Validity of BRADeR Learning Model Development: An Innovative Learning Model to Improve Science Literacy Skills for Junior High School Students

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Abstract

The results of the preliminary study show that the scientific literacy ability in 4 SMP Negeri Pematangsiantar is still relatively low. Since science study habits are still traditional and minimize the significance of being able to read science as a competency that students must acquire, there is a tendency for the learning process to not aid students in developing their scientific literacy skills. Due to this, the BRADeR learning model was developed using innovation, taking into account the benefits and drawbacks of the inquiry and SETS models as well as supporting theoretical and empirical research. This study serves to determine the validity of the BRADeR learning model that has been developed. The method of collecting validity data uses the focus group discussion (FGD) method. The validity of the BRADeR learning model was assessed based on content validity and construct validity. The BRADeR learning model was established and is in the very valid category, according to the validity results from experts in the field of science education (IPA). The BRADeR learning paradigm can be used to enhance high school students' science literacy abilities.

Keywords: BRADeR learning model, content validity, construct validity, science literacy skill

1. Introduction

Among the 16 talents deemed necessary for the 21st century by the World Economic Forum, scientific literacy is one (Wefusa, 2015). Given the significance of scientific literacy, fostering it among individuals is the primary objective of any reform of science education.] (Holbrook & Rannikmae, 2009; Odegard et al., 2015; Wang & Zhao, 2016). Scientific literacy is related to knowledge, understanding, skills, and values contained in scientific studies (Huryah & Efendi, 2017). Students are expected to possess knowledge of science and be able to use it in their daily lives.

The results of research on students' scientific literacy skills in several regions in Indonesia gave low results (Ardianto & Rubini, 2016; Diana et al., 2016; Putra et al., 2016; Fakriyah et al., 2017; Hasanah et al., 2017; Siagian et al. al, 2017; Noviana & Julianto; 2018; Rubini et al., 2018). Some aspects of low scientific literacy are in explaining natural phenomena which include aspects of thinking and working scientifically. Likewise, the results of a preliminary study conducted in several SMP in Pematangsiantar City which gave very low results (Simamora et al., 2020). The factors that cause the low scientific literacy of Indonesian students are that Indonesian students have not been trained and accustomed to solving problems with characteristics such as those on PISA (Rakhmawan et al., 2015; OECD, 2016; Hasanah et al., 2017). Another factor is the unavailability of scientific literacy-based learning tools, even though teachers also need scientific literacy-based evaluation tools to be able to improve scientific literacy (Fraenkel, et al. 2012). Because they are unfamiliar with how to create these evaluation instruments, teachers frequently disregard those that are based on scientific literacy. Additionally, students' poor levels of accomplishment in scientific literacy are influenced by their background circumstances, interests, level of learning, and attitudes toward science (Rahayu, 2014; Hasanah et al., 2017; Herman et al., 2020).

It is preferable for the teacher to employ a learning model prototype when discussing the learning process. The learning process can be improved with the help of the learning model to meet the desired learning objectives

(Herman et. al., 2022). In order to include good attitudes about science and improve scientific literacy abilities, teachers need be knowledgeable about learning paradigms. However, not every learning paradigm can always be adjusted to topics relating to scientific literacy (Rusilowati et al., 2016; van Thao et. al., 2021). As a result, in order to help students in developing their scientific literacy, a learning model that is tailored to the study of science is required.

The problem of the low scientific literacy ability of junior high school students can be overcome with the BRADeR learning model. In an effort to enhance junior high school students' scientific literacy abilities, the BRADeR learning model was created by taking into account the advantages and disadvantages of the Inquiry and SETS models (Simamora et al., 2020). This learning model has also been studied based on theoretical studies and supporting empirical studies so that scientific literacy skills can be improved (Simamora et al., 2020).

A good learning model must meet three requirements, namely: 1) validity, 2) practicality, and 3) effectiveness (Nieveen & Plomp, 2007). The focus of this research is to obtain the content and construct validity of the BRADeR learning model in improving the scientific literacy skills of junior high school students.

2. Method

The developed BRADeR learning model was validated by 3 (three) experts in the field of science education through a discussion forum commonly called Focus Group Discussion (FGD). FGD is a discussion activity that involves groups with few participants (small groups) where discussion participants provide responses from a series of questions focused on one topic (Marreli, 2008). The results of the FGD are a reference for revising the BRADeR learning model. The validity of the BRADeR learning model was assessed based on content validity and construct validity (Nieven & Plomp, 2007).

