



Exploring conative constructs and self-regulation of e-learners: A mixed methods approach

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This study explores end-users' e-learning experiences from several perspectives in order to learn about the how and why of their e-learning process with particular focus on their conative constructs and self-regulation. Research questions are targeting how novice e-learners manage their learning in a computer-based learning space.

The study was conducted at a media laboratory for content testing. Mixed methods were used to collect data and triangulated in the analyses. Methods used were questionnaires, eye tracking, screen recordings, observation, and a stimulated instant recall (SIR) interview. The SIR-interview ties the methods together by targeting in-depth qualities of users' subjective experiences.

Different phases of analyses are described in the paper emphasizing how methods can be triangulated in order to create an authentic picture of e-learning experiences. The study is still work in progress intending to explore how theories of motivation and self-regulation are applicable to e-learning contexts, and how this can be used in further studies on how to evaluate e-learning environments.

Keywords: Mixed methods, triangulation, e-learning process, conation, self-regulation, motivaton

Introduction

What are the methodological alternatives for investigating a person's learning process in self-paced e-learning? This paper discusses a mixed methods approach used in an empirical study targeting e-learning experiences of corporate learners. The point of departure from a methodological perspective was to try to approach the field of study in an open-minded manner with the ambition of overriding epistemological paradigms by bringing in several perspectives by triangulation of methods (e.g., Turner, 2001; Volet, 2001).

The empirical study looks at how novice e-learners manage a self-paced e-learning course, exploring the how and why of their e-learning process. One assumption guiding the study is that how and why we take actions in order to learn reveals our learning process, and that the learning process equals our learning outcome; what we learn (Marton & Säljö, 1986).

How we make choices for our actions when we aim to learn something is studied as the field of conation. Conation involves goal-orientation, intrinsic motivation, volition, will, self-regulation, and self-direction. It is defined as the mental process directing and activating our actions (Huitt, 1999; Huitt & Cain, 2005). In a self-paced e-learning environment the conative process is reciprocally dependent on the environment (Zimmerman, 1989; 2005). Let us look at a short example.

A male person in his 30s is sitting at a desk, staring into the screen of a laptop computer in front of him. The atmosphere is relaxed and quiet, except for a monotonous voice coming from the laptop

speakers. The only noticeable movements visible to the eye of an observer are the person's right hand while moving the mouse and the screen changing as the person sporadically clicks on some objects on the screen. After a while, not even these movements are noticeable anymore. The person sitting at the desk has fallen asleep.

This is the scenario that unfolded during a pilot testing of a mass-produced e-learning course in a media laboratory for content testing. It is an example of how digitalized material, framed as e-learning, can work against its own purpose – that is learning. One assumption guiding this study is that the design of e-learning materials needs to be anchored in human needs for learning, and that the experience within the learning context makes a difference for the outcome of learning. Research questions are targeting how e-learners manage their learning in a self-paced e-learning course. In order to manage your learning a number of areas of self-regulation is involved: cognition, motivation/affect, behaviour, and context (Bandura, 1986, Pintrich, 2000).

The targets of the study can be derived from Zimmerman's (2005) theory of sub processes of self-regulation for learning. These processes regulate our learning on an intra-individual level. The sub processes are cyclical by nature and consequently one experience influence how we perceive the next one (ibid, 2005, p. 15-18). Table 1 presents these sub processes of self-regulation in relation to metaphoric questions and targeted determinants of the learning process as well as external facilitators of the e-learning environment. That is, the targets are two-fold in looking at both internal determinants and external facilitators, and how these work together in creating the learning experience. The table is of course a simplification of a dynamic process, and in real life the frames of the boxes are not as distinct as they appear in the table.

The first sub process of self-regulation is the learner's forethought related to the learning situation, i.e. "influential processes that precedes efforts to act and set the stage for it". The second sub process, performance/volitional control, concerns the processes during motoric effort, i.e. the experience within the situation, which then affect both action and attention. The third sub process is self-reflection, which comes after the experience and performance efforts. It influences how the learner responds to the experience (ibid, 2005, p. 15-18). Zimmerman further divides self-regulation into overt and covert dimension where the overt pertains to an external regulation towards the environment, and the covert works on an internal level. The environment is seen as an influential factor affecting how we self-regulate.

