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VALIDATION OF THE INSTRUMENTS OF LEARNING READINESS WITH E-LEARNING USING RASCH MODELING TO EMPOWER TECHNOLOGICAL CONTENT KNOWLEDGE (TCK)

Mobinta Kusuma [1], Purwo Susongko[2], Yuni Arfiani[3]

[1] **Program Studi Pendidikan IPA, FKIP, Universitas Pancasakti Tegal**
Tegal, 52122, Indonesia
mobintakusuma@upstegal.com

[2] **Program Studi Pendidikan IPA, FKIP, Universitas Pancasakti Tegal**
Tegal, 52122, Indonesia
purwosusongko@upstegal.ac.id

[3] **Program Studi Pendidikan IPA, FKIP, Universitas Pancasakti Tegal**
Tegal, 52122, Indonesia
yuniarfiani@upstegal.ac.id

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ABSTRACT

E-learning based learning is a trend in era 4.0 that requires learning readiness. This study is aimed at (1) developing GS-based e-learning readiness scale items to empower standardized TCKs; (2) validating the scale of e-learning readiness using Rasch modeling. The method used is the research on the development of modified Plomps according to needs, consisting of 3 stages, namely (1) the initial investigation stage; (2) stages of development (scale design & construction); and (3) assessment stages (tests, evaluations and revisions). ata analysis using Rasch modeling with R-program 3.1.2. The results showed that the preparation of standardized e-learning learning readiness scale items through (a) study of the learning readiness scale theory; (b) defining concepts and operations; (c) determine dimensions; (d) determine indicators; (e) compile scale items; (f) rational validation by experts; (g) field trials; (h) Rasch modeling validation test. Validation of rasch modeling shows that e-learning readiness scale items are declared valid by considering aspects of content and substance. Therefore, this instrument can be applied in learning.

Keywords: ***instruments, e-learning readiness, TPCK, Rasch modeling***

[1] Corresponding Author

Introduction

Learning e-learning in era 4.0 is a necessity in the world of education. The existence of e-learning has a usefulness associated with the opening of access to knowledge more broadly and deeply. E-learning is one of the learning media that supports student achievement. E-learning based learning is a supporter of effective learning achievement (Chen & Lin, 2002).

The success of learning based on e-learning requires a conducive pre-learning condition. Pre-learning conditions are referred to as learning readiness conditions. Many factors influence the condition of learning readiness (such as the condition of students, the learning environment, facilities and infrastructure, and the ability of teachers as managers of e-learning learning classes) that can affect the achievement of learning objectives. Readiness of e-learning learning becomes the success of learning to use e-learning (Rohayani, 2015). Learning readiness with e-learning is also influenced by the availability of software, ease of use and stability of access to devices that can help students operate e-learning devices (Cheon, Crooks & Song, 2012).

One of the learning readiness factors using e-learning that affects the operation of e-learning devices has a correlation with the mastery of technology that supports the mastery of material abilities or often called Technological Content Knowledge (TCK). TCK Indicator is part of Technological Pedagogical Content Knowledge (TPCK), which is an understanding of mastery of material that is associated with how to teach the right based on the use of technology that supports the achievement of learning objectives (Koehler & Misra, 2009). Technological Knowledge (TK) is one of the important indicators in the success of learning with e-learning (Gozey & Roehrig, 2009).

Development of learning readiness instruments that specialize in Google classroom based e-learning learning aims to provide standard instruments that help educators to get ready-to-use instruments. Rasch modeling is a measurement model developed by Dr. George Rasch in the 1950s to test instruments by presenting valid and accurate interpretations of data, not just processing raw data scores interpreted at certain intervals (Soemintono, 2016). The purpose of this study is (1) to compile GS readiness e-learning scale items to empower standardized TCK; (2) validating the scale of e-learning readiness using rasch modeling.

Research Method

The research method used is the development of a modified version of Plomp according to needs. The stages of development consist of (1) the stages of the initial investigation (preliminary data collection on the need to develop learning readiness instruments); (2) stages of development (scale design of instruments & construction of instruments); and (3) stages of instrument assessment (instrument testing, instrument interpretation and revision). The sampling technique used convenience sampling for students of the 2016, 2017 and 2018 science education study programs with a total of 83 respondents. Data collection techniques using questionnaires and documentation. Data analysis techniques are carried out qualitatively and quantitatively. Qualitative data analysis was carried out by expert validation on instruments that tested the strength of agreement expert judgment through the coefficients of Cohen’s Kappa (figure 1) The Cohen’s Kappa coefficient interpretation is measured by the intervals presented in table 1. Quantitative analysis uses Rasch modeling version 3.1.2 with the fulfillment of indicators in table 2.

$$\kappa = \frac{\sum_{i=1}^{I} \pi_{ii} - \sum_{i=1}^{I} \pi_{i+}\pi_{+i}}{1 - \sum_{i=1}^{I} \pi_{i+}\pi_{+i}}.$$

