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The Assessment of Self-Regulated Learning: Where We Are Today

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Abstract: The study aims at a systematic review of the development of technology-supported assessment of Self-Regulated Learning (SRL). SRL refers to a self-directed learning process, which is the key for learners to master their own learning. Though many measure approaches were developed in the last two decades, assessment of SRL was still hampered by the unsatisfactory calibration of self-report surveys, the lack of event-based measure approaches, and labor-intensive data analysis in assessment. The innovative approaches powered by computerization in the latest five years provide some answers to the above stated problems.

1. Introduction

Self-regulated learning (SRL) refers to a series of learning events, including learning task selection, strategy adoption, self-control, self-evaluation and reflection. (e.g., Biggs, 1987; Simons, 1992; Pintrich, 2003; Zimmerman & Schunk, 2007) The different events constitute a self-directed learning process, which is the key for learners to master their own learning. (Zimmerman, 2008)

The last two decades witnessed an increasing research attention towards SRL. As network application and online communication tools become ubiquitous, learning is offered a new landscape which blends affordance of technology, and allow for more autonomy of learners. (McLoughlin & Lee, 2010) Many Literatures agree that SRL is more important in e-learning context than in traditional learning environment. (Jonassen et al., 1995; King et al., 2000; Puzziferro, 2008) Besides, assessment is seen as the key factor that relates to all dimension of SRL. (Paris & Paris, 2001) Therefore, research on assessment of SRL, especially in the context of e-learning, plays more of a key role in answering the question how learners could better direct learning themselves.

This paper aims at a discussion on development of SRL assessment, especially efforts to assess SRL in e-learning context in recent five years. Methodological and technological innovation would be emphasized, and described in detail.

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2. Widely Used Methods

Current widely-used methodologies mainly take the form of self-reports. Though many of them have doubtful calibration, and have limited data collection size, they still provide valuable information in the improvement of understanding of SRL, and rethinking on methodology design in e-learning environment. (Aleven, Roll, McLAREN & Koedinger,

2.1 Motivated Strategies for Learning Questionnaire

Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1993) is one self-report measure in wide use. It includes motivation scales that survey learners' values, expectancies, and affect, and a learning strategies section that measures learners' use of cognitive, metacognitive, and resource management strategies. (Dinsmore, Alexander, Loughlin, 2008) The three parts in the learning strategies section correspond to three key elements in SRL's definition, which are motivation, metacognition, and behavior. Every question in the questionnaire is based on 7 points rating scale, from "not at all" to "very true of me".

2.2 Self-Regulated Learning Interview Scale

Self-Regulated Learning Interview Scale (SRLIS; Zimmerman & Martinez-Pons, 1989) is another widely-used self-report measure of SRL. SRLIS prepares 6 different problem-solving contexts for learners, and learners are required to answer series of questions in the contexts. There are two types of questions: open-ended questions and multiple choices. The open-ended questions correspond to 14 SRL categories that mainly cover three key elements in SRL's definition: motivation, metacognition, and behavior. Multiple choice questions adopt 4-point rating scale, from "seldom" to "most of time"; they aim at surveying learners' consistency in using a particular learning strategy.

2.3 Microanalytic Methodology

Microanalytic Methodology (Kitsantas & Zimmerman, 2002) is the latest widely used approach to measure SRL compared with the above two. This approach is constructed on the premise that SRL could be viewed as a cyclical model of three phases: forethought, performance, and self-reflection, which correspond to before, during and after learning. (Zimmerman, 2000) Forethought phase includes mainly task analysis and setting motives to learn; performance phase involves self-control and self-observation; self-reflection phase includes mainly self-judgment and self-reaction. In this approach, learners are asked questions in three different phases. Questions include open-ended and closed ended ones, which produce qualitative and quantitative data separately. This approach could not only measure learners' SRL capability, but also sharpen learners' task analysis skills and self-judgment.

3. Innovative Methods

3.1 Trace Logs

Trace Logs realized the measure of SRL by actual observation rather than inference from learners' reports. Winne and his colleagues (Winne et al., 2006) designed a learning program named "gStudy", which could act as a shell allowing learners to perform multiple

learning tasks, like taking notes, highlighting texts, searching for learning information, and communicating with other learners.

Besides diverse supportive functions, gStudy also includes an Analyzer that records learners' learning activities without disturbing them. Traces are defined as observable indicators of learners' cognition; they could help educators construct event description of learners' adopted learning methods.