Content validity is that there is a need for the intervention and its design is based on state-of-the-arts (scientific) knowledge (Nieven & Plomp, 2007; Munthe et. al., 2021; Silalahi et. al., 2022). The content validity assessment is viewed from several aspects of the assessment, namely: (1) the need for model development; (2) The design of the model meets the novelty of knowledge; and (3) a description of the learning model developed (Nieven & Plomp, 2007; Joyce, Well and Calhoun, 2009; Arends, 2012). Construct validity is the intervention of logically designed. Assessment of construct validity in terms of several aspects of the assessment, namely: (1) Rational learning model developed; (2) Theoretical and empirical support of the developed learning model; (3) the syntax of the learning model developed; (4) Planning and implementation of the developed learning model (Nieven & Plomp, 2007; Joye & Well, 2009; Arends, 2012). The validity of the BRADeR learning model is determined by referring to the validity criteria contained in Table 1 below.

Table 1. Instrument Validity Assessment Criteria

Score interval	Scoring Category	Description
$3.00 \le P \le 4.00$	Very valid	Can be used without revision
$2.75 \le P < 3.00$	Valid	Usable with minor revisions
$1.75 \le P < 2.75$	Not valid	Can be used with multiple revisions
$1.00 \le P < 1.75$	Invalid	Can't be used yet and still need consultation

The BRADeR learning model's content validity and construct validity sheets were used to collect content validity and construct validity information from professionals in the field of scientific education who validated the created learning model. The interobserver agreement derived from the statistical analysis of the percentage of agreement (R) is used in the determination of the validity of the BRADeR learning model and the reliability of the content validity sheet instrument (Borich, 1994). If the instrument's dependability value is 75%, it is considered to be dependable (Borich, 1994).

3. Results

The BRADeR learning paradigm, which was established in this study, is used to enhance students' scientific literacy abilities in junior high schools. The BRADeR learning approach was created in response to pupils' poor scientific literacy skills. The BRADeR learning model was developed by taking into account the strengths and weaknesses of learning models that are often used to improve students' scientific literacy skills, namely the inquiry model

(Gormally et al., 2009; Fatmawati & Utari, 2015; Putra et al., 2016) and SETS (Poedjiadi, 2010; Akcay & Akcay 2015; Muhajir & Rohaeti 2015; Auteri et al., 2016; Zeidler, 2016; Irmita, 2017; Retno & Marlina, 2018; Ristina et al., 2018). The BRADeR learning model was also developed by considering several suggestions from previous researchers who paid attention to several aspects of learning to improve students' scientific literacy skills. The aspects are: brainstorming (Prastika et al., 2018); reading (Rusdi et al., 2017; Ayu et al., 2018); analyzing (Situmorang, 2016; Wulandari & Sholihin, 2016); and decision making (Toharudin et al., 2011; Rakhmawan et al., 2015).

The development of the BRADeR learning model is also based on its usefulness (need) in the implementation of the 2013 Curriculum. The use of several supporting theories, critical reviews of the results of previous research, and the benefits of the model on the implementation of the 2013 curriculum in the development of the BRADeR learning model can illustrate that the BRADeR learning model is valid in content and construct. Nieveen & Plomp (2007) state that the learning model as a product of educational research is said to be valid if it meets the criteria of being content valid and construct valid. Constructively valid refers to consistency between model components as well as between the generated model and underlying theories. Content validity denotes the presence of a new element (state-of-the-art).

4. Discussion

The BRADeR learning model is said to be content valid in terms of the novelty of the model (state-of-the-art). A description of the novelty of the BRADeR learning model can be reviewed in the rational section of the model. The expert who reviewed this model, during the focus group discussion (FGD) activity, suggested that the rational part of the model emphasizes the novelty elements so that the BRADeR learning model is content valid. The results of the content validity of the BRADeR learning model which were validated by 3 (three) experts in the field of science education (IPA) are presented in Table 2 below.