Figure 1. Cohen's Kappa coefficient

Table 1. Interpretation of *Cohen's Kappa test*

Nilai *K*	Strength of agreement
<0.20	Poor
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Good
0.81-1.00	Very good

Table 2. Quantitative validity criteria for Rasch modeling

Validity Aspect	Indicators	Criteria
Content	Fit item test Person-item map	P>0.01*)
Substance	Person fit statistic	P>0.01

*) The level of difficulty of items on the domain of the ability of students

Results and Discussion

Stages of initial investigation

The initial stages of the investigation were carried out to be able to arrange the development of instruments accurately by reviewing the readiness theory of learning and defining concepts and operations. The learning readiness indicator was developed by referring to the independent learning readiness test developed by Guilielmino (Litzinger, Wise, Lee & Bjorklund, 2003). Learning readiness is influenced by internal factors and external factors (Mulyani, 2013). Internal factors originate from students in the form of physical and mental health. Especially external factors that influence e-learning learning readiness are the availability of learning support facilities and the ability to use technology. This external readiness then impacts TCK empowerment for students. The definition of the concept of learning and operational readiness is a reference for the development of research aspects that include aspects of e-learning readiness and TCK empowerment for students.

Stages of development

Instrument development was carried out by determining dimensions, instrument indicators and item scale preparation. The dimensions of the instrument are used to determine the accuracy of the target respondents adjusting the study of learning readiness theory, conceptual and operational definitions related to e-learning learning readiness and achievement of TCK students. Instrument indicators were developed based on two dimensions which later became the basis for developing scale items. Construction of test items on instruments was developed based on indicators as a grid development process (Khumaeraoh, Susongko, & Rokhman, 2017). The results of the development of dimensional construction designs are contained in table 3. There are 32 scale items developed in e-learning learning readiness instruments.

Stage of instrument assessment

The instrument assessment stage consists of expert validation, field trials, and validation using Rasch modeling. The instruments that have been developed are then validated qualitatively and quantitatively

Table 3. The results of developing instruments of learning readiness with e-learning

Dimension	Indicators	Items	Number of Item
learning readiness	Physical Readiness	5	1,2,3,4,5
	Mental Readiness	12	6,7,8,9,10,11,12,13,14 ,15, 16,17
TCK mastery	Findable information	3	18,19,20,
	Recognition	1	21
	Material compatibility	3	22,23,24
	Availability of information technology	2	25,26
	Accessible of technology	6	27,28,29,30,31,32

Table 4. Level of Difficulty Items

No. Item	Estimate	No. Item	Estimate	No. Item	Estimate	No. Item	Estimate
beta V1.c1	-1.325	beta V10.c1	-2.500	beta V18.c2	0.082	beta V27.c2	1.889
beta V1.c2	-0.348	beta V10.c2	-2.785	beta V19.c1	0.207	beta V28.c1	-1.107
beta V1.c3	2.150	beta V10.c3	0.016	beta V19.c2	3.249	beta V28.c2	1.883
beta V2.c1	-0.769	beta V11.c1	-1.900	beta V20.c1	-1.012	beta V29.c1	1.544
beta V2.c2	1.578	beta V11.c2	0.031	beta V20.c2	2.419	beta V30.c1	-2.511
beta V3.c1	0.324	beta V12.c1	-2.438	beta V21.c1	-0.598	beta V30.c2	-1.178
beta V3.c2	3.589	beta V12.c2	-1.270	beta V21.c2	3.232	beta V31.c1	-2.035
beta V4.c1	1.544	beta V12.c3	2.070	beta V22.c1	0.221	beta V31.c2	-2.907
beta V5.c1	-1.220	beta V13.c1	-2.015	beta V22.c2	3.149	beta V31.c3	-1.129
beta V5.c2	-2.165	beta V13.c2	-0.881	beta V23.c1	0.398	beta V32.c1	-1.041
beta V5.c3	-0.519	beta V14.c1	-2.176	beta V23.c2	4.476	beta V32.c2	-1.718
beta V6.c1	-1.003	beta V14.c2	-1.689	beta V24.c1	-1.279	beta V32.c3	0.762
beta V6.c2	1.215	beta V14.c3	1.407	beta V24.c2	2.047		
beta V7.c1	-1.961	beta V15.c1	-1.588	beta V25.c1	-1.471		
beta V7.c2	0.318	beta V15.c2	0.068	beta V25.c2	-2.175		
beta V8.c1	-0.708	beta V16.c1	-1.781	beta V25.c3	0.232		
beta V8.c2	0.812	beta V16.c2	-0.360	beta V26.c1	-0.526		
beta V8.c3	6.769	beta V17.c1	-0.961	beta V26.c2	-1.518		
beta V9.c1	0.569	beta V17.c2	1.038	beta V26.c3	1.772		
beta V9.c2	5.131	beta V18.c1	-1.305	beta V27.c1	-0.321		

