination. However, Reitinger's principle based on the works of Deci & Ryan (2004) may address a more basic human need (Reitinger, 2013a, pp. 47–51, 2015, p. 2), whereas Self-organized Learning focuses on the organizational aspect of Musical Inquiry Learning. This may lead to a generic difference between the two groups of principles. Whereas Reitinger's principles of Inquiry Learning primarily relate to basic human needs and, in addition, actions that involve all participants in the Inquiry Learning process, some of the principles of reframing music education can be seen as exclusively relating to the role of the Musical Inquiry Learning coach. These principles are (1) Absence of Fear-inducing Habits, (2) Skill Orientation and (3) Benign Clarity. As opposed to Reitinger's action-orchestrating principles, they go one step further and give recommendations for action. However, the principle of Benign Clarity relates to Reitinger's principles of Trust, Safety and Clearness. These principles can be adhered to Musical Inquiry Learning arrangements by means of Benign Clarity. The principles (1) Experience-driven Learning and (2) Self-organized Learning also relate to desirable behavior of Musical Inquiry Learning coaches, but in a secondary and, therefore, different way. Primarily, the two principles relate to what the coaches want to achieve for their inquiry learners by sculpturing the learning environment as already discussed. Thus, these principles rather refer to the process of Inquiry Learning itself and may therefore be seen as compatible with the Criteria of Inquiry Learning.

The same may hold true for the principle of Navigating Development. Here, in line with the principles of Inquiry Learning, all parties involved are addressed. Moreover, Navigating Development also corresponds with the principles of Structuring and Personalization. Autonomy and structure can be seen as compatible variables (Reitinger, 2013a, p. 54) that can be balanced by Navigating Development. This suggests that Navigating Development incorporates different aspects of Musical Inquiry Learning and offers rather complex interrelations with Reitinger's frame constructs. Reitinger et al. (see Chapter 1) describe Inquiry Learning as a process "grounded in individualized participation". This may be realized by overcoming the synchronicity of learning processes in groups. Implementing the principles of Experience-driven Musical Learning, Self-organized Musical Learning and Navigating Development can be considered appropriate in this context. As already mentioned, Potentialentfaltung breaks ranks as it can be seen as the overall aim and consequence of Musical Inquiry Learning. At the same time, the orientation towards Potentialentfaltung, in line with the Theory of Inquiry Learning Arrangements (Reitinger, 2013a, pp. 63–70), suggests a change in education paradigms.

On the basis of the comparison of the two groups of principles, a new structure for the principles of reframing music education may emerge. In addition, the Theory of Inquiry Learning Arrangements (TILA) can also enrich the process of reframing music education by emphasizing the importance of Critical Discourse and Conclusion-based Transfer (Reitinger, 2013a, pp. 37–40).

4.5 RESTRUCTURING THE CORE PRINCIPLES OF REFRAMING MUSIC EDUCATION

As discussed above, the comparison between the two groups of principles has revealed the following: (1) Some of the principles of reframing music education exclusively relate to the self-image and behavior of Musical Inquiry Learning coaches; (2) Some principles relate rather to the process of Inquiry Learning itself and can, therefore, be directly interrelated with the Criteria of Inquiry Learning; (3) Some principles offer rather complex interrelations with the frame constructs; (4) With this in mind, a new structure for the core principles of reframing music education has to be found. In addition, to conflate the reframing of music education with the Theory of Inquiry Learning Arrangements (TILA) successfully, the necessity of renaming the core principles emerges.

Corresponding to the arguments stated above, the core principles of reframing music education can be grouped as follows: (1) Absence of Fear-Inducing Habits, Skill Orientation and Benign Clarity as directly relating to the actions and behavior of the Musical Inquiry Learning coaches. Therefore, this group of principles not only relates to but also underpins the principles of Inquiry Learning. (2) Experience-driven and Self-organized Learning as relating to the Inquiry Learning process itself. These two principles stand in line with the Criteria of Inquiry Learning. In more detail, Experience-driven learning relates to Experience-based Hypothesizing, whereas Self-organized learning rather refers to Authentic Exploration. (3) Navigating Development and Potentialentfaltung cannot be subsumed under one specific frame construct.

