



Validation of the Revised Self-regulated Online Learning Questionnaire

Renée S. Jansen^(✉), Anouschka van Leeuwen, Jeroen Janssen,
and Liesbeth Kester

Utrecht University, Heidelberglaan 1, 3584 CS Utrecht, The Netherlands
r. s. jansen@uu.nl

Abstract. Self-regulated learning (SRL) is essential for students in online education to be successful. The Self-Regulated Online Learning Questionnaire was developed to measure SRL in online educational contexts. In this paper, a revised version of the questionnaire is presented and tested with three datasets. The scale ‘metacognitive skills’ is split into three subscales: metacognitive activities before, during, and after a learning task. Next to the three scales measuring metacognitive activity, the questionnaire contains scales measuring time management, environmental structuring, persistence, and help seeking. The revised questionnaire was found to have improved validity, usability, and reliability.

Keywords: Questionnaire · Online education · Blended learning
MOOCs

1 Introduction

In online and blended learning, learners have more autonomy than in face-to-face education [1, 2]. This increase in autonomy makes it essential for learners to be actively involved in their own learning process, meaning that they self-regulate their learning [3, 4]. To accurately measure learners’ self-regulated learning in online education, the Self-regulated Online Learning Questionnaire (SOL-Q; [5]) was developed. While this questionnaire is a useful instrument, its validity, reliability, and usability could be improved. In the current paper, a revised version of the questionnaire is presented tested with three datasets.

1.1 Self-regulated Learning

Self-regulated learners are actively involved in their own learning process, not only during learning (performance phase), but also before (preparatory phase), and after learning (appraisal phase) [6, 7]. In the preparatory phase, learners think about what and how they will learn and the goals they have for the current learning session; they engage in (strategic) planning and goal setting. In the performance phase, learners engage in comprehension monitoring and strategy regulation. They furthermore manage their ‘resources’, including their time and study environment, as well as find

help when needed and persist when motivation drops. During the appraisal phase, learners reflect on their learning progress and their learning strategies [6].

1.2 Self-regulated Online Learning Questionnaire (SOL-Q)

To improve students' SRL in online education, it is important that students' SRL can be measured. The SOL-Q [5] was a first attempt at developing a questionnaire suitable to measure students' SRL in *online* learning environments. The developed questionnaire was based on several existing well-established SRL questionnaires (such as the Motivated Strategies for Learning Questionnaire; [8]): items from these questionnaires were selected and adapted to fit the context of online education. Based on exploratory and confirmatory factor analysis, an initial version of the SOL-Q was published. The SOL-Q consists of five scales: metacognitive skills (18 items, $\alpha = .90$, time management (3 items, $\alpha = .71$), environmental structuring (5 items, $\alpha = .67$), persistence (5 items, $\alpha = .79$), and help seeking (5 items, $\alpha = .83$).

1.3 Further Development of the SOL-Q

Although a satisfactory, initial version of the SOL-Q was created, the scale 'metacognitive skills' proved to be large and diverse. It consisted of items from a range of metacognitive self-regulation activities (e.g., goal setting, comprehension monitoring, reflection) and covering all SRL phases (preparatory, performance, and appraisal phase). The clustering of metacognitive items into a single metacognitive scale is not unexpected. In the SRL model presented by Zimmerman [9], significant correlations between the variables within a SRL phase are described, and Sitzmann and Ely [10] indeed found strong correlations between SRL constructs. While learners may not be able to distinguish among all the metacognitive activities, learners may be able to distinguish among the SRL *phases*. We therefore propose to split the scale 'metacognitive skills' into three separate subscales: activities before, during, and after a learning task. Not only would a separation into these three scales lead to an improvement of the face validity of the questionnaire, but it would also allow for more specific use of the questionnaire's (sub)scales, and for conclusions to be drawn about specific phases in the SRL process.

Based on the possible methodological and theoretical improvements on the scale 'metacognitive skills' outlined above, the aim of the current study is to create and test a revised version of the SOL-Q to improve its validity, reliability, and usability.

2 Method

2.1 SOL-Q Revised (SOL-Q-R)

The scale metacognitive skills within the SOL-Q was expanded and revised to generate three subscales. The existing 18 items in the scale were divided over the three subscales (i.e., before, during and after learning) based on the meaning of the item and on words signaling the timing of the activity. For instance, the item 'I am aware of what

strategies I use when I study for this online course' was placed into the subscale 'metacognitive activity during learning'. Second, the subscales were complemented to make sure all relevant aspects of metacognition were sufficiently present in each subscale. Strategic planning in the preparatory phase was not present in the existing items and only four appraisal items were present. Therefore, an item measuring strategic planning was added to the scale 'metacognitive activity before learning' ('At the start of a task I think about the study strategies I will use'), and two items measuring reflection on learning progress and learning strategies were added to the scale 'metacognitive activity after learning' ('After studying for this online course I reflect on what I have learned' and 'After learning for this online course, I think about the study strategies I used'). Specific attention was paid to words signaling timing when formulating the new items.