Table 4. Items fit rejected by Rasch modeling

	Chisq	df	p-value	Outfit MSQ	Infit MSQ	Outfit t	Infit t
V1	139.441	82	0.000	1.680	1.647	3.77	3.81
V26	128.915	82	0.001	1.553	1.330	2.34	1.62
V32	119.811	82	0.004	1.444	1.317	2.30	1.75

Table 6. Result of Items fit Rasch modeling

	Chisq	df	p-value	O-MSQ	I-MSQ	O-t	I-t
V1	139.441	82	0.000	1.680	1.647	3.77	3.81
V2	63.514	82	0.935	0.765	0.781	-1.61	-1.56
V3	76.958	82	0.637	0.927	0.873	-0.49	-0.90
V4	70.000	82	0.825	0.843	0.912	-1.01	-0.90
V5	106.338	82	0.037	1.281	1.137	1.48	0.83
V6	77.589	82	0.617	0.935	0.944	-0.37	-0.34
V7	82.604	82	0.461	0.995	1.009	0.03	0.11
V8	82.261	82	0.471	0.991	0.966	-0.01	-0.20
V9	75.336	82	0.685	0.908	0.915	-0.64	-0.61
V10	83.912	82	0.421	1.011	1.008	0.12	0.10
V11	78.537	82	0.588	0.946	0.963	-0.28	-0.21
V12	81.085	82	0.508	0.977	1.031	-0.10	0.26
V13	69.078	82	0.845	0.832	0.858	-0.92	-1.03
V14	78.065	82	0.603	0.941	0.948	-0.35	-0.31
V15	66.619	82	0.891	0.803	0.832	-1.25	-1.20
V16	64.560	82	0.922	0.778	0.821	-1.37	-1.32
V17	82.076	82	0.477	0.989	0.968	-0.02	-0.17
V18	72.582	82	0.762	0.874	0.880	-0.70	-0.84
V19	74.162	82	0.719	0.894	0.915	-0.74	-0.58
V20	62.857	82	0.943	0.757	0.837	-1.33	-0.91
V21	74.922	82	0.697	0.903	0.925	-0.49	-0.39
V22	97.762	82	0.113	1.178	1.201	1.24	1.41
V23	74.297	82	0.715	0.895	0.898	-0.72	-0.71
V24	83.934	82	0.420	1.011	1.013	0.12	0.13
V25	87.129	82	0.328	1.050	1.021	0.34	0.18
V26	128.915	82	0.001	1.553	1.330	2.34	1.62
V27	69.084	82	0.845	0.832	0.845	-1.15	-1.13
V28	72.320	82	0.769	0.871	0.883	-0.70	-0.66
V29	56.778	82	0.985	0.684	0.722	-2.24	-3.14
V30	64.197	82	0.927	0.773	0.814	-1.40	-1.47
V31	87.749	82	0.312	1.057	0.958	0.38	-0.21
V32	119.811	82	0.004	1.444	1.317	2.30	1.75

Qualitative validation is carried out by two experts who look at the substance and construction of the instrument. The results of qualitative validation obtained the Cohen's Kappa coefficient value of 0.63 with the closeness criteria of agreement in the strong category. The closeness test results using using the kappa coefficient were conducted to test the consistency of expert validation (Warrens, 2010).

Quantitative validation using R program 3.1.2 is obtained: (a) The level of difficulty of the instrument of use is in the range of -2 to 6 with a significant level indicator p> 0.01 showing that the level of difficulty of the instrument items can be accepted by all respondents as an assessment of aspects of content; (b) Based on the test of the substance aspect of the item there are three items that do not meet p> 0.01, namely items V1, V26 and V32. But in general it can be concluded that instrument items are declared valid (table 6) with validity values of 90.625% as many as 29 items. Items are declared acceptable if the respondent is able to answer all items with a level of difficulty below the respondent's ability (Aeni, Susongko & Rokhman, 2017). Whereas the 3 items that were rejected were considered that the consistency of weak items was considered bias, namely items V1, V26 and V35 which were clarified in table 5. The use of rasch modeling to multiply test questions was considered more equitable for students in ordinal data score scoring calculations (Susongko , 2016).

Conclusion

The results of the study were obtained (1) developing standardized e-learning learning readiness scale items can be done through (a) reviewing the theory of learning readiness scale; (b) carry out conceptual and operational definitions; (c) determine dimensions; (d) determine indicators; (e) compile scale items; (f) rational validation by experts; (g) field trials; (h) rasch modeling valiadasi test; (2) Validation of rasch modeling shows that scale items of e-learning learning readiness instruments are declared valid by considering aspects of content and substance. The implications of this study can provide standardized and valid instruments to be used in measuring e-learning learning readiness.

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