4.6 RENAMING THE CORE PRINCIPLES OF REFRAMING MUSIC EDUCATION

On the basis of Reitinger's Theory of Inquiry Learning Arrangements (TILA, Reitinger, 2013), the following structure for the further implementation of Musical Inquiry Learning can be suggested:

Absence of Fear-inducing Habits, Skill Orientation, and Benign Clarity can be seen as the action-orchestrating principles of reframing music education. Their interrelation can clearly be classified as non-linear. This corresponds with Reitinger (2013a, p. 17–19, 71–81) characterizing the Criteria of Inquiry Learning "as indicators, not as procedural steps" (see Chapter 1).

Experience-driven and Self-organized Learning can be seen as two definitional criteria of Musical Inquiry Learning. Their interrelations with the Definitional Frame Construct of Inquiry Learning as put forward by Reitinger (2013a, pp. 20–45) will have to be discussed in more detail in the process of further implementation of Musical Inquiry Learning.

As stated above, both Navigating Development and Potentialentfaltung cannot be subsumed under the criteria or principles of Musical Inquiry Learning, as they do not exclusively refer to the action of musical inquiry coaches (musical inquiry learners respectively) or the process of Musical Inquiry Learning itself. Quite to the contrary, Potentialentfaltung can be seen as a keyword in the process of changing education

paradigms (Hüther, 2011, 2015), whereas Navigating Development corresponds with different frame constructs.

By introducing this structure for the principles of reframing music education, new questions arise and need to be considered. How can these principles be integrated into the theoretical model of Inquiry Learning arrangements in a meaningful way? How can the principles and Criteria of Inquiry Learning arrangements nurture the process of reframing music education in its further implementation?

5 Introducing Musical Inquiry Learning

In this section, the process of implementing the reframing process of music education by introducing Musical Inquiry Learning is examined. As shown above, in line with the Theory of Inquiry Learning Arrangements (TILA), any musical education endeavor to be classified as Inquiry Learning is characterized by six criteria (Reitinger, 2013a, pp. 20–45). Thus, the question arises, how the action-orchestrating principles and definitional criteria of reframing music education can be implemented so that these criteria will be met. In addition, the Organizational Frame Construct will also be integrated in order to realize Musical Inquiry Learning in the classroom.

5.1 GENERAL DISCOVERY INTEREST

According to Reitinger (2013a, pp. 20–24), curiosity can either emerge by itself or be fostered intentionally by inquiry coaches. Either way, the emergence of curiosity is based on meeting the needs of inquiry learners. This corresponds well with the model of Life-enriching Education as put forward by Rosenberg (2004). The action-orchestrating principle of Benign Clarity can support General Discovery Interest by communicating feelings and needs in an empathic way. Recurring to Bandura's concept of observational learning (Bandura, 1971), students will be encouraged to be open and frank in return as well. In addition, Benign Clarity will strongly support the emergence of trust and safety. This goes hand in hand with the application of the action-orchestrating principle of Absence of Fear-inducing Habits. By meeting students in a compassionate and benevolent way, any difficulties that may arise during the Musical Inquiry Learning endeavor can be faced together. By establishing trust, students will confidingly turn to their inquiry coaches for advice. This may not be the case if students are confronted with fear-inducing behavior by inquiry coaches. Thus, also Absence of Fear-inducing habits supports the emergence of General Discovery Interest.

5.2 METHOD AFFIRMATION

Reitinger (2013a, pp. 25–26) emphasizes the crucial role of autonomy and authenticity in the context of implementing Inquiry Learning. Thus, the criterion Method Affirmation can be linked with Navigating Development, which has already been introduced

in the treatise at hand. Conducting inquiry into biographies and audiobiographies supports the process of addressing individual dispositions specifically. On the basis of this thorough examination of previous learning experience and the actual motivational level, inquiry coaches start to navigate development by negotiating objectives. Therefore, aspects of Navigating Development can help to reach Method Affirmation (Reitinger, 2013a, pp. 25–27). However, its implications extend far beyond, where Method Affirmation can be seen as a constituent starting point for the continuous process of Navigating Development as explained above.

