

The Strategic E-Learner: Variations of Cognitive Strategies and Learning Needs

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When we are creating instructional design for e-learning environments we need a holistic understanding of learner needs. The process of learning determines our learning outcome. According to social-cognitive theory the environment, the personal factors of the learner and his/her behaviour are the three major determinants affecting the learning process. Bandura (1986) called this relationship for a triadic reciprocal causation. The learning environment is the mediative factor, and the learner needs both cognitive, affective, and behavioural self-regulation techniques in order to adapt to new ways of learning. In e-learning, the way we manage the environment visualises the process of our learning. Thus, how we are able to integrate new knowledge from e-learning, has a lot to do with the strategic behaviour we develop for managing the learning space. This analysis is looking at the relation between instructional design of an e-learning course and variations of how test persons are discussing cognitive strategies and needs during video-stimulated recall interviews.

Keywords: cognitive strategies, learning needs, instructional design, workplace e-learning

INTRODUCTION

The purpose of my research, presented in this paper, is to find variations in how novice e-learners develop cognitive strategies for learning in a self-paced e-learning course in a large, international corporation. It is assumed that how learners discuss their cognitive strategies will also illuminate both internal and external factors that facilitate the learning process. This analysis is one step in a series of analyses of data from the same test population. From observations of learners' physical behaviour in their course work two web-management levels emerged: navigating and manipulating. These categories refer to their level of self-direction in their learning (Wiklund-Engblom, 2007). Thereafter, interview data were analysed to find variations of how learners chose content and actions in their course work. Here 15 approaches and 10 strategies were found (Wiklund-Engblom, 2008)

When asking learners directly what kind of strategies they were using in taking the self-paced e-learning course, they usually referred to having no specific strategy. How we learn is often an intuitive and subconscious process (Richardson, 2000). However, while listening to how test persons discussed their own learning within their course work, several variations of cognitive strategies, as well as facilitators for learning could be detected. An inductive and phenomenographical approach was used for analysing interview data.

THEORETICAL BACKGROUND

Weinstein, Husman & Dierking (2005, p. 741) describe learning strategies as "tools used in the service of goals". This means that a learner's goal- and motivational orientation determines how and if learning strategies are used. Tessmer and Jonassen (1988) say that "learning strategies represent a learner-controlled method for processing and recalling of knowledge from instruction and instructional materials". While Weinstein et al. (2005, p. 733) define learning strategies as "... any thoughts, behaviors, beliefs, or emotions that facilitate the acquisition, understanding, or later transfer of new knowledge and skills." Shortly, we could describe a strategic learner as one who knows what measures need to be taken in order to learn something in a specific situation and environment. Weinstein (1994) emphasizes on our ability to be in charge of our skill, will and self-regulation. Learning is more than cognition. It is an internal process of affective, cognitive, and behavioural factors where the end result is dependent on our ability for self-regulation (Weinstein, et al., 2005).

The factors are constantly changing within a learning situation. The self-regulatory process is adjusted based on continuous feedback and experiences of the self in the environment. The learner needs to continuously monitor progress through three self-oriented feedback loops; 1) behavioural self-regulation (strategically adjusting study tactics based on self-observation), 2) environmental self-regulation (adjustment of environmental factors or

outcome), and 3) covert self-regulation (adjusting and monitoring cognitive and affective states) (Zimmerman, 2005). According to social cognitive theory for learning, there is a triadic reciprocal causation between the environment, the learner, and his/her self-regulation of behaviour (Bandura, 1986). In self-paced e-learning this reciprocal relationship becomes obvious in concrete ways, because of the absence of a teacher/trainer. This fact makes the environment itself the sole external mediative factor for facilitating learning.

Several researchers divide self-regulated learning into two categories: motivation and learning strategies (Pintrich, Smith, Garcia & McKeachie, 1991; Ruohotie, 2002). Similarly, Tessmer & Jonassen (1988) divide learning strategies into two categories based on how they function to control the learning process: primary strategies and support strategies. Primary strategies work directly with the information to be learned and has to do with our cognition. Support strategies are all aimed at improving general cognitive functioning, and has to do with our self-regulation for learning.