Table 1: Research targets and metaphoric questions

Sub processes of Self-Regulation	Metaphoric Questions	Targeted Internal Determinants of the Learning Process	Targeted External Facilitators for Learning
Forethought:	<i>Where am I going and Why?</i>	Goal-Directedness, Intention, Motivation, Expectation	Course Objectives, Guidance, Interface Look and Feel
Performance, Volitional Control:	<i>How do I get there?</i>	Strategy Development, User Experience	Tools, Resources, Instructions
Self-Reflection:	<i>Where have I arrived, and how do I see myself in this place?</i>	Reflection, Cognitive Reasoning, Meaning Making	Feedback, Contextual Real Life Connection

Research questions

The learning process, i.e. the whole scenario of learning resulting in some sort of learning outcome, includes learning activities, and strategies that are undertaken in order to manage the learning environment. How and why does the experience of e-learning vary and what does this reveal about the learning process within the context of e-learning? This question aims to explore variations of how self-paced e-learners manage the e-learning environment in order to learn, how they describe their learning experience related to what they do and why. This involves experiences of learning on all levels: physical, cognitive, emotional, as well as contextual/social (Pintrich, 2000).

Methodology

From a contextual perspective on learning, a learner's cognition, motivation and emotion are integrated and dynamic aspects of the learning process. For instance, socio-cultural, situated cognition and socio-cognitive theories have recognized that social values and the context of learning impact motivation of individual learners. These perspectives explore how learning activities support or limit learners' engagement, but also how learners' subjective situational assessments mediate their learning motivation (Järvelä, 2001, p. 4-5). The ontological perspective of this study derives from the belief that learning is contextually bound, and that the learning environment (affordances and constraints, as well as its instructional design) will influence the learning process and strategic behaviour of the learner (Bandura, 1986; Zimmerman, 1989; 2005).

Marton and Booth (1997, p. 16) write: "We have to ask learners what their experiences are like, watch what they do, observe what they learn and what makes them learn, analyse what learning is for them." Therefore, it becomes essential to investigate the end-user's total experience of the learning situation in order to know which factors influence the learning process. This approach represents one of two paradigms related to the investigation of learning (Entwistle, 1986/2000). The two paradigms can be defined by the difference in their philosophically based epistemology. The first paradigm uses methods to collect quantitative data, and has a reductionist perspective focusing on predictions. The second paradigm represents an approach with roots in phenomenology focusing on the experiences of the learners, using an emphatic understanding of the meaning making of the learner.

In this study, motivation is seen as an essential aspect of the learning process as it influences both emotional and cognitive dimensions of learning and will be explored as how it influences learners' proactive behaviour pertaining to intentions and actions for learning. Järvelä (2001) argues that there is still a lack of a coherent theoretical foundation for the construction of motivation in learning contexts, and that traditional motivational theory does not properly attend to issues of situated motivation. A great extent of prior research on motivation has been conducted using deductive and quantitative methods (e.g., Pintrich & Ruohotie, 2000). However, these methods are limited in exploring the how and why of learning. More varied methods are needed for conceptualizing motivation in context, as well as for framing the dynamics of learning processes more broadly. This is what Entwistle, (1986/2000) described as the paradigm difference of studies on learning. The paradigm shift in viewing the importance of context has led to researchers applying a range of multilevel approaches and methods for investigating subjective and dynamic processes related to the context of learning (Järvelä, 2001, p. 7; Turner, 2001). A few studies on self-regulated e-learning strategies have combined quantitative and qualitative data in analyses (DiPaolo, 2001; Susimetsä, 2006). These studies are in similar ways applying methodological triangulation for exploring subjective and dynamic processes of learning pertaining to the how and why questions.

One key factor impacting the design of the empirical study was the inception of iDTV Lab (2003) at MediaCity, an independent unit within Åbo Akademi University in Vasa. The lab is equipped for audience and content testing, and particularly used for evaluative studies during iterative product design processes. For this study, mixed methods were used in order to see how different methods allowed for a varied exploration within the context of study. The study in itself was an exploration of the methods, as well as of the research subject. This approach can be compared to Feyereabend's epistemological thesis that research paradigms need not be limited to a specific method, but rather explored with an open-minded attitude regarding research design (Molander, 2003). Methodology can be defined as the principles and epistemologically based thinking about how to conduct research within a specific field of study (Bjereld et al., 2009; Creswell, 1998). Hodkinson and Macleod (2007) argue that specific research methodologies usually have strong affinities with different conceptualisations of learning. They claim that "No methodology can act as a conceptually neutral lens, transparently revealing what learning is." Hence, a methodological triangulation can be beneficial in exploring the e-learning process, and a research design including a mixed methods approach such as in the present study should be more likely to expose paradoxes and contradictions (Turner, 2001, p. 91).