Furthermore, three small adaptations were made to improve the validity and reliability of the questionnaire. The first adaptation concerned the item 'I know what the instructor expects me to learn in this online course', originating from the Metacognitive Awareness Inventory scale for task definition [11]. Factor analyses during the development of the SOL-Q placed the item in the scale 'environmental structuring'. As the item does not measure environmental structuring, and is therefore also not conceptually similar to the other items in the scale, the item was removed from the questionnaire. Second, there were three negatively phrased items in the original design of the SOL-Q. These items were removed after factor analyses, as they did not fit the factor structure. Polar opposite items (i.e., 'I often feel so lazy or bored when I study for this online course, that I quit before I finish what I planned to do') are however known to result in lower internal-consistency reliabilities [12]. These three items, two in the persistence scale and one in the help-seeking scale, were rephrased to be polar positive and added to the SOL-Q-R. Finally, the time management scale was slightly adapted to improve its reliability as it was the scale with low reliability in the SOL-Q, which was likely due to the small size of the scale (3 items). Therefore, two items were added to the scale. The first item was already part of the originally developed questionnaire, but fell out during factor analyses. As the item conceptually fits in the scale, it was re-added ('I make good use of my study time for this online course'). The second item was formulated in line with the meaning of the scale ('I allocate studying time for this online course.').

The answering format was not changed for the SOL-Q-R. All questions had to be answered on a 7-point Likert scale ranging from 'not at all true for me' (= 1) to 'very true for me' (= 7). The full SOL-Q-R can be found at SOONER.NU/SOL-Q-R.

2.2 Participants and Procedure

The SOL-Q-R was administered to two groups of MOOC participants and one group of participants in a blended university course.

First, the questionnaire was implemented as a voluntary activity in a MOOC on Clinical Epidemiology offered by Utrecht University, The Netherlands, on Coursera. This MOOC consisted of 7 modules: an introductory module, 4 content modules, a module with a peer-graded assignment, and a module with a final exam. While students were free to decide on their own pace of studying, one module per week was

recommended. The questionnaire was added as a voluntary activity at the end of Module 2, to make sure students could reflect on their actual learning in the online course, and would not answer based on what they planned or expected to do. Complete data was gathered from 149 students. The responses of three students were considered outliers as they answered all questions identically (SD of their answers was 0). Responses of 146 students were used for analyses ($M_{\text{age}} = 36.08$, 48.6% male).

The questionnaire was also implemented as a voluntary activity in a MOOC on Environmental Sustainability offered by Wageningen University, The Netherlands, on edX. The MOOC consisted of seven modules: an introductory module and six content modules. In this MOOC, students were also free to study at their own pace, while one module per week was recommended. The questionnaire was added as a voluntary activity at the end of Module 2. Complete data was gathered from 73 students. Three students were considered outliers (SD = 0). Responses of 70 students were used for analyses ($M_{\text{age}} = 39.67$ 40.0% male).

The SOL-Q-R was also administered in a blended higher education course about designing educational materials at Utrecht University, the Netherlands. The course lasted 10 weeks, and followed a weekly structure of online preparation activities and face to face teacher-guided sessions (i.e., a flipped classroom design). In week 10, the students took an individual exam. The questionnaire was added as a voluntary online activity in week 4 of the course. Complete data was gathered from 94 students. One student was considered an outlier (SD = 0). Responses of 93 students were used for analyses ($M_{\text{age}} = 23.59$, 10.8% male).

2.3 Analyses

The SOL-Q and SOL-Q-R were compared based on reliability analyses. Furthermore, model fit was calculated using SPSS AMOS to test if the revised version had acceptable model fit. In line with the analyses done for the development of the SOL-Q [5], NC (normed Chi square) and RMSEA (root mean square error of approximation) were used as absolute fit statistics [13, 14].

3 Results

Reliability analyses were conducted to compare the internal-consistency reliabilities of the SOL-Q and the SOL-Q-R (Table 1). The results of the reliability analyses indicate higher reliabilities for the scales time management, environmental structuring, persistence, and help seeking in the SOL-Q-R. The reliability of the three metacognitive subscales are slightly lower than the reliability of the metacognitive skills scale. However, reliability is above .740 for all subscales, indicating good reliability.

An overview of the model fit statistics of the SOL-Q-R is presented in Table 2. Normed Chi square (NC) is a measure of χ^2 corrected for sample size, as χ^2 is known to be highly influenced by sample size [13]. Values of NC between 2.0 and 3.0 indicate acceptable fit and smaller values are better [13]. All tested models score below 2.0 thus indicating good fit of the SOL-Q-R in all three datasets. For RMSEA, smaller values indicate better fit and values below .08 are reasonable [15]. Based on the RMSEA

Table 1. Internal-consistency reliabilities of the SOL-Q and SOL-Q-R scales.