Based on these references I conclude that for the development of cognitive strategies for e-learning we need affective and cognitive self-regulation, as well as environmental mediation. The sum of your cognitive and affective you and your interaction with the environment is the input to your self-regulatory system, while the actions you choose to take (based on that sum), is the output. The output results in your new position, which is what you base your next choices of strategies on for continued learning. Therefore, your self-regulatory abilities determine the direction you take in learning, and thus, self-regulation precedes self-direction. I call the processes of self-regulation for "the introspective input" (cognitive and affective aspects of a learning strategy), and the processes of self-direction for "the behavioural output" (physical activity aspects of a learning strategy). This is a pragmatic approach for distinguishing the conceptual difference between these phenomena as aspects of the learning process.

RESEARCH QUESTIONS

Research questions guiding this analysis of my interview data have been two-folded: it concerns learners' cognitive strategies, and how these strategies are facilitated. The questions are: What kinds of variations of cognitive strategies can be detected from how e-learners discuss their course work? (How they are taking cognitive actions for learning?) What kinds of factors facilitate their cognitive understanding and strategy development?

METHODS

At two test periods (2003 and 2004) two groups (N=10; 7) of male e-learners, novice to e-learning, were individually tested in a media laboratory (iDTV lab at Åbo Akademi University, Vasa, Finland) while taking an e-learning course related to their workplace. The course subjected to study was under development during the test period. It was improved with regard to learner feedback for the second test group. Hence the groups were confronted with slightly different course version. A mixed methods approach was used to collect data (observations, video recordings, screen recordings, surveys, interviews, psychophysiological measuring, and eye-tracking). Analyses and results reported in this paper are based on data from video-stimulated recall interviews, in which screen recordings served as a stimulus for discussing a test-persons course work. The interviews were recorded and transcribed by the researcher.

While analyses of data from observations gave an idea of how the test population managed the environment as such, and their needs on a more technical level, it revealed nothing about the learners' cognitive strategies (Wiklund-Engblom, 2007). On the contrary, interpreting their affective and cognitive standards based on observations proved to be misleading in many ways. This could be noted from making an integrated worksheet of data collected per person, in which the interviews, interview interpretations, narrative of course work based on observations, and observation interpretations were all lined up for each screen in order to get an overview of a person's total learning profile. Therefore, it was evident that the interviews were critical for investigating their cognitive strategies and internal and external facilitators in their learning process.

An inductive and phenomenographical approach was used to analyse variations of qualities of the 17 interviews. Phenomenography, as a research approach, is based on variation theory and used for analysing qualities of a phenomenon. It provides a second-order perspective on peoples' conceptions of a phenomenon, opposed to a phenomenological perspective, which is looking at the essence of the phenomenon from a first-order perspective (Marton, Hounsell, & Entwistle, 1986).

All 17 interviews were treated equally, regardless of group belonging, since the aim was not to find differences between the two groups, but to find variations of learners' cognitive strategies for learning. The interviews were coded in N'Vivo, which is a well-suited computer program for approaching qualitative data inductively. It allows

you to play around with data and build categories that are either hierarchically or horizontally related, and also to endlessly manipulate structures of categories until you feel that the data is saturated.

RESULTS

A learning strategy is an action taken in order to learning something. In my analyses, I have focused on the cognitive actions that are directed towards learning the content. In the following, I will present three categories of factors dealing with cognition for learning. The first category is represented by the actual cognitive strategies that describe their cognitive actions directed towards the content; the behavioural output in our learning process. The second category is represented by an individual's internal facilitators for learning; personal supportive factors for learning, such as prior knowledge of the content and the ability for behavioural, cognitive, and affective self-regulation. This is our introspective input in the learning process. The third category is represented by external facilitators, which involves the physical surroundings, as well as the actual course environment and content. These are the factors that aid us in our learning and development of cognitive strategies.

