Theory of Inquiry Learning Arrangements

Research, Reflection, and Implementation

Johannes Reitinger
Christina Haberfellner
Eric Brewster
Martin Kramer
(Eds.)

kassel university press

Theory of Inquiry Learning Arrangements

Research, Reflection, and Implementation

Johannes Reitinger
Christina Haberfellner
Eric Brewster
Martin Kramer
(Eds.)

kassel university press

Theory of Inquiry Learning Arrangements: Research, Reflection, and Implementation
Johannes Reitinger, Christina Haberfellner, Eric Brewster, Martin Kramer (Eds.)

This publication was kindly supported by the
Austrian Federal Center for Professionalization in Educational Research
(Österreichisches Bundeszentrum für Bildungsforschung; BZBF).

Bibliographic information published by the German National Library
This publication is listed in the German National Bibliography.
Detailed bibliographic data are available at http://dnb.dnb.de

ISBN: 978-3-7376-0144-3 (print)
ISBN: 978-3-7376-0145-0 (e-book)
DOI: http://dx.medra.org/10.19211/KUP9783737601450
URN: http://nbn-resolving.de/urn:nbn:de:0002-401453

2016, kassel university press GmbH, Kassel
www.upress.uni-kassel.de

Typeset in Arno & Hypatia
Typo & Layout: Martin Kramer
Cover graphics: fotolia.com

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

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).

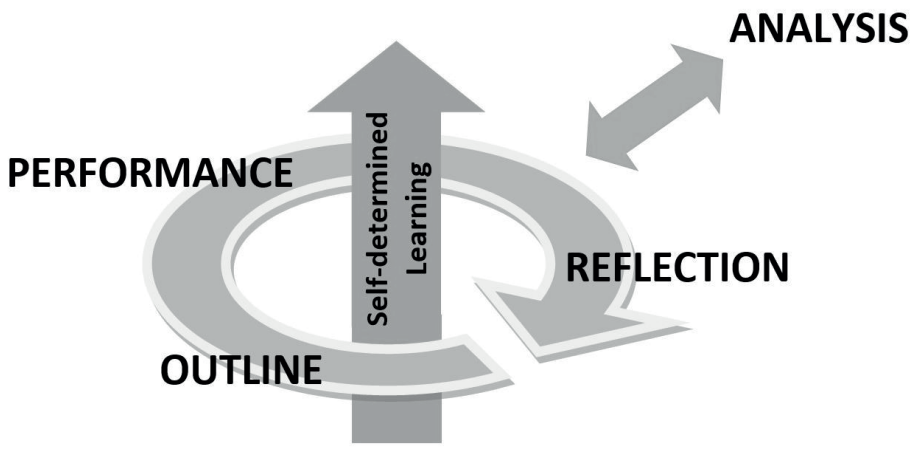
Nevertheless, despite considering these issues, a teacher or an inquiry coach will maximally be able to foster the evolvement of the six Criteria of Inquiry Learning and, thus, the probability of self-determined inquiry within a learning arrangement through his or her engagement of preparation and coaching. 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*).

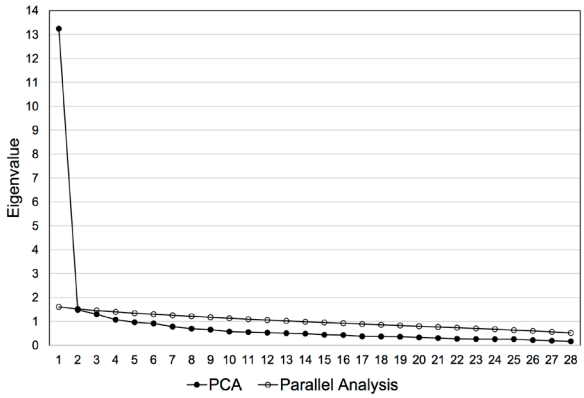
Exploratory Factor Analysis (EFA)

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); $p < 0.01$

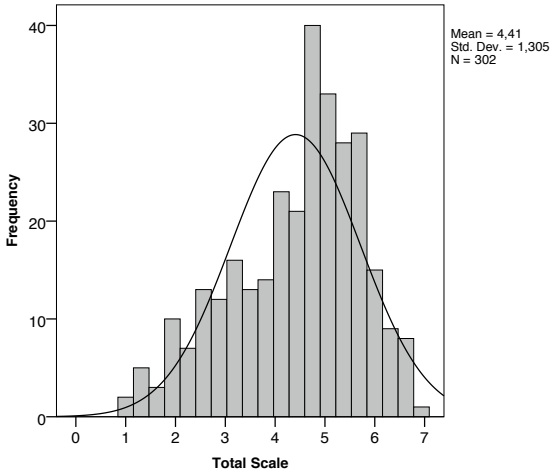
This outcome emphasizes the correspondence between the four theoretical criteria of inquiry-related action domains and supports the thesis that the total 16-items scale represents a homogeneous entire construct. Nevertheless, further investigations are necessary to confirm or disconfirm this thesis (see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