5.3 EXPERIENCE-BASED HYPOTHESIZING

Both Experience-based Hypothesizing and Experience-driven Musical Learning address the importance of experience in any kind of learning endeavor. Reitinger (2013a, pp. 27–28) argues in this context that the act of hypothesizing facilitates embedding actual experience within the learning continuum of life-long learning. As a result, the innate act of making assumptions about potential relationships while perceiving the environment will be committed intentionally to support any Inquiry Learning endeavor. In addition, this deliberate measure can bring about a higher level of awareness regarding hypothesizing on an everyday basis. The definitional criterion Experience-driven Musical Learning goes one step further as it addresses the need of embedding musical learning in real-life situations. As opposed to exclusively theory-driven musical learning, Musical Inquiry Learning emerges on the basis of joyful experience and Authentic Exploration.

5.4 AUTHENTIC EXPLORATION

Exploration has been defined by Reitinger (2013a, pp. 29–33) as a key domain of action in the context of Inquiry Learning arrangements. Together with Reeve (2004), Reitinger (2013a, p. 33) links authenticity with autonomy and explicates the supportive role of inquiry coaches by stressing the aspects of (1) personalization, (2) trust and understanding, (3) flexibility, (4) arousal of interest, (5) challenging and significant learning contexts and (6) the concern-oriented design of learning environments. Thus, these criteria can be linked with the definitional criterion of Self-organized Learning as outlined above. Both Authentic Exploration and Self-organized Learning enhance the individualization of Inquiry Learning endeavors by emphasizing students' responsibility for their own development and the role of inquiry coaches as positive forces that can be resorted to primarily on demand. This has far-reaching implications for the self-image of teachers and inquiry coaches and may, therefore, be seen as one major challenge in implementing Musical Inquiry Learning.

5.5 CRITICAL DISCOURSE

Reitinger (2013a, pp. 33–39) accentuates the importance of broadening the discourse perspectives from the sole focus on output to an integration of procedural and per-

sonally meaningful aspects and contexts. Thus, Critical Discourse also addresses the procedural nature of Inquiry Learning. All in all, Reitinger (2013a, p. 38) characterizes discourse in Inquiry Learning arrangements as multi-dimensional by reflecting the output, the process, and the emergence of personal significance. Thus, Critical Discourse can also be seen as a crucial criterion for realizing Navigating Development.

5.6 CONCLUSION-BASED TRANSFER

Communicating, applying, and transferring discoveries constitute Conclusion-based Transfer as introduced by Reitinger (2013a, pp. 39–40). This criterion also addresses the need of establishing personal significance and may help to answer the omnipresent question: "What have I learned by doing this?" In the context of Musical Inquiry Learning, Conclusion-based Transfer can easily round off the endeavor by having students play together, preferably in the context of a self-organized performance, which is realized collaboratively.

5.7 INTEGRATING THE ORGANIZATIONAL FRAME CONSTRUCT

In the Organizational Frame Construct, Reitinger (2013a, pp. 73–78) introduces the OPeRA-Model consisting of four phases (Outline-Performance-Reflection-Analysis) to structure the organizational process of Inquiry Learning. Corresponding with the self-determined character of and a constructivist view on Inquiry Learning arrangements, Reitinger (2013a, p. 74) emphasizes the high degree of unpredictability within these endeavors. This can be faced by means of action-related deductions as constitutive components of the highly dynamic model at hand (Reitinger, 2013a, pp. 75–78). By organizing Inquiry Learning according to OPeRA, the Inquiry Learning phase (performance) is embedded in an organizational frame that also entails outlining, detailed reflection and meta-reflection of the process (Reitinger, 2013a, p. 74, 2015, pp. 5–6). This Organizational Frame Construct will also be applicable in the context of Musical Inquiry Learning as introduced in the treatise at hand.

To implement authentic Inquiry Learning in class, Reitinger (2011, 2013b, p. 33, 2014b) provides two concepts on the basis of OPeRA: Authentic Reflective Exploratory Learning and Interaction Arrangement (AuRELIA) and Criteria-Based Explorations in Education (CrEEd). Both concepts cater for the criteria and principles of Inquiry Learning. They mainly differ in their procedural structure. AuRELIA offers a rather closed design with seven steps (Emergence – Speculation – Conception – Investigation – Discovery – Critical Phase – Transfer; cf. Reitinger, 2011, p. 2), whereas CrEEd accentuates an open procedural structure to foster the utmost emergence of the Criteria of Inquiry Learning (Reitinger, 2013b, p. 33, 2014b, pp. 188–189). The applicability of AuRELIA and CrEED in the context of Musical Inquiry Learning will have to be considered carefully in the implementation and future development of Musical Inquiry Learning.