COGNITIVE STRATEGIES

The cognitive strategies presented here, are based on how e-learners discussed their cognition in relation to learning the content during their course work. Ten categories of strategies were found: cognitive preparation, persistent focus, content patching, speculative associating, targeted associating, self-testing, critical thinking, cognitive reliance on visual illustration, cognitive reliance on text, and comprehension through variation.

a) Cognitive Preparation

Cognitive preparation involves cognitive actions that the learner takes to somehow prepare for the content and for mending his mind in order to be able to increase learning. This has to do with our metacognitive ability and regulation (see Internal Facilitators below). Two such examples are, to reflecting on how to think about the subject beforehand, or to prepare to formulating questions in order to better understand. The following excerpt illustrates both of these examples: *"It's good to have some guidance in your mind, what you think in advance what would be the content of the whole course, then you know it in your mind when you go through the whole text, and ... so you know what should be your attitude of this, what they would like you to learn, and if you need to raise some questions in your mind to yourself, to make it easier to understand [04-3]."*

Another cognitive preparation strategy is to start out by scanning a page in order to get a first impression of content before reading more carefully. One person explained his reading strategy like this: *"I'm reading it through fast at first, and then I'm looking at the images, and then I'm reading it another time in order to get a relation. [04-03]"* This excerpt also illustrates what I call a content patching strategy (see below).

b) Persistent Focus

This strategy is about the learner's effort regulation, i. e. his persistence in focusing on the content until he feels that he understands it to a satisfactory level. Examples of this strategy are: repetition of practice features in order to understand, repetition of text until understanding is reached, and focus on image until understanding is reached. It involves repetition and persistent focus on content. The following three excerpts illustrate persistent focus on text: *"I didn't understand this ... I had to repeat the text a few times in order to really understand it. [04-03]"* *"You can see that I have really read every single word, and tried to see what it is all about. [12-04]"* *"I had to read about ten times in order to understand it. [10-03]"* The next excerpt shows how a person kept persistent focus on a picture until he understood it: *"I had to keep looking [at the picture] in order to know what I was looking at. [14-04]"* The next excerpt is rather expressing a cognitive need instead of a strategy. However, it shows that his cognitive strategy would have been to repeat practice features until he felt he had learned the material. *"I need some more exercises if I should do some learning like this. [09-03]"* This person was aware of his cognitive needs for learning, although he did not get to express them fully due to limits of the course environment.

c) Content Patching

Content patching strategy involves actions taken by the learner in order to build on his own knowledge from different sources or forms of presentation. He might be looking for additional information outside the actual course environment, or he might be using different resources within the course environment. His aim is either to look for added information, or to confirm pieces of information for the purpose of adding to his own patchwork of knowledge. The following person is discussing his expectations for options of links to additional information, so that he could learn as much as he felt he needed: *"... if this would have been something that I really would have to learn, on a detailed level, then I would have expected to get a list of links or whatever, that I would be able to learn some more. [04-03]"* Another person said: *"./I was trying to find some more information for this page. But I could not. Cause I'm not familiar with this. [09-03]"*

Another example of a content patching strategy is to search for a relation between text and image in order to build understanding: *"I'm reading it through fast at first, and then I'm looking at the images, and then I'm reading it another time in order to get a relation. [04-03]"* After the first scan of text, he is looking at the images. He is patching together pieces of information (text and images), then he is repeating the text again to really understand the relation between the different pieces of content. He is focused on collecting all pieces of information in order to understand.

d) *Speculative Associating*

In order to understand the content, the e-learner is discussing the material and speculating about the information in an associative way. He is trying to see how the pieces of information fit together and make sense of the material. *"I had some difficulties on this page. What do they really mean? This is ok for all, according to paragraph 11... all engine types on XX. I guess... but the red markings indicates compatibility and the black markings indicates half compatibility. Or how should you interpret this? [01-03]"* He was elaborating on the information without having enough prior knowledge to relate it to; he is speculating about the content. Another test person said: *"I don't know... maybe it's mechanical ... but I don't understand what it means this free assembly. Ok, free assembly probably means that it's flexible, that you can freely put it in the way that it fits, but ... probably... [09-03]"*

e) *Targeted Associating*

The learner is relating the information to his own prior experiences of similar matters. The following statement is an example of this: *".../ when the pipe becomes longer it affects this [he explains details]/... I learned something new there. .../ This was new. I have never thought about that before. On our engines this is the same length. [14-04]"* He is comparing the information to his experience of similar engines. Another relation made was how the content fits into their own work duties, and relating to reality; how it works in real life.

f) *Self-Testing*

The learner uses resources to test his level of knowledge. *"[Did you always take the practice questions?] Yeah. .../ their good because then you know what you've learned. It doesn't matter if the answer is wrong or right. If you get it correct or not. But you know. [17-04]"* This person stated that he felt that the practice questions helped him check whether he had understood the content or not, and for that reason he took all the practice questions available. He was using the practice questions to confirm his understanding.