There are different forms of triangulation, of which two are present in this study; methodological triangulation and data triangulation. Methodological triangulation is when multiple methods are

used to collect data, while data triangulation is about cross-validating sources of data against each other during analyses. Triangulation might be used as verification against error in the research process, as multiple methods provide stronger evidence for a conclusion through convergence and corroboration of findings. The approach of mixing methods is hence seen as decreasing potential weaknesses of any single method (Turner, 2001, p. 91, Brannen, 2005; Johnson & Onwuegbuzie, 2004) or is a way to avoid a biased perspective due to methodological distortion (Hodkinson & Macleod, 2007). However, regarding studies on learning, Hodkinson and Macleod point out that a mixed method approach does not fully solve the problem of a biased methodological perspective, as it derives from a philosophical dilemma, not empirical. The methodology might have a tendency to skew data towards a specific conception of learning, but this need not be deterministic. They advice researchers using mixed methods to be aware of the conceptual and theoretical process this research approach will lead to.

The most common techniques of triangulation in collecting formative data for instructional development are observations, interviews, and documents (Reigeluth & Frick, 1999). According to Repstad (1993) there are several benefits gained in research from combining qualitative and quantitative methods. Qualitative interviews can be used, for instance, for improving questionnaire items. Or the other way around, a quick survey might give the researcher ideas on how to better focus interviews to target subtle matters. Both of these perspectives are present in this study. But perhaps one of the most obvious benefits is that the researcher builds a more complex picture of the topic, and is thus more capable of drawing conclusions in the analyses.

The figure below displays the multiple methods used in this study for collecting a variation of data, which can be classified as objective formative, subjective formative, objective summative and subjective summative data. The methods used were video recording, screen recording and eye tracking, interviews, two questionnaires, and psychophysiological measuring (the latter was not used for analyses as it did not contribute in answering the research questions). As can be seen in the figure, the formative data is targeting the how and why question, and are thus the most significant data for looking at the how and why of the learning process. Triangulation was used already during the data collection process, as instant recall in the interview was stimulated by screen recordings, eye tracking and questionnaire items. Therefore, the summative subjective data played a role in the collection of formative data. Although not all data collected for this study are used for reporting actual results, it still served a significant purpose as background material to gain an intuitive understanding of the phenomenon (e.g., the psychophysiological data).

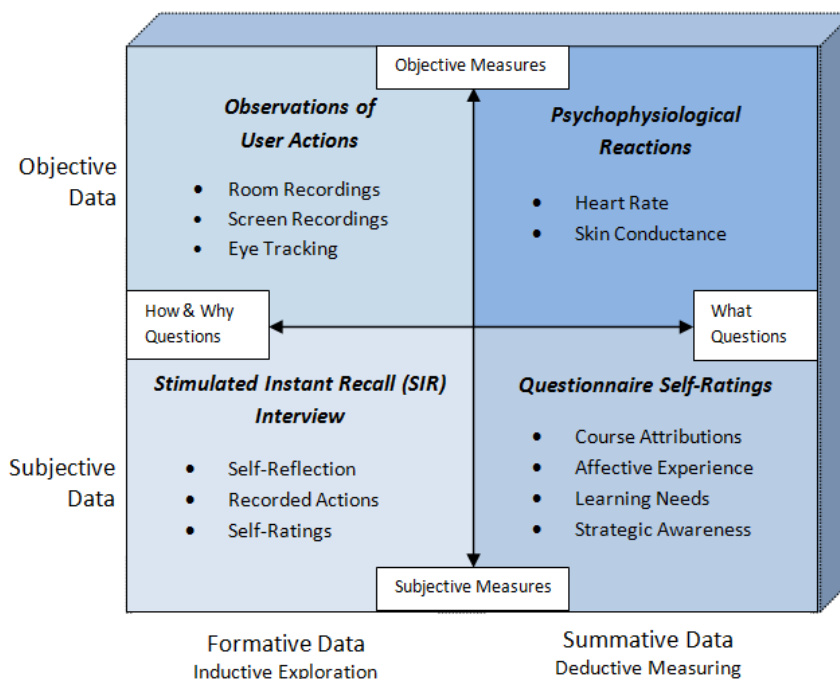


Figure 1: Methodological triangulation for exploring e-learning experiences.