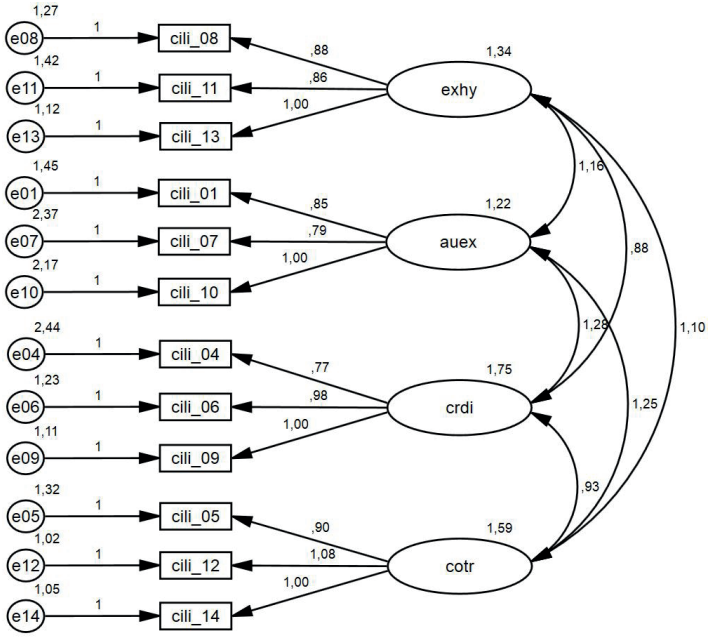
Confirmatory Factor Analysis (CFA)

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.

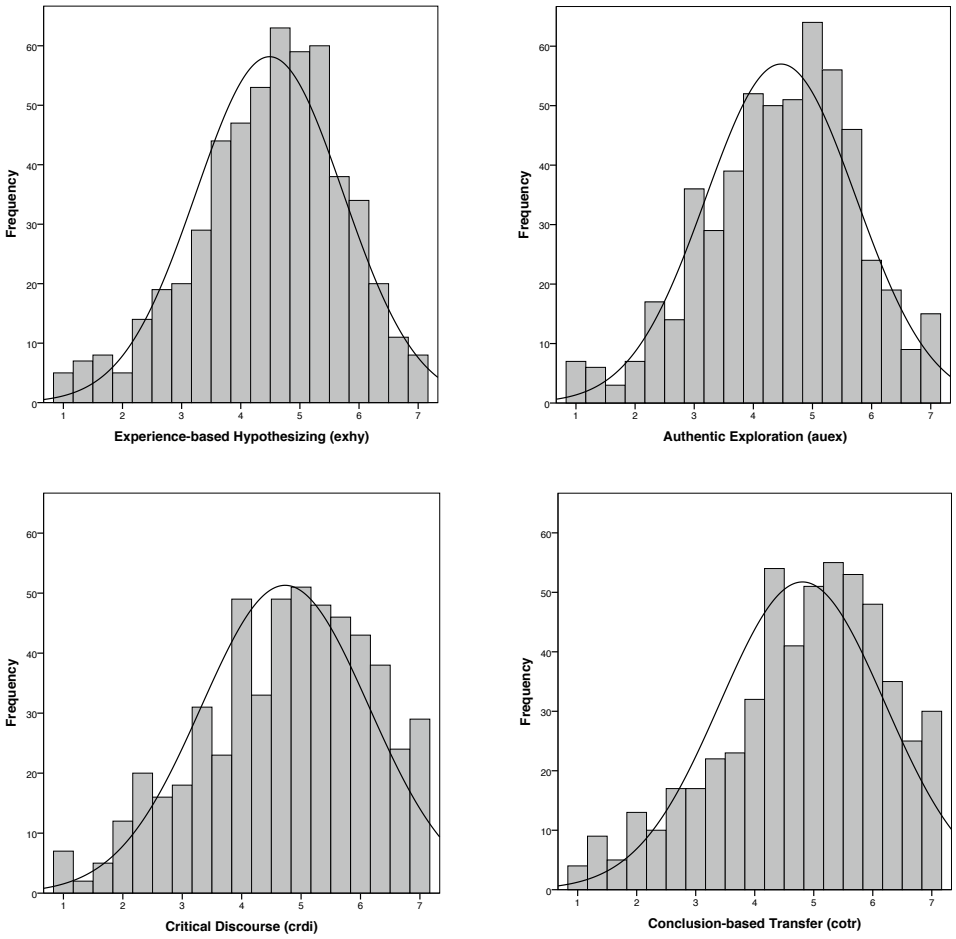
Correlations with the curiosity-dimensions (*Stretching Curiosity, Embracing Curiosity*) according to Kashdan et al. (2009) are significant but weak concerning their size of effect. This outcome matches well as it indicates that post-interventional estimations of the evolvement of Criteria of Inquiry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