g) *Critical Thinking*

The learner is in one way or the other questioning the information. For instance, *"...if they say it's not relevant, why then do they include it here? .../ In my job we do it like this [he explains], .../ and that makes this much longer than this one here. [01-03]"* This excerpt also includes a targeted associating strategy, when he compares the information to his own work experience, and builds his criticism on this prior knowledge.

h) *Cognitive Reliance on Visual Illustration*

A visual illustration aids cognition in many ways. It can help a learner understand text better, aid in recalling facts, or as one learner said: *"Images are good as usual. I have a visual memory .../ I remember a little bit from the text and a little bit from the image, and then you get a better holistic picture of it. [16-04]"* This person memorised and learned with the help of visual image. The excerpt also shows a content patching strategy, as he mentioned how he piece together information from different sources in order to get a fuller understanding. Comprehension with the help of visual image was also discussed during interviews. One person commented: *"It kind of proves the text. So I can believe it better, when I have seen the picture as well. [08-03]"* In his opinion, the visual illustration confirmed the reliability of the content. In that sense, it helped him to better understand the content.

i) *Cognitive Reliance on Text*

You rely your comprehension on focusing on the written text. This strategy, as well as the previous strategy, is similar to having a preference for learning, which is usually called a learning style. In this case, while asking the material the question *how* they are taking cognitive actions for learning, cognitive reliance on text is a cognitive strategy for understanding the material. The following excerpt illustrates this: *"I don't waste time to try to memorise images. I can't. I have learned to learn from text. If you understand the text content, then you understand. [12-04]"* I see this as an example of McKeachie's (1995) suggestion that learning styles can become learning strategies.

j) *Comprehension Through Variation*

Many of the learners commented on how emphasis on variation made the content easier to understand. Seeing differences and variations, alternative ways of doing things, illustrations of a right way and a wrong way of putting something together, etc. increased their understanding. Also having variations in illustrating the same thing (photo plus diagram) helped the following learner understand: *"These photographs over there..., so you can see how it works. I wouldn't have understood, if I hadn't seen the photograph first. [So from the photograph you understood the drawing?] That's what I did. I went back, and it said .../ and then I went back and forth and back and forth, to see, ok, that was the pipe that was being referred to in the diagram. [17-04]"* This is also an example of the content patching strategy, as described earlier. Another person said: *"I didn't understand this first one at all. .../ It's not clear enough to tell what has been before and what was after. I mean, what has changed. [08-03]"* He

requested more emphasis on the differences between solutions, since he felt that this would have been a better way for him to learn.

INTERNAL FACILITATORS FOR COGNITION

I divide internal facilitators for learning into two categories: the first has to do with our prior knowledge of the subject matter and our experiences that relates to this. The second has to do with our abilities for self-regulation. Self-regulation works on many levels. Variations of self-regulative abilities found in the interview data included self-regulation of attitudes, effort and persistence, motivation and interest, goal-directedness, metacognition, and concentration.

1) *Prior Knowledge and Experiences*

The e-learner's cognitive thinking strategies are supported by prior knowledge of the content matter, familiarity with terminology, and/or similar real life experiences.

2) *Self-Regulation*

Self-regulation deals with our inner world. It is about how we constantly modify and regulate our thoughts and behaviour based on our introspective input. Many factors work together in this mill of self-regulation. Six variations of self-regulation were found in the data. These are: goal-directedness, metacognition, attitudes, interest and motivation, effort and persistence, and concentration.

a) *Goal-Directedness*

To be goal-directed in learning is to know why and what we want to learn. The learner can be goal-directed because he needs to learn the content for his own work. One person stated clearly "*One should learn the main principles of the subject matter. The details should be put in ././ a table to be checked when you need it. [15-04]*" He saw no point in memorising detailed information related to the subject matter of the course. In his opinion learning should focus on principles, not on memorising detailed information. He chose to learn that which had relevance to his own job. Hence, he was goal-directed in choosing what to learn within the course. In other words, he regulated his learning to target his own work demands.