6 Limitations and Further Implications

It has been shown that many complex interrelations between the Theory of Inquiry Learning Arrangements (TILA) and the core principles introduced during the process of reframing music education at the Private University College of Education of the Diocese of Linz can be found. Some of them have been dealt with in this article, offering a new structure for the implementation of Musical Inquiry Learning according to TILA. However, this can only be a starting point of conflating the Theory of Inquiry Learning Arrangements (TILA) with the principles and criteria of reframing music education, opening up space for future endeavors including the empirical validation of the constructs introduced and the implementation and documentation of Musical Inquiry Learning in schools and universities. To be more specific, the principle of Navigating Development needs further discussion in its relations to TILA as it has been argued that it cannot be subsumed exclusively under the Action-Orchestrating or Definitional Frame Construct. On the contrary, Navigating Development could serve as a meta-orientation for Musical Inquiry Learning incorporating the frame constructs introduced by Reitinger (2013a, pp. 20–45, pp. 46–62, pp. 73–78).

As has been shown and discussed in this article, the application of TILA can foster the implementation of Musical Inquiry Learning in a way that musical inquiry coaches adopt a new self-image and also sculpture their learning environments accordingly. This could lead to a change in music education paradigms on the basis of self-determined Musical Inquiry Learning as introduced above.

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Part IV
Conclusion

15 Research and Reflections on the Theory of Inquiry Learning Arrangements: Commentaries and Further Directions

Johannes Reitinger

The writing of this concluding article containing commentaries on *Theory of Inquiry Learning Arrangements. Research, Reflection, and Implementation* is assigned to me in my role as creator of TILA, AuRELIA, and CrEEd (Reitinger, 2013). In view of the fact that this anthology bears the hallmarks of several ambitious acquainted educators and scientists who are all engaged in discussing, implementing, and spreading the non-mainstream approach of self-determined Inquiry Learning, this is undoubtedly an honorable job.

1 Commentaries on the Contributions of Part II (Research on the Theory of Inquiry Learning Arrangements)

Part II of the current volume contains qualitative and quantitative research on CrEEd and AuRELIA. It is impossible to summarize the considerable sets of evidence concerning the two concepts collected and documented in Part II by the authors Keplinger, da Rocha, Beer, Haberfellner, Reitinger, Hauer, Hollick, and Oyrer. Nevertheless, in a very abridged manner, I allow myself to assert that the studies confirm the motivating character of CrEEd and AuRELIA, the proclaimed linking to the Criteria and Principles of Inquiry Learning, and the practicability of the TILA approach.

Further, the authors applied some promising micro methods, educational materials or useful tools within their investigated treatments that should be mentioned here: Keplinger's specific application of the OPeRA Portfolio (Chapter 5); the inquiry diary, masterfully applied by da Rocha (Chapter 6); the collaborative assessment according to Beer, Haberfellner, and Reitinger (Chapter 7); Hauer's unique usage of image vignettes (Chapter 8); Hollick's ambitious orchestration of the *Autonomous Weeks* (Chapter 9); and the motivating approach to start and accompany AuRELIA successfully according to Oyrer (Chapter 10). All these innovative ideas are worth incorporating into the current repertoire of viable elements of Inquiry Learning Arrangements.

The empirical treatises in Part II are supplemented by four theory-oriented contributions in Part III. Patry, Kramer, Bertsch and Gritschenberger, and Waid reveal relationships to other theoretical frameworks, give estimations of the theoretical relevance of TILA, and indicate hypothetical fields of potential differentiations of TILA. In what follows, I would like to address and comment on some of the crucial arguments put forward in these essays.

2 Commentaries on the Contributions of Part III (Relating TILA to other Theoretical Frameworks)

Within Part III of this volume, four authors discuss TILA in relationship to other theories or concepts. Specifically, they address approaches like Critical Multiplism, Viability Check, Inquiry-based Science Education, the Theory of Expansive Learning, and Musical Inquiry Learning.