Case description

One corporate e-learning course under development was selected for the study. The learners (N=17) were engineers in a multi-national corporation who were novices to e-learning. The fact that the process of creating the interface and instructional design of the course was in its infancy, provided an opportunity to compare a course at two phases of development where the second version was altered based on end-user input. This procedure gave two groups of participants, which were presented with the same course content, but with a slightly different instructional design.

The self-paced e-learning course was short enough to be used in a laboratory testing. The range of time used for study varied between 30 and 120 minutes. The course consisted of six modules (chapters), including 24 main screens in total, plus some additional linked documents. Every module included a practice option with multiple choice questions. The screens mostly consisted of more or less static images, static text, and a few hyperlinks. There was also a final test, which was based on the same multiple choice questions of the practice sequences. To pass you had to receive a score above 75 %.

One difference between the first and second version of the course was how feedback was delivered to the learner during the practice with the multiple choice questions and after the final test. The first version of the course did not provide feedback on mistakes. This left the learners ignorant to where they were lacking in knowledge and where mistakes had been made. Based on the learners' responses to lack of feedback the course design was changed. The second group then received information about the correct alternatives for the multiple choices, as well as a pop-up window at the end of the final test. This pop-up included all the replies and stated which ones were incorrect. Hence participants knew where they had failed and could go back and retake the test immediately. Their old replies remained intact within the 15 minutes time limit set for the Final Test, which gave them the opportunity to make corrections, and thus learn from their mistakes.

Furthermore, an additional number of smaller changes were made to the course in order to improve the usability. For instance, more instructions were added to interactive features, the font style of hyperlinks was streamlined, and a course map was provided.

Principles of analyses

For each participant, an integrated work sheet of data collected was compiled to organise data and create an overview as a foundation for the analyses. This work sheet included: 1) screen shots of all 24 content pages, 2) interview transcripts, 3) interview interpretations through meaning condensation, 4) narrative of course work based on observations of screen recordings, and 5) interpretations of these observed actions in terms of strategies used. All dimensions were lined up for each screen in order to get an overview of the learning profile as a sequence from start to finish. This was the obvious way to organise data, since the interview discussions were stimulated by the video recordings of what each person had done during their course work. The integrated work sheet was a tool for organising and synthesising data, as well as for triangulating data and cross-validating the preliminary findings from the first stages of analyses.

Table 2: Example of integrated work sheet for data triangulation

Sida: 4 kapitel	Reflektioner - Intervju	Strategi & behov	Narrativ av kursgenomgång - Från videobandning	Strategiskt beteende
Intro - ögon	Here we started with the Overview. Can you tell me something about it? Just that I read the text, then I started to look at the pictures and the text beside them. Okej, this was more or less clear, because I knew this beforehand. There was nothing new, basically. Have you seen this thick SOLAS manual? Yes, I have done it for the Finnish engines. So I was more or less familiar with it. So it was more or less repetition. Yes.	Började med texten Han känner igen sig Tycker det är klart Tycker det är något av en repetition	95 Ingen aktivitet syns	
2 Ög: 1 Overview	What about this layout ...? Okay, this phase it was okay. There was no problem. I think it was working well. This was also basic information about SOLAS. It's an overview.	Tycker alltfunkar bra Anser det vara basinformation	76 Tar alla tre länkar	Använder resurs (länk)

Stimulated instant recall interview (subjective formative data)

The interview data were analysed using a hermeneutically influenced process of interpretation, looking for meaning from clues answers the questions how and why. Hermeneutic interpretation is a process of reading between the lines in order to unveil the existential meaning hidden in, for instance, how people describe a specific phenomenon. During the phase of naïve reading, the researcher creates a preliminary understanding of the whole, before stepping into the interpretation of parts and pieces (Nyström, 2007). Thus, familiarization with interview data was done through repeated listening to the interviews, as well as by transcribing them word by word. The transcripts of the stimulated recall interviews were lined up in the integrated work sheet in accordance with each screen. Meaning condensations were made for each statement in order to find the essence of all conversations related to each screen and the participant's interactions with it (Kvale, 1997). Preliminary categories were made based on the condensations as well as on the observational data. The interviews were then imported into the N'Vivo software, and the full statements were categorized in accordance with the preliminary categories. The categories were worked with inductively and recategorized several times using methods of comparison of variation as well as grouping of similar categories and sub categories. The various groups were labelled and organised in primary categories and sub categories. The essence of each category was then described and excerpts of interview statements are used in order to highlight the essence of the category as well as for establishing credibility of the analysis.

