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Developing Students' Engagement in Online Learning Questionnaire using Rasch Measurement Model

Elisabeth Pratidhina, Dadan Rosana, and Heru Kuswanto*

Universitas Negeri Yogyakarta, Indonesia

Abstract.

Student engagement is an essential factor in online learning. Hence, it needs to be assessed. This study developed a questionnaire to measure student engagement in online learning. Initially, 24 items were developed. All items were measured using a five-point Likert scale. Experts reviewed the items; revisions were conducted based on experts' appraisals. Then, Rasch analysis was conducted to determine the construct validity and reliability. One hundred seventeen undergraduate students participated in the trial phase. Based on the Rasch analysis using Winsteps, the item and person reliabilities were 0.98 and 0.82, respectively. The item reliability can be considered very good. The item and person separation indexes were 6.37 and 2.15, respectively. The mean-square (MNSQ), standardized as a *z*-score (ZSTD), and point measure correlation were used as criteria to refine items. Five items should be dropped because they did not meet the requirements. The final questionnaire consisted of 19 items.

Keywords: student engagement, online learning, Rasch Measurement model

Corresponding Author: Heru Kuswanto; email: herukus61@uny.ac.id

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1. Introduction

Education has been influenced by the development of advanced communication technology and the growing accessibility of the internet. Online learning is one impact of technology development on education. Recently, online learning also gains more demand as it offers flexibility and personalization in learning[1]. COVID-19 pandemic has also triggered significant growth of online learning[2].

The success of online learning is not only depending on technology and internet access. Student engagement is one of the factors that determine the success of online learning. It has a positive impact on student's performance and satisfaction in online learning[3].

Hu [4] defined student engagement as the quality of efforts that students themselves devote to educationally purposeful activities that contribute directly to desired

outcomes[4]. Student engagement is a multi-facet concept that influences the quality of students' learning process[5]. In most references, there are three main dimensions in student engagement, i.e., cognitive, behavioral, and emotional engagement [6,7,8].

Cognitive engagement is about how students approach understanding their learning. It can be related to learning strategies, self-regulation, and persistence in education[9]. Emotional engagement is related to students' emotional reaction during the learning process; it may include interest, the perceived value of learning, and enjoyment[10]. Behavioral engagement relates to involvement in academic and class-based activities, positive conduct, and the absence of disruptive action[6]. In addition to the three dimensions,[11] propose the social engagement dimension. Social engagement is about the quality of social interactions with peers and teachers. It also includes the willingness to maintains the relationships while learning[11].

To ensure the quality of online learning, measurement of student engagement in online learning is necessary. This study aims to develop a questionnaire to measure undergraduate student engagement in online learning. We adapt four dimensions of student engagement, i.e., cognitive, behavior, social, and emotional engagement.

Instrument to measure student engagement in online learning must be valid and reliable. Type of validity that usually used in a research is content validity and construct validity. Content validity can be obtained from experts' appraisal. Construct validity can be obtained from several types of analysis, such as factor analysis and item response theory. In this study, item response theory using Rasch Measurement Model has been conducted for construct validity.

2. Method

Questionnaire items were prepared based on four dimensions of student engagement and online learning context. The items were initially reviewed by a professor and two faculty members in the college of education. The suggestions from reviewers were used to revise the questionnaire. Twenty-four items had been constructed in the initial phase; the items were presented in Indonesian. All items were measured using a five-point Likert scale, ranging from always to never. For positive items, always=5, often=4, sometimes=3, rarely=2, and never=1. For the negative statements, the response is reversed coded. We randomly asked undergraduate students to fill the online questionnaire through email; 117 undergraduate students participated in this study. The questionnaire was administered by using google form. The construct validity and reliability were

determined through item analysis using a Rasch Measurement Model-based software, i.e., Winsteps 5.1.4.0

3. Results and Discussion

In this study, we classify indicators of student engagement in online learning into 4, i.e., behavioral engagement, cognitive engagement, social engagement, and emotional engagement. Initially, we developed 24 items to represent those indicators. The scale has been reviewed by three experts, i.e., one professor and two faculty members in the college of educations. Table I shows the English translation of the items and the indicators.

