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The Theory of Inquiry Learning Arrangements (TILA)

Introduction to a Theoretical Framework for Self-Determined Inquiry Learning in Institutionalized Educational Settings

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Abstract

TILA represents a general theory of inquiry learning, which has already been published in research literature in German. 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.
First, the article at hand 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, Dewey´s educational principles, Bildungstheorie, and neuroscience.
Second, the inquiry-oriented learning concept AuRELIA (Authentic Reflective Exploratory and Interaction Arrangement) is introduced. This concept is compatible with TILA and has been proved to be effective in secondary and tertiary education.
Finally, a summary of research which was carried out in order to evaluate inquiry learning based on TILA with regard to the constructs *self-efficacy, inquiry habit of mind* and *motivation* is given.
Up to now, only German publications on this theory have been available. This English article aims to open up TILA as well as corresponding research findings collected in recent years to international discourse and application.

Theorie forschender Lernarrangements (TILA)

Vorstellung eines theoretischen Rahmenmodells zum selbstbestimmten forschenden Lernen in institutionalisierten pädagogischen Settings

Zusammenfassung

TILA stellt eine allgemeine Theorie forschenden Lernens dar, welche bereits in der deutschsprachigen Forschungsliteratur publiziert wurde. TILA bezieht sich dabei auf autonomieorientierte Lernarrangements in Schulen oder Hochschulen und ist gegenwärtig – nach erfolgter empirischer Untermauerung – bereit für den Transfer in den internationalen und interdisziplinären Diskurs.
Der vorliegende Artikel erläutert das theoretische Rahmenmodell zum selbstbestimmten forschenden Lernen (TILA), welches sich aus drei Rahmenkonstrukten zusammensetzt (definitorisches Rahmenkonstrukt, handlungsleitendes Rahmenkonstrukt, organisatorisches Rahmenkonstrukt). Darüber hinaus wird die Verknüpfung der Theorie mit der Selbstbestimmungstheorie, Deweys pädagogischen Prinzipien, der Bildungstheorie und der Neurowissenschaft dargestellt.
Außerdem erfolgt eine Einführung in AuRELIA (Authentic Reflective Exploratory and Interaction Arrangement), ein Praxiskonzept für selbstbestimmtes, forschendes Lernen, welches mit TILA kompatibel ist und sowohl im Schul- als auch Hochschulkontext angewendet werden kann.
Eine zusammenfassende Darstellung von Forschungstätigkeit, welche die Wirksamkeit forschenden Lernens nach TILA in Bezug auf die Konstrukte *Selbstwirksamkeit*, *Forschender Habitus* und *Motivation* untersuchte, bildet den Abschluss des vorliegenden Beitrages.

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Bisher wurden Publikationen zu dem theoretischen Rahmenmodell TILA fast ausschließlich in deutscher Sprache verfasst. Mit diesem englischsprachigen Artikel sollen TILA und damit korrespondierende Forschungsergebnisse der letzten Jahre für den internationalen Diskurs und für die Anwendung im internationalen Kontext zugänglich gemacht werden.

Keywords:	*Schlüsselwörter:*
TILA (Theory of Inquiry Learning Arrangements)	TILA (Theorie forschender Lernarrangements)
Inquiry learning	Forschendes Lernen
AuRELIA (Authentic Reflective Exploratory and Interaction Arrangement)	AuRELIA (Authentic Reflective Exploratory and Interaction Arrangement)
Self-determination	Selbstbestimmung

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 endeavours 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 contributed substantially to the specification of what inquiry learning means over the past years (Littleton, Scanlon & Sharples, 2011).

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, 2013a). By outlining the Theory of Inquiry Learning Arrangements (TILA), 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 European Bildungstheorie (Benner, 2011; Klafki, 1999) has been made.

2 Self-determined Inquiry Learning

In the opinion of advocates of the European Bildungstheorie, 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 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 (2008) theory of inquiry, self-determined action is inherently anchored in every human being's mind. Autonomous 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 such as sensory tangible discovery, systematic exploration, or 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 over the past years. 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 only be classified as inquiry learning if these six 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 process. 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. This agreement concerning the applied method between learners and teachers can be reached by collaborative and demand-oriented negotiation (Seyfried, 2002).