Patry (Inquiry Learning Arrangements from the Perspective of Critical Multiplism and related Concepts; see Chapter 11) discusses TILA as well as the corollary tools AuRELIA and CrEEd with regard to their theoretical constitution and concludes that these approaches can be seen as examples of Critical Multiplism (Patry, 2013), namely on the object-theoretical level as well as on the meta-theoretical level. Further, he emphasizes the explicit references between TILA, the concept of viability check, and Dewey's principle of warranted assertibility (1941). In the course of his theoretical analysis, Patry argues that AuRELIA and CrEEd are not cookbooks but widely open concepts with many creative possibilities of organization. Hence, these concepts need some kind of translation to fit the pragmatics of application. In this regard, the question arises if and how teachers can be taught this theory and its possibilities of transfer into practice. Therefore, Patry gives some pursuing hints although he notes that the sufficient conveyance to the teachers is not always and fully possible.

Kramer (Inquiry Learning Arrangements and Expansive Learning: A Tentative Dialogue: Investigating TILA from a Cultural-Historical Perspective; cf. Chapter 12) examines TILA from the perspective of Engeström's Theory of Expansive Learning (2015) which represents an activity-theoretical approach. He locates compatibility between TILA and Expansive Learning as well as potentials of reciprocal support on various levels, not the least in the sense of a Critical Multiplism on the meta-theoretical level. What seems to be a promising hint in Kramer's theoretical examination is the recommendation to consider TILA from a more situative position, acknowledging the fact that learners are always part of the world around them, embedded in culture and history. This complementary perspective might contribute to a broader understanding of the learning process.

In Chapter 13 (Inquiry Based Science Education and Teacher Professional Development), Bertsch and Gritschenberger compare TILA with current conceptions of

Inquiry Based Science Education (IBSE). In so doing, they question TILA's strong criteria-based definition of Inquiry Learning (Definitional Frame Construct; see Chapter 1). In their opinion, "restrictive definitions with the idea that an endeavor can only be classified as Inquiry Learning if all the criteria of the definitions are met have little value for educational settings because these are highly situated and contextual." (Chapter 13, p. 216). It should, however, be stressed, that the Criteria of Inquiry Learning are of a continual nature (cf. Chapter 4) and can evolve to various degrees. Insofar, the statement that all criteria should be met is relative, as is pointed out in Chapter 1, p. 4 (cf. also Reitinger, 2013, p. 42): "That is to say, the higher the number of criteria met and the more fully the evolvement, the more intensive the Inquiry Learning process." In my estimation, the articulated example of practice in Bertsch's and Gritschenberger's treatise (see Chapter 13, p. 215) broadly meets the six Criteria of Inquiry Learning, which reveals the compared approaches TILA and IBSE to be closer to each other than suggested. Further, in the course of concept development or research an orientation towards a differentiated definition of the envisaged context is necessary as it avoids arbitrariness. We need to know what we are thinking about. TILA's frame constructs, especially the Definitional Frame Construct, are an attempt at such a definition. Of course, it is up to the researchers or educators, to which concrete understanding they refer their endeavors. Nevertheless, the six Criteria of Inquiry Learning embrace a wide field of action-domains, derived from various theoretical frameworks in a Critical Multiplism style, hence, they should not be considered to be restrictive. Who could argue that Discovery Interest, Method Affirmation, Experience-based Hypothesizing, Authentic Explorations, Critical Discourse, and Conclusion-based Transfer are not plausible parts of successful and sustainable processes of self-determined Inquiry Learning, independent on the age of the learners? Nevertheless, Bertsch and Gritschenberger make a good point that their described IBSE frameworks are more specific on how to connect students' findings to current scientific knowledge. In this concern, TILA needs to be advanced. Further, the authors' practice-related deliberations are creditable, as they provide many useful hints, explanations, and necessary differentiations for a successful inquiry-based education at primary schools.

Finally, the endeavor of Waid (Introducing Musical Inquiry Learning according to TILA; see Chapter 14) is commendable. By deploying the premises of TILA within his promising specific didactical framework of Musical Inquiry Learning (MIL), he broadens the potential range of perception of MIL and TILA and enhances the probability of a transfer into practice.