After being reviewed by the experts, the questionnaire were administered to 117 undergraduate students. The data is then analysed by using Rasch measurement model implemented in Winsteps 5.1.4.0. The unidimensionality is identified by using the principal component analysis (PCA). As shown in Table 2, the raw variance explained by measures is 40.3%. Despite being somewhat noisy, this value is still passing the cutoffs value (>40%) used in several studies[12,13,14,15]. The unexplained variance in the first contrast is 6.7%. In the Rasch analysis, the requirement for unexplained variance in the first contrast is less than 15%[13]. Thus, the 24 items in the developed Student Engagement in Online Class Questionnaire still meet the unidimensionality requirements.

As presented in Table 3, the item separation is 6.37, which can be classified as excellent. Meanwhile, the person separation is not good enough; it is only 2.15, classified as fair[16]. The item measurement reliability is 0.98, which can be classified as excellent, and the person measurement reliability is 0.82, which can be classified as good[16]. Overall, the separation and reliability are still fit with Rasch analysis requirement.

There are some indicators of item fit, i.e., infit MNSQ, outfit MNSQ, infit ZSTD, and outfit ZSTD. The MNSQ between 0.5 and 1.5 is productive for measurement[17]. Based on that criteria, two items are not fit, i.e., S5 dan C6 with outfit MNSQ of 1.73 and 1.55, respectively (see Table 4). The ZSTD should be in between -2.0 to +2.0. Thus, items S5, C6, C3, S1, and C2 do not fit the requirement and should be refined. In total, 19 items fit with an acceptable range of MNSQ and ZSTD in the Rasch model.

Point measure correlation determines the item discrimination. As shown in Table 4, all items have a point measure correlation between 0.3-0.7. Point measure correlation above 0.4 is very good, and between 0.30-0.39 is good [18].

Table 1: The indicators and items in the developed student engagement in online class questionnaire.

Indicators	Items (English translation)	Item Code
Behavioral Engagement	I finish an assignment on time during online learning	B1 (+)
	I ignore complex material in online learning and do not find a way to understand it.	B2 (-)
	I broke the approved rules in the online class	B3 (-)
	I actively participate in discussion during online meetings	B4 (+)
	I express ideas in the online class through asynchronous discussion forums in the learning management system (LMS)	B5 (+)
	I raise questions in the online class through asynchronous discussion forums in the learning management system (LMS).	B6 (+)
Cognitive engagement	I study additional material to broaden my knowledge of the topics studied in the online class	C1 (+)
	I tried to dig up information about how to apply the knowledge learned in the online class	C2 (+)
	I connect new knowledge learned in online lectures with previously studied material.	C3 (+)
	When solving problems or projects given by lecturers in an online class, I think of several different alternative ways.	C4 (+)
	I easily give up on completing projects/assignments in online lectures that require complex thinking processes.	C5 (-)
	I make mind maps, diagrams, visualizations, or other representations that make learning material in the online class easier.	C6 (+)
Social Engagement	I try to understand the ideas conveyed by friends in the online class.	S1 (+)
	I'm trying to help a friend who is struggling to learn online class material.	S2 (+)
	My friends and I made equal contributions while working together on projects in the online class.	S3 (+)
	I communicate with lecturers/tutors outside of class when I need help in understanding online class material.	S4 (+)
	I hesitate to ask my friends even though I have difficulty in the online class.	S5 (-)
	I am willing to accept the help of friends in learning online class materials.	S6 (+)
Emotional Engagement	I enjoy learning new things during an online class.	E1 (+)
	I feel that the material in the online class is boring.	E2 (-)
	I feel comfortable being part of the online class community.	E3 (+)
	I am enthusiastic about participating in activities in the online class.	E4 (+)
	I feel that my friends in online classes respect me as an individual.	E5 (+)
	I feel being respected as an individual by lecturers in the online class.	E6 (+)

(-) negative statement (+) positive statement

Category functioning was also checked. Figure 1 shows the relation between category probability and measure relative to item difficulty for each category. As shown in Fig. 1,

Table 2: Standardized residual variance for 24-items.