References

Benner, D. (2011). *Bildungstheorie und Bildungsforschung: Grundlagenreflexionen und Anwendungsfelder.* Paderborn, Germany: Schöningh.

Benner, D. (2012). *Allgemeine Pädagogik: Eine systematisch-problemgeschichtliche Einführung in die Grundstruktur pädagogischen Denkens und Handelns.* Weinheim, Germany: Juventa.

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., & Zettle, R. D. (2011). Preliminary psychometric properties of the acceptance and

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."

action questionnaire–II: A revised measure of psychological inflexibility and experiential avoidance. *Behavior Therapy, 42*(4), 676–688.

Byrne, B. M. (2009). *Structural equation modeling with AMOS: Basic concepts, applications, and programming.* New York, NY: Routledge.

Deci, E. L, & Ryan, R. M. (2004) (Eds.). *Handbook of self-determination research.* Rochester, NY: The University of Rochester Press.

DeVellis, R. F. (2011). *Scale development: Theory and applications.* Thousand Oaks, CA: Sage.

Dewey, J. (1933). *How we think.* Lexington, KY: Courier Dover Publications.

Elliot, A. J., McGregor, H. A., & Thrash, T. H. (2004). The need for competence. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-Determination Research* (pp. 361–387). Rochester, NY: University of Rochester Press.

Field, A. (2009). *Discovering statistics using SPSS.* Thousand Oaks, CA: Sage.

Guay, F., Vallerand, R. J., & Blanchard, C. (2000). On the assessment of situational intrinsic and extrinsic motivation: The situational motivation scale (SIMS). *Motivation and Emotion, 24*(3), 175–213.

Hogrebe, W. (1996). *Erkenntnis und Ahnung.* Berlin, Germany: Suhrkamp.

Iacobucci, D. (2010). Structural equations modeling: Fit indices, sample size, and advanced topics. *Journal of Consumer Psychology, 20*, 90–98.

Kaiser, H. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31–36.

Kashdan, T. (2010). *Curious? Discover the missing ingredient to a fulfilling life.* New York, NY: Harper.

Kashdan, T. B., Gallagher, M. W., Silvia, P. J., Winterstein, B. P., Breen, W. E., Terhar, D., & Steger, M. F. (2009). The curiosity and exploration inventory-II: Development, factor structure, and psychometrics. *Journal of Research in Personality, 43*(6), 987–998.

Klafki, W. (1999). Die bildungstheoretische Didaktik im Rahmen kritisch-konstruktivistischer Erziehungswissenschaft. In R. Gudjons, R. Teske, & R. Winkel (Eds.), *Didaktische Theorien* (pp. 13–34). Hamburg, Germany: Bermann & Helbig.

Kline, R. B. (2004). *Principles and practice of structural equation modeling.* New York, NY: Guildford.

McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the intrinsic motivation inventory in a competitive sport Setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport, 60*(1), 48–58.

Merriam-Webster. (2015): *An Encyclopaedia Brittannica Company: Dictionary.* http://www.merriam-webster.com/dictionary/arrangement

Moegling, K. (2010). *Kompetenzaufbau im fächerübergreifenden Unterricht. Förderung vernetzten Denkens und komplexen Handelns.* Immenhausen bei Kassel, Germany: Prolog.

Moosbrugger, H., & Schermelleh-Engel, K. (2012). Exploratorische (EFA) und Konfirmatorische Faktorenanalyse (CFA). In H. Moosbrugger & A. Kelava (Eds.), *Testtheorie und Fragebogenkonstruktion* (pp. 325–344). Berlin, Germany: Springer.

Neuweg, G. H. (2004). *Könnerschaft und implizites Wissen: Zur lehr-lerntheoretischen Bedeutung der Erkenntnis- und Wissenstheorie Michael Polanyis.* Münster, Germany: Waxmann.

Pallant, J. (2010). *SPSS survival manual: A step by step guide to data analysis using SPSS.* Maidenhead, UK: Open University Press.