(3) Experience-based Hypothesizing: Inquiry learning includes the acts of hypothesizing and making assumptions. Participants 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 foreknowledge and individual subjective concepts. This way it is likely to become more memorable.

(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, teachers, etc. who cater for the learners' individual needs and who act primarily on demand.

(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).

(6) Conclusion-based Transfer: Demonstrating one´s competence (Elliot, McGregor & Thrash, 2004, p. 361) by transferring the findings and discoveries (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 (Dewey, 1933).

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 planning, 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 (a) General Discovery Interest, and (b) Method Affirmation. Additionally, four inquiry-related fields of action are characteristic of self-determined inquiry learning. These domains are (c) Experience-based Hypothesizing, (d) Authentic Exploration, (e) Critical Discourse, and (f) Conclusion-based Transfer. Inquiry learning arrangements, therefore, are educational settings characterized by collaborative endeavors of inquiry learning, in which these six criteria (a-f) unfold.

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 by literature review. 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). This relevance of the six theory-based principles of inquiry learning listed below has already been empirically confirmed among various groups of teacher trainees in the context of inquiry lesson organization (Reitinger, 2013a, pp. 164–168).

(1) Trust: Establishing rapport between learners and teachers (henceforth referred to as inquiry coaches) aiming to create trustworthiness serves as an indispensable basis for inquiry learning, if not for successful learning in general (Seyfried, 2010, p. 33).

(2) Self-determination: Autonomy, competence-orientation and social relatedness have been identified as crucial factors in generating intrinsic motivation (Ryan & Deci, 2004, pp. 7f.). 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 (demand-orientation; 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, 2013a, 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 (quoted in 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. Contrary, 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 as well as by conceding responsibility for learning (Reitinger, 2013a, p. 61).

(6) Personalization: Inquiry learning involves the careful consideration of different motivations, interests and personal capacities. The inquiry learning process is grounded on individualized participation. This personalization stems from activity which is considered relevant by the learner, can be organized independently, and is discussed collaboratively. 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.

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 conductive 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, meaning Outline-Performance-Reflection-Analysis-Model, (Reitinger, 2013a, 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, we 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 pupils 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 outline and performance process.

(4) Analysis: The three interacting phases - 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, or working together with other researchers to evolve collaborate innovation etc. (Corno & Randi, 1997; Naashia, 2014, p. 49). Such meta-reflective actions wield influence upon educational endeavor in form of regulative effects (quasi-direct influence on actions) and progressive effects (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 are supportive to the organization of highly open collaborative learning processes (action-supportive deductions). For a detailed report see Reitinger (2013a, pp. 75–78).

2.3.1 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 this model of TILA.

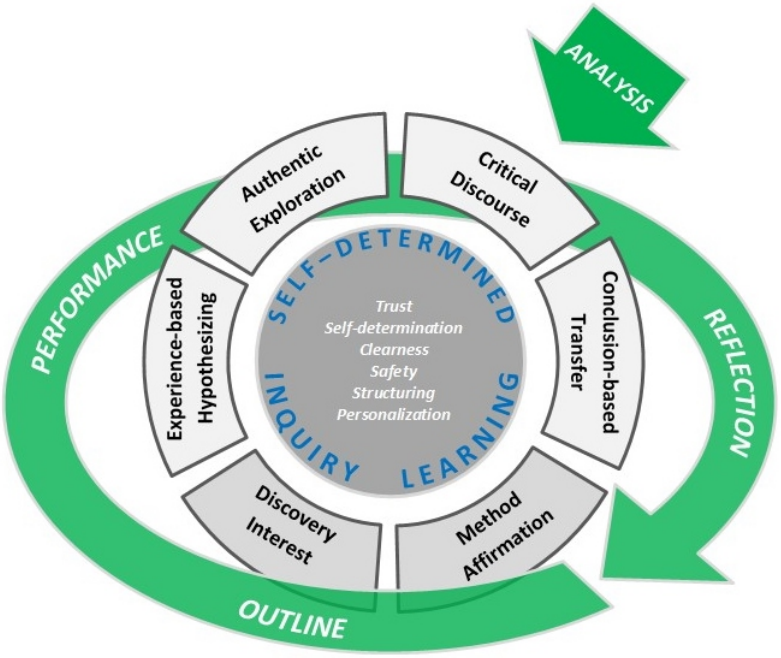

Figure 1: TILA – Theory of Inquiry Learning Arrangements (Reitinger, 2013a)

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 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; the criteria are understood as indicators, not as procedural steps (Reitinger, 2013a, 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 secondary and tertiary education and further research seem to be next logical steps. The following chapters will deal with these intentions.