3 Paths to Further Implications for the Implementation of TILA

The contributions of the reference book at hand represent an important further step concerning the implementation of TILA. They summarize the theoretical constitution

of TILA, specify realms of efficacy of AuRELIA and CrEEd, and open new horizons of diversification by conflating the approach with other theoretical frameworks.

I hope that on this contemporary theoretical and empirical grounding further endeavors of investigation, dissemination and implementation of TILA, AuRELIA, and CrEEd will follow. If so, the following suggestions derived from various articles of this book could serve as parameters of orientation:

(1) It is suggested that research on efficacy, endeavors of contextualization (e.g., "Autonomous Weeks", implementations in specific didactic fields, projects at school, application of inquiry diaries), and exemplary well-organized Inquiry Learning Arrangements according to the Theory of Inquiry Learning Arrangements should be further supported and published. It is important to aid interested researchers, teachers, and learners with further data and information about possibilities and opportunities of TILA's successful and sustainable application in various educational situations. As Patry argues in Chapter 11, this can be best done with concrete examples.

(2) To unfold and differentiate increasingly more interrelations between self-determined Inquiry Learning and other theoretical approaches, further scientific endeavors in the sense of conflations as documented in Part III of this volume will be necessary.

(3) Following Patry (see Chapter 11), I suggest using methodical Critical Multiplism for further scientific endeavors around TILA to enhance the warranted assertibility of the theoretical approach and its practical implementations. Further, the conduction of TILA from a more situative position that additionally recognizes the importance of culture and history seems to be recommendable, as Kramer argues (see Chapter 12). I derive from Bertsch's and Gritschenberger's reflections (see Chapter 13) that TILA could be advanced concerning its specificity on how to connect students' findings to current scientific knowledge. And, not least, Waid's principles of MIL are worth of further recognition (see Chapter 14).

(4) The Criteria of Inquiry Learning Inventory (CILI; Reitinger 2016) introduced in Chapter 4 represent a possibility to analyze diverse (Inquiry) Learning Arrangements in tertiary education. It is desirable that this inventory will find multifaceted applications in practice as well as research on AuRELIA and CrEEd. Further, this inventory can be used to examine to what extent other educational concepts or didactical models are supportive according to the unfolding of Criteria of Inquiry Learning. Hence, CILI opens an interesting field of comparative investigation and, therefore, a promising future research domain.

(5) Finally, I would highly appreciate if more educators would take hold of TILA's corollary concepts. Although AuRELA and CrEEd are complex frameworks, the arduous and long process of internalization can be positively influenced by endeavors within which researchers and practitioners work collaboratively together (collaborative innovation; Corno & Randi, 1997), as some prototypical examples

documented in this reference book demonstrate. Hence, in order to intensify support for this purpose, several prospective modi might be conceived, e.g., further field research (see Part II), professionally supported action research at schools (Rauch, Schuster, Stern, Pribila, & Townsend, 2014; Atrichter & Posch, 2006), which is also in line with the activity-theoretical approach discussed by Kramer (cf. Chapter 12), the wide-ranging application of the Criteria of Inquiry Learning Inventory (CILI; see Chapter 4) in tertiary education, or the implementation of laboratories in schools, colleges, and universities with an emphasis on self-determined Inquiry Learning.

4 Harking back to the very mission

Nothing is closer to pathology than the cult of normality pushed to the limit.

Elisabeth Roudinesco

The ambitious reader will undoubtedly have noticed that TILA is a non-mainstream approach dedicated to a radically autonomy-oriented concept of humanity. Since humans display a tendency not to generally want to leave thinking to others, and with the endeavor to professionally, reflectively, and gracefully support each individual on the grounds of such a disposition, the paradigm of a curious, self-determined, and inquiring human might lead us towards a promising future. In view of such a perspective, my fellows and I regard the pedagogical construct of self-determined Inquiry Learning as a promising paradigmatic approach well worth the effort of further examination and implementation. This is the very mission we pursue, knowing that this less consulted and widely uncharted way is not an easy one:

The best way to a breakthrough is constant small improvement.
Those waiting for the big break are just lazy.
They're waiting to be teleported to the top of the hill instead of walking.