Patry, J.-L. (2001). Die Qualitätsdiskussion im konstruktivistischen Unterricht. In H. Schwetz, A. Reiter, & M. Zeyringer (Eds.), *Konstruktives Lernen mit neuen Medien* (pp. 73–94). Innsbruck, Austria: Studienverlag.

Pauli, C. & Reusser, K. (2000). Zur Rolle der Lehrperson beim kooperativen Lernen. *Schweizerische Zeitschrift für Bildungswissenschaften, 22*(3), 421-442.

QuestBack (2013). *Enterprise Feedback Suite.* Retrieved from http://www.apsdigital.ch/wp-content/uploads/2013/07/EFSSurvey91Manual_GER.pdf

QuestBack (2015). *Unipark*. Retrieved from http://www.unipark.com/en

Reeve, J. (2004). Self-determination theory applied to educational settings. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-Determination Research* (pp. 183–203). Rochester, NY: University of Rochester Press.

Reich, K. (2008). *Konstruktivistische Didaktik: Lehr- und Studienbuch mit Methodenpool.* Weinheim, Germany: Beltz.

Reich, K. (2010). *Systemisch-konstruktivistische Pädagogik: Einführung in die Grundlagen einer interaktionistisch-konstruktivistischen Pädagogik.* Weinheim, Germany: Beltz.

Reitinger, J. (2013a). *Forschendes Lernen: Theorie, Evaluation und Praxis in naturwissenschaftlichen Lernarrangements.* Immenhausen bei Kassel, Germany: Prolog.

Reitinger, J. (2013b). Forschendes Lernen und Reflexion. In A. Weinberger (Ed.), *Reflexion im pädagogischen Kontext* (pp. 9–36). Wien, Austria: LIT.

Reitinger, J. (2015). Self-determination, unpredictability, and transparency: About the nature and empirical accessibility of inquiry learning. *Schulpädagogik heute, 6*(2), 1–15. Retrieved from http://www.schulpaedagogik-heute.de/SHHeft12/02_Forschung/02_03.pdf

Reitinger, J. (2016). Selbstbestimmung, Unvorhersagbarkeit und Transparenz: Über die empirische Zugänglichkeit forschenden Lernens anhand des Criteria of Inquiry Learning Inventory (CILI). In S. Schude & K. Moegling (Eds.), *Transparenz im Unterricht und in der Schule* (pp. 42–69). Immenhausen bei Kassel, Germany: Prolog.

Reitinger, J., Haberfellner, C., & Keplinger, G. (2015). Theory of inquiry learning arrangements (TILA): Introducing a theoretical framework for self-determined inquiry learning applicable to institutionalized educational settings. *R&E-Source. Open Online Journal for Research and Education, 4*(2), 78–90.

Roth, G. (2009). Die Bedeutung von Motivation und Emotionen für den Lernerfolg. In R. Messner (Ed.), *Schule forscht: Ansätze und Methoden zum forschenden Lernen* (pp. 57–74). Hamburg, Germany: Köberstiftung.

Ruf, U., & Goetz, N. B. (2005). Dialogischer Unterricht als pädagogisches Versuchshandeln: Instruktion und Konstruktion in einem komplexen didaktischen Arrangement. In R. Voß (Ed.), *Unterricht aus konstruktivistischer Sicht: Die Welten in den Köpfen der Kinder* (pp. 73–92). Weinheim, Germany: Beltz.

Ryan, R. M., & Deci E. L. (2004). An overview of self-determination theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-Determination Research* (pp. 3–36). Rochester, NY: The University of Rochester Press.

Schermelleh-Engel, K., & Werner, D.-P. C. (2012). Methoden der Reliabilitätsbestimmung. In U.-P. D. H. Moosbrugger & D.-P. A. Kelava (Eds.), *Testtheorie und Fragebogenkonstruktion* (pp. 119–142). Berlin, Germany: Springer.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action.* New York, NY: Basic Books.

Schreiber, J. B., Stage, F. K., King, J., Nora, A. & Barlow, E. A. (2006). Reporting structural equation modeling and confirmatory factor analysis results. *The Journal of Educational Research, 6*, 323-337.

Seyfried, C. (2002). Unterricht als Moderation von Anliegen. *Atelier Schule, 17*, 19–23.

Steiger, J. H. (2007) Understanding the limitations of global fit assessment in structural equation modeling. *Personality and Individual Differences, 42*(5), 893–898.

Watkins, M. W. (2000). *Monte Carlo PCA for parallel analysis: Computer software.* State College, PA: Ed & Psych Associates.