Table 2. Results of the Content Validity Assessment of the BRADeR Learning Model

No	Aspects of Assessment of Model Components	Validity Score				Conclusion	Reability	
		V1	V2	V3	r		R	K
1	The need for model development	4.00	4.00	3.80	3.93	Very Valid	97%	Reliable
2	State of the art of the knowledge	3.75	4.00	3.75	3.83	Very Valid	93%	Reliable
3	Description of BBADeR Pembelajaran Learning Model	3.25	3.50	4.00	3.58	Very Valid	92%	Reliable

Description: V = Validator; r = average R = Percentage of agreement; K = Category

Table 2 above shows that the content validity score of the BRADeR learning model in terms of the need for the development of learning models to produce graduate competencies in accordance with the demands of 21st century skills obtains very valid criteria. The content validity of the BRADeR learning model in terms of state-of-the-art knowledge by considering theoretical and empirical support, as well as recommendations from relevant research results obtained very valid criteria. The validity of the content of the BRADeR learning model in terms of the description of the model in developing model objectives, implementation of learning, management of the learning environment as well as assessment and evaluation obtained valid/very valid criteria. The reliability coefficients for all aspects of the content validity of the BRADeR learning model are in the range of 92% to 97%, so the results of the model content validity assessment using the content validity assessment instrument of the developed BRADeR learning model are reliable.

In terms of consistency between phases in the model syntax, consistency between model elements, and consistency between the models and underlying theory, the BRADeR learning model is stated to be constructively valid. Through the model book and the items on the model construct validation sheet, the construct validity of the BRADeR learning model can be observed and tracked. Consistency between phases in the model syntax can be seen and traced from the rational sequence of phases to form a model syntax. Consistency between model components can be seen and traced based on the relationship between rational model, model syntax, social system, learning environment, reaction principle, instructional impact and accompaniment impact. Based on the connection between the model and supporting theories, the consistency between the model and the underlying theory may be seen and tracked (complex cognitive processes, advance organizers, information processing, problem solving, constructivism, and scaffolding) as well as empirical support from the latest research results. The results of the content validity of the BRADeR learning model validated by 3 (three) experts in the field of science education are presented in Table 3 below.

Table 3. Results of the Construct Validity Assessment of the BRADeR Learning Model

No	Aspects of Assessment of Model Components	Validity Score				Conclusion	Reability	
		V1	V2	V3	r		R	K
1	Rational Learning Model BRADeR	4.00	3.67	4.00	3.89	Very Valid	95%	Reliable
2	Theoretical and Empirical Support for the BRADeR Learning Model	4.00	4.00	3.80	3.93	Very Valid	97%	Reliable
3	BRADeR Learning Model Syntax	3.33	3.50	3.50	3.44	Very Valid	95%	Reliable
4	Model planning and execution	3.50	4.00	3.83	3.78	Very Valid	92%	Reliable

Description: V = Validator; r = average R = Percentage of agreement; K = Category

Table 3 above shows that the construct validity scores for both the rational aspect of the BRADeR learning model, the theoretical and empirical support aspects for each syntax in the BRADeR learning model, the syntax aspect of the model which describes the logical sequence of learning activities as well as the interrelationships between mutually supportive phases, social systems, learning environment, reaction principle and instructional impact and accompaniment impact for the BRADeR learning model as well as aspects of planning and implementation of the model all obtained very valid criteria. The reliability coefficients for all aspects of the construct validity of the BRADeR learning model are in the range of 85.7% to 100%. The reliability coefficients for all aspects of the construct validity of the BRADeR learning model are also in the range of 92% to 97%, so the results of assessing the construct validity of the model using the construct validity assessment instrument of the developed BRADeR learning model are reliable.

A review of aspects of validity shows that the BRADeR learning model is said to be valid both content and construct. The BRADeR learning model is said to be content valid because it is based on state-of-the-art and constructively valid because the parts of the model are interrelated (Nieven & Plomp, 2007). A valid BRADeR learning model can provide opportunities for educational practitioners to apply it in science learning so as to improve students' scientific literacy skills by involving aspects of science processes and products.

5. Conclusion

The content validity assessment of the developed BRADeR learning model has a very valid category. The range of 92% to 97% is considered reliable for the percentage of agreement (R) in the assessment of the content validity of the BRADeR learning model. A very valid category is included in the evaluation of the created BRADeR learning model's construct validity. The BRADeR learning model is deemed reliable because the proportion of agreement (R) from the assessment of the content validity falls between 92% and 97%. The BRADeR learning paradigm can be used to help junior high school students learn and develop their science literacy abilities.

The findings of this study call for additional investigation, particularly when they are applied to the instructional process in the classroom. The BRADeR learning model's implementation seeks to ascertain the applicability and efficacy of the created BRADeR learning model. Further study is anticipated to determine whether the BRADeR learning approach is efficient and practicable for enhancing junior high school students' scientific literacy abilities.

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