Another form of goal-directedness is to aim at learning or memorising content according to demands for passing the course. The learner figures out what it takes to pass the course, and then approaches content according to these demands, whether he feels that he learns something relevant or not. "*I learned from the corrections [feedback on practice questions] ././ it was no learning. It was only temporary [memorising] for taking the test. [15-04]*" This person learned about the demands of the final test, and memorised the practice questions in order to pass, although he was aware of not actually learning the content as such.

b) *Metacognition*

This involves the learner's ability to think about his own thinking. For instance, to create preconceptions of content before starting, or to raise questions to himself in order to understand better. Regulation of metacognition is our ability to elaborate on our own understanding of something in order to increase our learning.

c) *Attitudes*

Regulation of attitudes works on an emotional level. The learner regulates how he feels about the content. The ability to regulate attitudes towards content is an integrative part of motivating ourselves for learning something.

d) *Interest and Motivation*

Having interest in something and motivation to learn, is an inner feeling of positive attitude towards the object for learning. The learner's interest in the content and the motivation level for taking a course help him regulate effort, affection, and cognition for learning. Because the target group consisted of corporate learners, the approach to learning the content was pragmatic (Wiklund-Engblom, 2007). It was obvious how their motivation differed depending on how closely the content related to their own work situation. One person said: "*This felt like reading a brochure ././ I would like the content to be about something that you have to do at work – something you have to learn. [02-03]*"

e) *Effort and Persistence*

Effort and persistence has to do with our ability to keep going until we reach our goal. This dealt with the effort learners put into their course work. A few learners put in a lot of effort and struggled to pass the final test. They used extensive manipulating of the course environment in order to do so. Whereas others took a more convenient route through the material without caring too much about neither the test result, nor about learning the content. Regulation of effort and persistence is closely related to regulation of motivation.

f) *Concentration*

Concentration deals with a person's ability to focus on the content. Therefore it has a physical aspect to it. Most of the test persons commented on the quiet surroundings in the test laboratory, and how this helped them

concentrate. It was obvious that their own work place did not provide similar circumstances for learning. Concentration was also discussed in relation to a persons motivation for taking the course.

EXTERNAL FACILITATORS FOR COGNITION

The external facilitators presented in the following, are factors that e-learners have discussed in the interviews in relation to what has facilitated their cognitive understanding and cognitive strategy development in their course work. External facilitators work on many levels. They help us understand the content, and relate it to real life. But they also support our internal facilitators in a reciprocal way (e.g., Bandura, 1986). The presentation of facilitators below is given the perspective: what learners need from external factors in order to facilitate cognition.

a) *Environmental Level*

Several persons explained how a similar course would be difficult to complete at their own work place due to noise and interruptions of other work duties. The need for quiet surroundings without disturbances is essential in order to be able to concentrate.

b) *Layout Level*

It is no surprise that the layout of the environment needs to be clear on all levels: clear presentation of content, clear headings, clear visual illustrations (images, photos, illustrations, drawings, etc.), large enough font size, and also a logical combination of text and visual illustrations. One person said: *"In the beginning I didn't understand what the pipe was. In that respect, I should say that there should be more information on the drawing. The text was so small, and you couldn't see all the text. [03-03]"* He expressed several concerns about the layout of the e-learning environment.

c) *Semantic Level*

Test persons expressed the need for clear and logical terminology and an easily comprehensible language. Some learners became confused by use of abbreviations, or terminology. The course language was written as a *"typical engineer-kind-of-text"* as one test person explained, and this caused some problems for a number of people. The learner will need to put up more cognitive effort if he is not familiar with this kind of terminology. There is a risk that he might start to focus too much on the sign (text) instead of the signified in the content, which is defined as surface learning (e.g., Marton *et al.*, 1986).

d) *Instructional Level*

The instructional design is an important frame for knowing how to manage within an e-learning environment. The instructions are informing the learner of his alternatives and ways to learn and manage. A number of aspects surfaced during interviews, which point to a relation between an instructional level of the learning environment and the learner's development of cognitive strategies. Prompt instructions give the learner the confidence of knowing his options at all steps of the way. Logical instructions aid the learner in understanding what he can do in the e-learning environment. Consistent instructions help the learner get a flow in the environment; he knows what to expect, which allows him to concentrate fully on the content instead of on the environment.

e) *Objectives Level*

The objectives give the learner a frame of reference to relate the information to and knowing what he is supposed to learn from the course. They help learners become goal-directed. Clear objectives aids the learner in his metacognitive regulation of his understanding, as they support the learner's ability to form an opinion about the content beforehand.