3 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, meaning Authentic Reflective Exploratory Learning and Interaction Arrangement (Reitinger, 2013b, pp. 18–27). AuRELIA takes into account the criteria of inquiry learning (see Table 1). Moreover, it refers to specific steps of reflective thinking and acting (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 (Dewey 1933; Reich, 2008, p. 189), as well as the scientific-knowledge building process (thematic access; identifying hypotheses by consulting foreknowledge; designing an investigation; performance; evaluation; review; estimation of results) according to Demuth, Gräsel, Parchmann, and Ralle (2008).

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.

Table 1: The Relation between AuRELIA and the Criteria of Inquiry Learning

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.

(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 phase(s), updating knowledge 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.

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. 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. Hauer (2014) and Reitinger (2013c) provide further insight into the practice of AuRELIA.

4 Results of Research

Effectiveness and *acceptance* of AuRELIA have been the subjects of recent publications describing the results of empirical studies which focused on inquiry learning (Hauer, 2014). In the following sections, 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 these outlines aims to acquaint the English-speaking professional scientific community with the key findings from some of the latest research projects.

4.1 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 (Reitinger, 2012, pp. 125-129), which was carried out in heterogeneous lower secondary classes among pupils aged between 10 and 14 (see Table 2), investigated several dimensions of effectiveness of self-determined inquiry learning according to the concept AuRELIA. The following hypotheses – referring to students (Sts) in heterogeneous lower secondary classes – express the scholarly interest:

- 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.).

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

Table 2: Replication Study Design – Efficacy of AuRELIA

Results: In this setting with special focus on science lessons, the stated hypotheses were proved 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 3). The significant outcomes of the analytical testing, considering the absolute mean differences between pretest and posttest measure points (O1-O2), led to the conclusion that AuRELIA was effective in both cohorts.

		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: $F(1/25) = 5.834$, $p < 0.05$, $\eta^2 = 0.189$ Mean Effect: $F(1/25) = 11.538$, $p < 0.05$, $\eta^2 = 0.316$	Interaction Effect: $F(1/25) = 4.772$, $p < 0.05$, $\eta^2 = 0.160$ Mean Effect: $F(1/25) = 10.691$, $p < 0.05$, $\eta^2 = 0.300$	Interaction Effect: $F(1/25) = 8.728$, $p < 0.05$, $\eta^2 = 0.259$ Mean Effect: $F(1/25) = 11.184$, $p < 0.05$, $\eta^2 = 0.209$
	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
C2	**Sign. Text**	Interaction Effect and Mean Effect: ns Betw.-Subj. Effect: $F(1/37) = 4.159$, $p < 0.05$, $\eta^2 = 0.101$	Interaction Effect: $F(1/37) = 8.994$, $p < 0.05$, $\eta^2 = 0.196$ Mean Effect: $F(1/37) = 6.153$, $p < 0.05$, $\eta^2 = 0.143$	Interaction Effect: $F(1/25) = 6.153$, $p < 0.05$, $\eta^2 = 0.448$ Mean Effect: $F(1/25) = 6.153$, $p < 0.05$, $\eta^2 = 0.423$

Table 3: Replication Study Design – Effectiveness of AuRELIA

In addition, a Multivariate Analysis of Variance (MANOVA) was carried out in order to compare the differences between all mean scores of the pretest (O1). Obtaining no significant result, the means at the time of O1 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 (C1: F(1/25) = 10.604, p < 0.05, η2 = 0.298; C2: F(1/37) = 18.882, p < 0.05, η2 = 0.338; total sample: F(1/64) = 27.662, p < 0.05, η2 = 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 activity, (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 (1 – "hat mir gar nicht gefallen"; transl.: "did not like at all" – to 4 – "hat mir sehr gefallen"; transl.: "liked a lot"). The means of the treatment class of cohort 1 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 cohort 2 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).