In the comparative experiment by Winne and Jamieson-Noell (2002) of trace measure and self-report measure of SRL, it was found out that learners' self-report on the use of SRL strategies were not as accurate as their actual use, which means trace measure has a comparatively higher calibration.

The key advantages of Trace Logs Compared with traditional assessment approaches are the followings:

1. The assessment of SRL could be carried out without disturbing learners' knowledge learning.
2. Assessment data could be collected on an event-based view. (Aleven et al., 2010) Comparatively, traditional assessment approaches, like survey, could hardly be carried out on a large scale. Nor could they guarantee the quality of collected data.

3.2 Model Tracing

Though Trace Logs realized the measure of SRL by actual observation, the traces recorded are a heavy burden for educators to analyze when there are many learners, let alone giving suggestions to each learner on their SRL strategies. Both the burdens of assessment and of using the assessment in guiding learners improved their SRL strategies do not necessarily lay upon educators.

Aleven and his colleagues (Aleven et al., 2010) designed a model that automatically and unobtrusively assess one of learners' SRL strategies: help seeking. The core concept of the model is called "Model Trace": learners' learning behavior in a certain context would be compared to a behavior model in the same context, and by comparison learners' behavior is interpreted and assessed. (Anderson et al., 1995)

The model was embedded in a learning software named ""Geometry Cognitive Tutor" and tested in a following comparative experiment. The effect of the model is positively correlated with traditional assessment approach.

The noticeable feature of Model Trace is the following:

- The analysis process is completely automated. Educators could be freed from the labor-intensive analysis burden. The automatically generated assessment could directly be used by learners, guiding their further use of SRL strategies.

However, there is only one experiment examining the efficacy of Model Trace. More experiments are needed to valid this assessment approach.

3.3 Computerization of self-evaluation measure

Though some SRL strategies could be assessed by computer unobtrusively, some others could not, like self-evaluation, which expects learners to evaluate themselves, and calibrate their evaluation by contrast of their actual performance. During the process, learners have to be disturbed from knowledge learning.

The problems with traditional self-report assessment approach are mainly the followings:

1. The completion ratio of self-reports are comparatively low.
2. The analysis and coding are labor-intensive burdens for educators.
3. Assessment could not provide an event-based perspective to review learners' SRL strategy development.

Targeting on the above problems, Hudesman and his colleagues (Hudesman et al., 2011) computerized the assessment of self-evaluation based on the cyclical model (Zimmerman, 2000) of SRL. In the experiment, self-evaluation is divided into three steps: 1) Before solving a problem in learning, learners were required to make self-efficacy judgment; 2) After solving a problem, learners were required to make self-reflection, which involves the comparison of their estimates and actual performance. Self-evaluation and judgment were embedded in the learning program as mandatory parts. The difference between self-evaluation and actual performance were automatically visualized for reflection of learners and analysis of educators. The experiment also found that learners enjoyed the computerization of assessment more than traditional approaches.

Though promising as an innovative assessment approach, computerized assessment of self-evaluation still needs more experiment to validate its efficacy.

4. Implication for the future SRL research in e-learning environment

The e-learning environment offers an exciting opportunity for the reform of SRL assessment, yet many questions remain to be explored in the reform process.

The first question is on the efficacy comparison between trace measure and self-report survey. It is interesting to note that "Trace Logs" research concluded that SRL assessment by actual observation had a better calibration compared with self-report surveys, yet more research is in need to further verify the conclusion.

The second question concerns about the efficacy of model tracing measure. This measure realizes the automation of nearly the whole analysis and interpretation process in assessment, and provides a possible solution to event-based assessment of SRL. However, more experiments are in need to verify its efficacy.

The third question concerns about how to measure SRL in a more personalized e-learning environment. The potential of multimedia production and distribution tools for learning (e.g., Facebook, Twitter, & Tumblr) has been realized, and a more relaxed, autonomous and personalized learning environment is recommended. (e.g., McLoughlin et al., 2010) To assess SRL in such learning environment, disturbs should be minimized. However, for many SRL strategies (e.g., goal setting, self-control, & time management), assessment similar to Model Trace of help seeking is still in lack. The development of these SRL strategies' unobtrusive assessment is still in need.

5. Conclusion

Though still in their early stage, the innovative SRL assessment approaches indicate the development of future direction of SRL evaluation: automation, unobtrusiveness, and visualization.

More experiments are in need to extend findings of the above listed research, including comparison between self-report evaluation and trace measure, and efficacy verification of model trace measure. The development of SRL strategy e-assessment not covered in the listed research is also in need.

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