f) *Content Level*

Clear emphasis on key points will aid learners' comprehension, recollection, and organisation of the content. *"...if this is an important thing, then probably it should be circled, or pointed out somehow. ././ it would be nice to get the main ideas ././ I'm searching for the main idea that could be bolded or underlined. It's easier to remember if you have some kind of main thing ././ then you can build some kind of picture in your head that ... ok the main idea was there and it's logical that this and this and that belongs to that. [08-03]"*

Some learners were confused because of lack of figure texts relating illustrations to the text, or explaining significant details in illustrations. *"I could not understand the meaning of this [illustration]... maybe it [an arrow] is showing some small details, but/./ what this arrow is telling? ././ maybe there is some small detail, but ... [03-03]"* He did not understand the meaning of some arrows in an illustration, since there were no figure text relating it to the content. This exemplifies the importance of clear headings and text explaining illustrations, and also having a strong connection between illustrations and text.

As mentioned above in the description of the Comprehension through variation strategy, cognition is facilitated cognition when variations of details are visualised and emphasised. Variations point to differences within the whole, and how pieces fit together. The following excerpt illustrates the importance of visually differentiating important facts. *"I didn't get the image. All the three parts were visible at the same time. ././ they should have drawn this one first, without the other two parts, and next they should have taken that part and the third time this*

part. Then you would have seen that ... [02-03]" This person wanted to see the variations in the different parts of a system, and is giving suggestions how an animation could have supported his cognition. Another learner [16-04] suggested that it would have helped to have been able to open multiple windows on the screen in order to be able to compare different solutions. I see this as another example of how to learn through variation. The interviews also point to the importance of integrating text and visual illustrations in a logical and obvious way.

g) Application Level

Aspects regarding application of content, which I refer to as the application level, relate to getting a real life experience of something; or as real life as possible in a computer-based environment. Examples given by the test group illustrates needs for showing visually how something works in real life, showing real life illustrations, and exemplifying how to do something in real life. Video material, real life photos, images etc were suggested by the test persons, as well as suggestions for hands on activities, simulations and possibilities for manipulating data to see results. Another application aid suggested was to provide links to additional information for further study.

h) Practice Level

The practice level has to do with the learners own interactivity with the material for learning. This involves options for repeating and practicing in order to learn and check what he has learned so far. This level is somewhat related to the application level, since applying something through simulations also includes the learner being interactive and practicing.

i) Feedback Level

The first test group did not get any other feedback than Correct or Not Correct during the practice questions. This caused a lot of frustration for the learners, since they did not know what they did wrong. *"If there would have been feedback given to you, then the final test would have been much easier at the end.[02-03]"* Another person said: *"I got frustrated, I wanted to know what is the correct answer. ./ it's easier to learn if you know what you did wrong. [08-03]"* Providing feedback on user actions, such as practice options and mistakes made by the user is an important part of learning. This was the most obvious facilitator for learning, which altered the users' behaviour in their course work (Wiklund-Engblom, 2007).

j) Test Level

The final test was made of the same questions as the practice questions within the course modules. This was commented on as making it easier to pass the test. However, it was not supporting their understanding of the content. Instead it made them adapt their cognitive strategies towards a surface learning approach, in which they focused on memorisation of phrasing of questions instead of on the content of questions. *"If the questions are the same [in practice and in the final test], then I get away with lesser effort. Because you remember the wording, but not necessarily the content. If you rephrase the final test questions, then you need to really [learn]. [12-04]"* Other comments concerned the need for a clear relation between content and final test questions. This was a reoccurring issue and cause for much frustration by the test group during their course work.

DISCUSSION

Analyses of interview data were done with an inductive and phenomenographical approach. The purpose was to find cognitive strategies used by the test population. The test population (N=17) was novice to e-learning, so that focus could be placed on the development of learning strategies of people new to e-learning. The test persons were all male, adults in a large international corporation. This fact was reflected in how they discussed their course work, and how they approached the content. They all had an integrating approach towards the information, i.e. they looked at the information in terms of how they could integrate it with their prior knowledge and relate it to their work situation (Wiklund-Engblom, 2007). This is a pragmatic approach to learning, which is typical for adult learners (Knowles, Holton & Swanson, 1998).