Observations of user actions (objective formative data)

Familiarization with observational data was done through repeated viewing of the screen recordings simultaneously with psychophysiological data and eye tracking for each screen. Bookmarks were made for the screens with the eValue8 analysing tool in order to record seconds spent on each screen. The observational recordings were transcribed into short descriptions of user activities related to each screen. Finally interpretations were made based on these descriptions of user activities. Both descriptions and interpretations were lined up in the integrated work sheet organized in accordance with each screen and compared to the interview transcripts and meaning condensations of relevant interview statements.

Questionnaires self-ratings (subjective summative data)

Two questionnaires were used: a pre-course questionnaire - Strategic Flexibility Questionnaire (SFQ) to measure learners' perceived approaches to self-regulatory control (Cantwell & Moore, 1996), and a post-course questionnaire - Reflecting on E-learning Strategies Questionnaire (RESQUE), which is based on two other surveys: Motivation Strategies for Learning Questionnaire (Pintrich, Smith, Garcia & McKeachie, 1991), and Learning And Study Strategies Inventory (Weinstein, Palmer & Schulte, 1987). The SPSS software was used for factor analyses of questionnaire items. Since the sample is too small for drawing any conclusions from quantitative analyses, the questionnaire items of, for instance, learning outcome, motivation, and learning experience will be used for triangulation of data in a mixed methods-based analyses using the QSR N'vivo software (work in progress).

Psychophysiological reactions (objective summative data)

The psychophysiological reactions measured were heart rate and skin conductance. The e-valu8 analysing tool developed for visualizing this kind of data supported the observational data. The data was not used separately for analyzing learner activities, as the interviews were not linked with the reactions as stimuli for the discussion. However, this would be possible using another set up.

Phases of analyses

The iterative analyses of the varieties of data has been guided by the research question of how and why of the e-learning process, and more specifically by looking at learning outcome, physical and cognitive activities as well as affect. The table below presents an overview of the phases.

Table 3: Phases of Analyses

Phase 1: Learning Outcome and Self-Assessment	
Research Question:	How did the groups differ regarding outcome, self-assessment and course assessment?
Data:	Subjective summative data from RESQUE (Reflecting on E-learning Strategies Questionnaire)
Principles of Analyses:	T-tests and deductive reasoning (SPSS-software)
Phase 2: Overt Self-Regulation	
Research Question:	Are there visible differences of web-management between passers/failures, and between groups?
Data:	Objective formative data from screen recordings
Principles of Analyses:	Hermeneutic interpretation and inductive reasoning
Phase 3: Covert Self-Regulation and Choice of Content	
Research Questions:	What kinds of intentions are directing their choice of content? What is the nature of their actions for managing the learning environment?
Data:	Subjective formative data from stimulated instant recall interviews
Principles of Analyses:	Hermeneutic interpretation and inductive reasoning (N'Vivo software)
Phase 4: Cognitive Strategies and Facilitators for Learning	
Research Questions:	How are they using cognitive strategies for learning? What kinds of factors facilitated their learning?
Data:	Subjective formative data from video-stimulated instant recall interviews
Principles of Analyses:	Hermeneutic interpretation and inductive reasoning (N'Vivo software)
Phase 5: Outcome and Experience vs. Conative Output	
Research Question:	How does learning outcome and their experience of e-learning correlate with their conative output?
Data:	Mixed methods (subjective summative data from RESQUE, and subjective formative data from interviews)
Principles of Analyses:	Theorizing and abductive reasoning using mixed methods (N'Vivo software)

The first phase targeting learning outcome was analysed by the use of quantitative data from test results and questionnaire replies in order to see tendencies. The second phase targeting physical activities was analysed by using observational data of screen recordings. Based on the observations of participants' course work a preliminary structure of categories of user activities was made (Wiklund-Engblom 2007). This activity-based typology was used as a hypothesis for how to categorize interview data using the N'Vivo software. As a first attempt to find variations, all original interview statements were coded in N'Vivo according to these typologies.