		Eigenvalue	Observed
Total raw variance in observations	=	40.2	100.0%
Raw variance explained by measures	=	16.18	40.3%
Raw variance explained by persons	=	4.4	10.9%
Raw variance explained by items	=	11.8	29.4%
Raw unexplained variance (total)	=	24.0	59.7%
Unexplained variance in the 1^{st} contrast	=	2.7	6.7%
Unexplained variance in the 2^{nd} contrast	=	2.4	6.0%
Unexplained variance in the 3^{rd} contrast	=	1.9	4.9%
Unexplained variance in the 4^{th} contrast	=	1.7	4.2%
Unexplained variance in the 5^{th} contrast	=	1.6	4.0%

Table 3: Item and person measurement separation and reliability.

	Separation	Reliability
Person	2.15	0.82
Item	6.37	0.98

Table 4: Item statistic.

Items	INFIT		OUTFIT		Point Measure	
	MNSQ	*ZSTD*	*MNSQ*	*ZSTD*	*Correlation*	*Exp*
S5 C6	1.71 1.54	4.65 3.88	1.73 1.55	4.78 3.91	.41 .36 .30	.47 .49
B3 E5 S4	1.26 1.24	1.93 1.79	1.18 1.23	1.41 1.79	.37 .41 .43	.42 .46
C5 E3	2.21 1.17	1.60 1.33	1.21 1.17	1.62 1.36	.48 .44	.49 .46
S6 S3 B5	1.16 1.06	1.21 .51	1.17 1.04	1.29 .39	.40 .34	.48 .43
B6 C4 B1	.99 .98	-.03 -.11	.99 .97	-.01 -.16	.42 .34	.45 .49
B4 E4 B2	.97 .96	-.24 -.24	.96 .97 .91	-.28 -.23	.53 .37	.49 .48
E1 E2 E6	.96 .92 .91	-.25 -.57	.95 .91 .86	-.63 -.35	.54 .54	.40 .48
S2 C1 C3	.85 .84	-.65 -1.18	.81 .83 .82	-.69 1.16	.70 .42	.48 .47
S1 C2	.84 .82 .81	-1.30 -1.31	.80 .76 .74	1.60 1.34	.49 .62	.45 .49
	.76 .74 .70	-1.51 -1.56	.68 .60	1.54 1.68	.58 .62	.44 .48
	.60	-2.03 -		2.00 2.23	.56 .67	.48 .48
		2.21 -2.69		2.88 3.64		.45 .48
		-3.59				

each category consists of a peak, which means each category represents a single unit of a measured construct. The graph is also neat, and orderly increases indicate that all categorization functioned as intended.

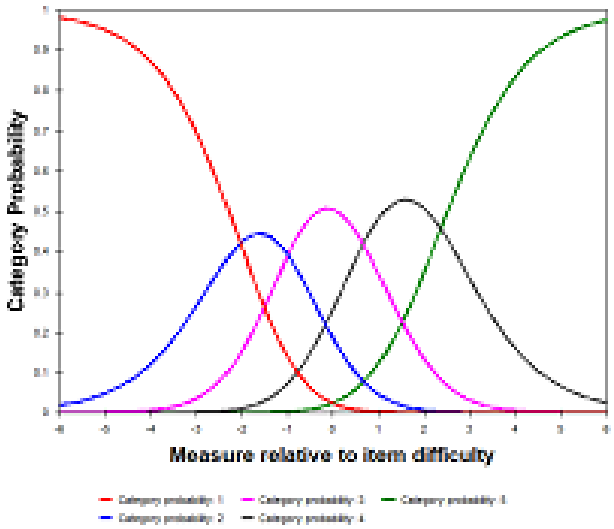

Figure 1: Category Functioning.

4. Conclusion

In conclusion, we have developed a five-point Likert scale questionnaire to measure student engagement in an online class. The content and construct validity of the instrument have been investigated through expert appraisal and Rasch analysis in the Winsteps software. The reliability of item and person measurement is excellent and good. There are 19 items in the questionnaire that fit construct validity criteria (MNSQ, ZSTD, and point measure correlation).

Authors' Contributions

All authors contribute equally in this work

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