4.2 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 university college of education 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. Contrary, they took the role of a professional learning companion who was available on demand.

According to Reitinger (2014, pp. 205–207), 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, 2008). 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 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:

- H1: 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 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 (1 – "stimme gar nicht zu"; transl.: "I strongly disagree" – to 5 – "stimme voll zu"; transl.: "I fully agree"). Details are given in Reitinger (2014, p. 206). Figure 2 shows the results of the repeated-measure survey.

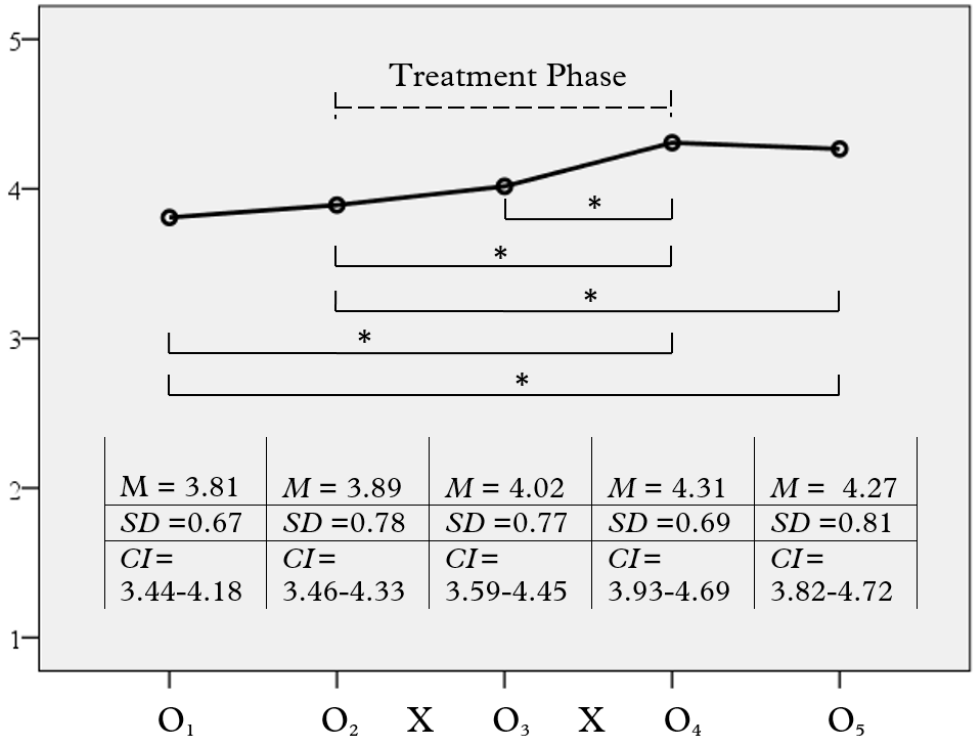

Figure 2: Development of *Inquiry Habit of Mind* – Repeated Measures

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 contrasts (O1-O4; O1-O5; O2-O4; O2-O5; O3-O4), indicating effectiveness of the treatment.

4.3 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 (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; 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 university college of teacher education. 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 university college of teacher education. 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?
- H1: 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 (M < 4; see Table 4) – indicate high affirmation of the dimensions of *motivation* in the investigated contexts of experience (participating / organizing inquiry learning according to the concept AuRELIA).

	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

Table 4: Comparison of Ratings of a) *Competence*, b) *Effort*, and c) *Attribution of Value*

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 H1 could be proved true for the dimensions *effort* and *attribution of value*.

5 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. We also hope that these outcomes underpin the relevance of TILA, despite the limitations of research which has as yet been conducted. 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 suggest that engaging with the concept will help them to assume the role of inquiry coaches in their later professional life.

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 and conceptually assembled according to AuRELIA a subject matter of both the international scientific discourse as well as educational practice.

(1) First, 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. At present, research is conducted which aims to develop and test a prototype of such an inventory according to Classical Test Theory and Item Response Theory (DeMars, 2010; Devellis, 2011). First results obtained from this project (Criteria of Inquiry Learning Inventory; CILI) will be published in 2015.

(2) Second, to achieve effective implementation in educational practice, it will be necessary to make TILA also known among the non-German-speaking scientific community. The article at hand represents an initial effort 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 inherently 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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