The next two phases targeting choice of content (Wiklund-Engblom 2009) and cognitive strategies (Wiklund-Engblom 2008) were analysed by the use of interview data. Each selected statement was subjected to the how and why questions in order to find out the intentions (why) behind their choices, as well as their strategies (how) to manage in their course work. This interpretation was attempted in order to find the essence of each statement targeting the research questions. The last and fifth phase will be analysed during the later part of 2010 and is a convergence of questionnaire items derived from theoretical frameworks, and qualitative categories of conation derived from subjective interview data. The purpose is to see the added value of mixed methods, and whether this research approach broadens our perspective on learning within the context of self-paced e-learning. Are new media creating options for new ways of learning?

Methods discussion

This paper discusses the mixed methods approach used in an empirical study for exploring conative constructs and self-regulation in e-learning. It is a description of the methodological underpinnings of the research design, as well as and the phases and principles of analysing the variety of data. However, the purpose of this paper is not to present results of the study, but to discuss the mixed methods approach.

From a methodological perspective different methods are better aimed at answering certain questions (Molander, 2003) and for a long time, research on human learning has been influenced by a positivistic epistemology (Järvelä, 2001; Volet, 2001). New trends in learning research takes influences from anthropology, ethnography and sociology in order to gain a wider perspective of the contextual and socio-cultural influences on learning (Volet, 2001). In the empirical study described in this paper the questions pertained to the how and why of a learner's actions for learning. The subjective formative data, such as the stimulated instant recall interviews, represented the key data for providing descriptive content of the experiences of learning. In addition, observational data and questionnaire data was used in several ways during the iterative analysing process.

The phases of analyses were guided by various logics in relation to data used. Both methodological triangulation and data triangulation was used for establishing credibility of findings, for instance by cross-validating sources of data against each other (Reigeluth & Frick, 1999; Turner, 2001). In true triangulation multiple data sources are used for corroborating the same phenomenon and answering the same research question. Consequently, a stated fact of a case is supported by more than a single source of evidence (Yin, 2003). In the present study, the empirical data has been guiding the iterative process of analyses and more specific research questions have been developed inductively across phases of analyses. Data triangulation has for instance been used as a source for creating hypothesis for how to structure further analyses. Observations of learner activities guided the categorisation of interview data, and survey data of the learners' self-ratings of motivation is used as attributes to be correlated to variations of actions and intentions for learning.

Regarding the choice of methods used to collect data, it can be noted that observations and video-stimulated recall interviews supported each other in the sense that the combination of them gave an extensive overview of a person's learning profile during his coursework. This was done through the combined work sheet of both interview transcripts, and observation transcripts, as well as the researcher's interpretations of both of these. The eye tracking supported the stimulated instant recall interviews as the interviewee could see how his eyes had moved during his course work. The pros of this was that the discussion could be more focused on what he had actually spent his time focusing on within the course and why. Whereas the cons of it were that the moving circles on the screen were quite hypnotic for the interviewee to watch, and it made it more difficult to concentrate on the discussion of his actual course work and thoughts about that. The eye tracking focal point highlights what they have been looking at, but neither why from an intentional perspective, nor why other things where not looked at.

The question remains how psycho-physiological measuring could complement the subjective data regarding affective states of the e-learners. For future research, perhaps one solution would be to have an integrated tool that presents recordings of the screen simultaneously with charts of a person's psychophysiological reactions and eye tracking. This would enable a greater focus on reactions triggered within a course. However, based on this research study, I would suggest combining such objective measuring with a stimulated instant recall interview, as objective data cannot substitute for a person's subjective experience.

Data triangulation in analyses of mixed methods is supported by the N'Vivo software (DiGregorio, 2008). Questionnaire data can be imported as attributes, and thus, correlated to categories of qualitative data. One aim of this study is to create a model for how to evaluate e-learning environments for their potential for facilitating learning and creating a positive user experience. The fifth phase of analyses (work in progress) will serve as a base for corroborating traditional theories of self-regulated learning by testing it against the new categories derived from the qualitative data. This will be an iterative process of looking at correlations with a strong focus on alternating between details and the whole, as is an important process in hermeneutic analyses (Nyström, 2007). A research instrument targeting user experience and self-regulated e-learning will be developed based on these results, which will be a tool for evaluating end-users' e-learning experience in relation to both self-regulation and learning outcome. Therefore, the present research study is partly a process of expanding learning theory for the context of self-paced e-learning.

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