Scale	Items	1	2	3	Items	1	2	3
		α	α	α		α	α	α
Metacognitive skills	18	.93	.91	.88				
Activities before					7	.87	.84	.77
Activities during					7	.82	.78	.75
Activities after					6	.86	.86	.81
Time management	3	.57	.72	.71	5	.68	.72	.80
Environmental structuring	5	.78	.74	.66	4	.82	.77	.69
Persistence	5	.78	.70	.84	7	.82	.76	.88
Help seeking	5	.87	.91	.82	6	.88	.90	.84

Note. Dataset 1 = MOOC Clinical Epidemiology, 2 = MOOC Environmental Sustainability, and 3 = Flipped course educational materials.

statistic, the revised version shows adequate fit only in the first dataset, which is also largest. RMSEA is known to indicate poor model fit for small samples [16], which may explain the RMSEA values above .08 for dataset 2 and 3.

Table 2. Absolute model fit statistics of the SOL-Q-R.

	MOOC 1	MOOC 2	Blended
NC	1.797	1.700	1.713
RMSEA	.074	.101	.088

4 Discussion

In this paper, a revised version of the SOL-Q was presented and tested: the SOL-Q-R. The revised version has increased face validity, as the items within the scales were conceptually more similar. The separation of the large scale metacognitive skills into three smaller subscales (metacognitive activity before, during, and after learning) increases the usability of the questionnaire, as specific aspects of metacognition can be measured with the revised version. The theoretical and practical value of the questionnaire thus increases in the revised version. The results of the reliability analyses showed that the adaptations furthermore led to reliable scales overall (all α above .67), with increased reliability for most scales. Model fit statistics are somewhat ambiguous, but provide no argument against acceptance of the SOL-Q-R. To conclude, the revised version of the SOL-Q is an improved version of the SOL-Q in terms of validity, reliability and usability and is therefore considered a valuable tool for researchers to measure students’ SRL in online education. The full SOL-Q-R can be found at SOONER.NU/SOL-Q-R.

References

1. Garrison, D.R.: Self-directed learning and distance education. In: Moore, M.G., Anderson, W.G. (eds.) *Handbook of Distance Education*, pp. 161–168. Lawrence Erlbaum Associates, Mahwah (2003)
2. Wang, C.-H., Shannon, D.M., Ross, M.E.: Students' characteristics, self-regulated learning, technology self-efficacy, and course outcomes in online learning. *Distance Educ.* **34**, 302–323 (2013)
3. Kizilcec, R.F., Pérez-Sanagustín, M., Maldonado, J.J.: Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. *Comput. Educ.* **104**, 18–33 (2017)
4. Beishuizen, J., Steffens, K.: A conceptual framework for research on self-regulated learning. In: Carneiro, R., Lefrere, P., Steffens, K., Underwood, J. (eds.) *Self-Regulated Learning in Technology Enhanced Learning Environments*, pp. 3–19. Sense Publishers, Rotterdam (2011)
5. Jansen, R.S., van Leeuwen, A., Janssen, J., Kester, L., Kalz, M.: Validation of the self-regulated online learning questionnaire. *J. Comput. High. Educ.* **29**, 6–27 (2017)
6. Zimmerman, B.J.: Becoming a self-regulated learner: an overview. *Theory Pract.* **41**, 64–70 (2002)
7. Puustinen, M., Pulkkinen, L.: Models of self-regulated learning: a review. *Scand. J. Educ. Res.* **45**, 269–286 (2001)
8. Pintrich, P.R., Smith, D.A.F., García, T., McKeachie, W.J.: *A manual for the use of the motivated strategies for learning questionnaire (MSLQ)*. University of Michigan, National Center for Research to Improve Postsecondary Teaching and Learning, Ann Arbor, MI (1991)
9. Zimmerman, B.J.: Investigating self-regulation and motivation: historical background, methodological developments, and future prospects. *Am. Educ. Res. J.* **45**, 166–183 (2008)
10. Sitzmann, T., Ely, K.: A meta-analysis of self-regulated learning in work-related training and educational attainment: what we know and where we need to go. *Psychol. Bull.* **137**, 421–442 (2011)
11. Schraw, G., Dennison, R.S.: Assessing metacognitive awareness. *Contemp. Educ. Psychol.* **19**, 460–475 (1994)
12. Woods, C.M.: Careless responding to reverse-worded items: implications for confirmatory factor analysis. *J. Psychopathol. Behav. Assess.* **28**, 186–191 (2006)
13. Kline, R.B.: Details of path analysis. In: Kenny, D.A. (ed.) *Principles and Practice of Structural Equation Modeling*. The Guilford Press, New York (2005)
14. Hooper, D., Coughlan, J., Mullen, M.: Structural equation modelling: guidelines for determining model fit. *Electron. J. Bus. Res. Methods.* **6**, 53–60 (2008)
15. Gatignon, H.: Confirmatory factor analysis. In: Gatignon, H. (ed.) *Statistical Analysis of Management Data*, pp. 59–122. Springer, New York (2010)
16. Kenny, D.A., Kaniskan, B., McCoach, D.B.: The performance of RMSEA in models with small degrees of freedom. *Sociol. Methods Res.* **44**, 486–507 (2015)