During the analysing phase, it became obvious that a difference could be made between actual cognitive strategies and external-, and internal facilitators for these strategies. These three categories work together in a continuous flow of feedback, support, self-regulation, and modification. This is what Bandura (1986) called triadic reciprocal causation between environmental, behavioural, and personal factors. It is not surprising that Bandura's learning theory was confirmed by the results. Although the e-learning environment is a new method and place for learning, the learners are still the same cognitive, and affective construct as before. The excerpts also show that the categories of cognitive strategies found are not used one by one, but several are rather acted on simultaneously and on many levels. The following figure illustrates the cognitive strategies found, as well as the facilitators for learning.

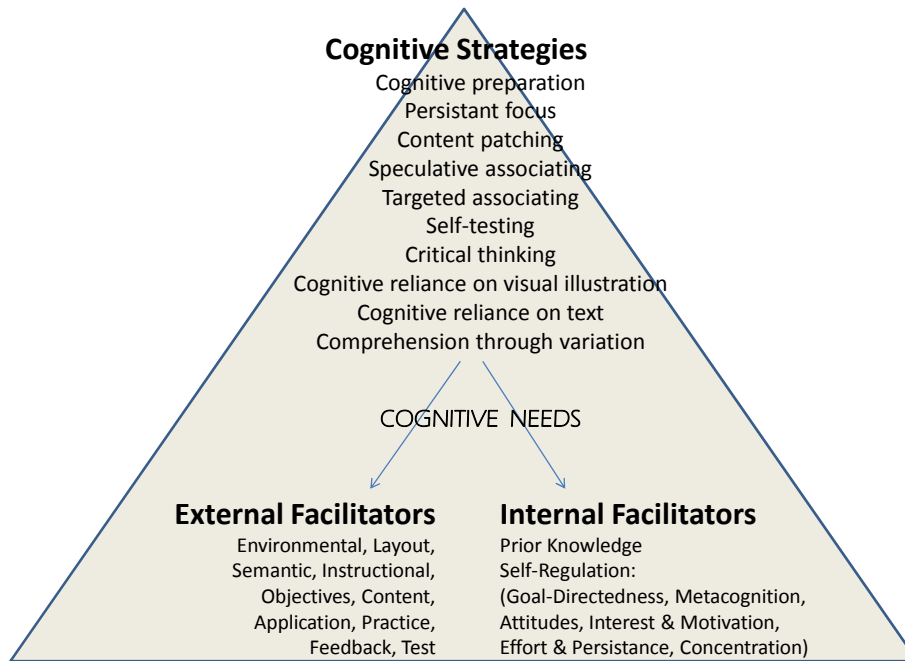


Figure 1. List of cognitive strategies in relation to external and internal facilitators as cognitive needs for learning.

Ten categories of cognitive strategies were found based on how e-learners discussed learning in their course work. These strategies are: cognitive preparation, persistent focus, content patching, speculative associating, targeted associating, self-testing, critical thinking, cognitive reliance on visual illustration, cognitive reliance on text, and comprehension through variation.

The internal facilitators for cognition were divided into two categories: the first has to do with our prior knowledge of the subject matter and our experiences that relates to this. The second has to do with our abilities for self-regulation. Self-regulation works on many levels. Variations of self-regulative abilities found in the interview data included self-regulation of attitudes, effort and persistence, motivation and interest, goal-directedness, metacognition, and concentration.

The external facilitators for cognition tell us how the environment mediates learning. These facilitators involve all levels in an e-learning course. Ten different levels of facilitating factors were found based on how the test population discussed their cognitive needs in their course work. These are: environmental level, layout level, semantic level, instructional level, objectives level, content level, application level, practice level, feedback level, and test level. It is evident that learners' cognitive needs flow through every aspect of a course; from the surrounding physical environment, to every detailed feature of the course itself. It is how these facilitators are designed that makes a difference for our comprehension and use of cognitive strategies.

I want to comment on the fact that these analyses of strategic behaviour for e-learning are still going on, and are part of my dissertation work. The whole research study involves several perspectives on e-learners' choices, actions, and strategies for learning, in which triangulation of the above mentioned methods are used for answering research questions (e.g., Wiklund-Engblom, 2007; 2008).

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