Gary Starkweather

5 Acknowledgements

Reviewing the preceding collection of considerable theoretical and empirical treatises from various authors, this final paragraph pales in comparison. Nevertheless, these concluding sentences represent my deep appreciation of everyone who had a share in the creation of the reference book at hand. Hence, gratitude is owed to all authors of this book who invested intellectual power and valuable time for the discussion, application, and investigation of TILA and its pragmatic concepts AuRELIA and CrEEd. I especially want

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May this project be remembered by all that were involved not just as a well-done job but rather as a personally important and playful experience of especially the sort of self-determined Inquiry Learning that was introduced here, so succinctly expressed as follows:

I tried to teach my child with books.
He gave me only puzzled looks.
I tried to teach my child with words.
They passed him by often unheard.
Despairingly, I turned aside.
"How shall I teach this child?" I cried.
Into my hand he put the key
"Come," he said, "play with me."

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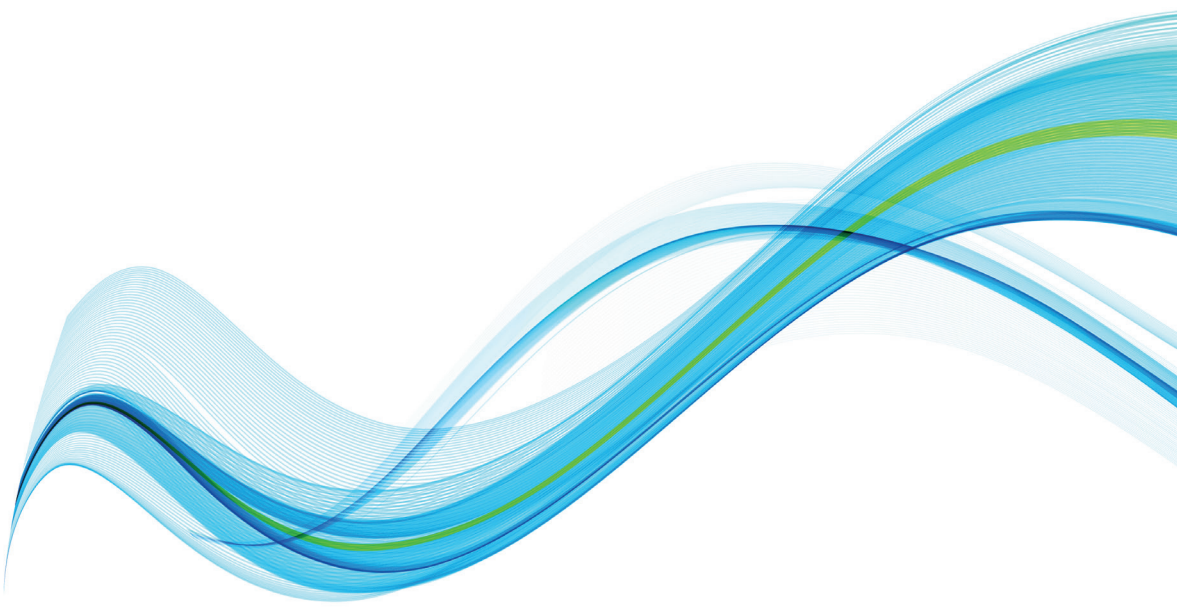
Humans come equipped with a curious and inquiring mind that strives toward free thinking and self-determination. Building on this paradigm and acknowledging its potential for human learning, the present volume points out ways of supporting learning endeavors in a professional, reflective, and conducive manner.
The authors regard the pedagogical construct of self-determined Inquiry Learning as a promising approach. The Theory of Inquiry Learning Arrangements (TILA) concretizes this approach according to the principles of critical multiplism. The theory and its corresponding concepts AuRELIA (Authentic Reflective Exploratory Learning and Interaction Arrangements) and CrEEd (Criteria-based Explorations in Education) are presented in detail, empirically investigated, and underpinned with practical examples. In the current edited volume, self-determined Inquiry Learning is further substantiated, and TILA is presented to the international community of educational scientists and practitioners.



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