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ITEM ANALYSIS OF CRITICAL THINKING SKILLS INSTRUMENT TO MEASURE EFFECTIVITY OF SCIENTIFIC GROUP INQUIRY LEARNING (SGIL) MODEL

ABSTRACT

The purpose of this study is to analyze the problem set items to get information and feedback on critical thinking skills tests. This research develops SGIL model that can improve students' critical thinki learning. This study uses a research and development design to develop the SGIL model. The SGIL model is proven to be able to improve the critical understanding of PGSD students. The syntax of SGIL consisting of 6 steps, namely: (1) discussion of problems and topic selection, (2) research planning, (3) implementation, (4) data integration, (5) analysis and synthesis, (6) conclusions and communication. The participants were 114 Elementary Teacher Education Program (PGSD) who selected by random sampling technique. This research was conducted in 3 sample universities. The data of SGIL model effectivity was measured using instrument critical thinking skills. This instrument has been analyzed for their validity, reliability, level of difficulty, and discrimination item. Tests to obtain data have been carried out for 90 minutes. The instrument was calculated by analysis of Quest and Lisrel

Keywords: SGIL, Critical Thinking Skills, PGSD

INTRODUCTION

The challenge of the 21st century in the world of education is to build a competitive generation in facing the era of increasingly advanced globalization. The era of globalization requires human resources who have intelligence, knowledge and high-level thinking skills include teachers who have important role in producing highly competitive students. The cess of learning objectives is determined by the role of the teacher in the learning process (Bashir, 2018; Mukeredzi, 2013). The teacher has a role in managing the class when they do the collaboration with other teachers. Classroom management can run well, if supported by teachers who are competent in teaching. Good teaching is one that can teach material through direct and contextual experience (Pukdeewut et al., 2013). Today, technological advances influence the world of education, both ways of teaching, learning processes (Kocakaya & Gnen, 2013). In the learning process, the teacher must master many things. They need to be equipped with thinking skills that make it easier to find factual, relevant and trustworthy information. Thinking skills will support science communication, inn ation and critical thinking skill (Alfin, 2019; Pandiangan et al., 2017; Jatmiko et al., 2018; Sunarti, 2018). In fact, there are many evidences that many student in some universities have less skill in critical thinking (Zarifsanaiey et al., 2016). In Abramova et al., (2013) research found fact that many lectures dominates the learning, therefore, student center learning is limited. Abundant PGSD materials cause the lecturer focusing in solving rather than giving students to think. Student receive more materials and less practice in thinking skill (Nazri et al., 2013; Vlachos et al., 2013).

According to Mapeala & Siew, (2015), a critical individual characteristic brings new meaning or purpose in a task, find new usages, solve problems or provide added value or beauty. expressing real personal characteristics such as : imaginative, have broad interests, independent in thinking, full of energy, confident, dare to take ris and brave in the establishment and belief. Indicators of critical thinking skills used in this udy use the formulation of Ennis, (1991). Critical thinking skills include: 1) providing simple explanations, 2) building basic skills, 3) concluding, 4) providing further explanation, 5) arranging strategies and tactics.

The PGSD program has a role in preparing prospective elementary school teachers who have critical thinking skills. PGSD lecturers have a task in preparing elementary teacher candidates who have critical thinking skills

(Sinaga & Feranie, 2017; Demİrhan, 2014) . A big challenge for lecturers is to stimulate students' critical thinking skills. Based on the obtained data, the consistency of critical thinking skills of PGSD UNS Surakarta students is still low. The consistency in critical thinking shows a level of low consistency at 54.85%. The low consistency of critical thinking is due to the problem solving of science based only on knowledge of theories and concepts (Wijayanti et al., 2016).

Critical thinking can be applied in various fields of science, according to the chosen field. Science is very diverse, one of them learns about the basic concepts of science. Learning the basic concepts of natural science, especially energy material task, is integrated from the branches of physics, chemistry and biology (Wijayanti, et al, 2018). Critical thinking skills are related to students' cognitive abilities in active learning. Through the learning process, students learn to select information received and determine truth in creating new ideas (Paul & Elder, 2014; FitzPatrick & Schulz, 2015). Students can also analyze, evaluate, summarize, and solve problems together when the learning process is carried out (Dwyer, Kozmian-Ledward, & Stockin, 2014).

A learning model cannot be implemented for all courses. Each course with certain material has certain characteristics. Creative lecturers can manage their class well (Pukdeewut et al., 2013). Therefore it needs a right learning model. That suits students' needs. Submission of an appropriate learning model can improve students' skills in thinking independently, and critically (Miftachul et al., 2016). Previous research shows that learning that is often used in SD is inquiry (Wijayanti et al., 2018). Learning models that are often used to improve critical thinking skills are based on concept discovery. Learning models still require further development to improve critical thinking skills. Some Research shows that the application of inquiry model has an effect on improving students' Science concepts compared to traditional models (Sahhyar & Nst, 2017). The reality in the field shows that inquiry has weaknesses, such as requires a long time so it is difficult to analyze the data. studied (Ratnasari & Harjunowibowo, 2018; Yusrizal, 2016; Susongko, 2016).

Measurement of the success of learning can be conducted by testing. The measured test is a test of critical thinking skills. Test items need to be analyzed so that students get proper grades and quality. Tests are good if they meet characteristics such as validity, reliability, difference in power and difficulty levels. So far, there are no instruments used to measure critical thinking skills in the Scientific Group Inquiry Learning (SGIL) model. Based on those problems, researchers are interested in examining the item analysis of critical thinking skills instruments to measure the effectiveness of scientific group inquiry learning (SGIL). The purpose of this study is to acknowledge the quality of the critical thinking skills test in terms of validity, reliability, questionability, and level of difficulty in PGSD students. This research offers a solution to measure critical skills with SGIL basis for PGSD students, especially on energy material topics.

METHODS

This research is a quantitative descriptive type. The data obtained were analyzed statistically and then synthesized to get new conclusions (Sugiyono, 2015: 14)

The subjects of SGIL were PGSD students from 3 sample universities, which are UNS, UMS, and UNIPMA. The purpose of this study is to produce a SGIL model that is feasible and effective in increasing critical thinking skills. This study applies the design of Research & Development (R&D). Data collection is performed with a critical thinking skills test, consist of 20 items, 114 answer sheets and answer keys. The data analysis technique is conducted by analyzing the validity, reliability, level of difficulty and different power of questions with the Quest program. The quest program is useful to identify whether the model is appropriate or identify the problem difficulty index. The model is fit if the MNSQ is in the range of 0.77-1.30. The instrument is reliable if it fulfills an index equal to or greater than 0.70. The instrument difficulty index is good if it is between -2 to +2.

RESULTS AND DISCUSSION

The results of the large-scale field operational tests of the SGIL model over the results of critical thinking skills test. The results of the questionnaire are presented in diagram form as in Figure 1.

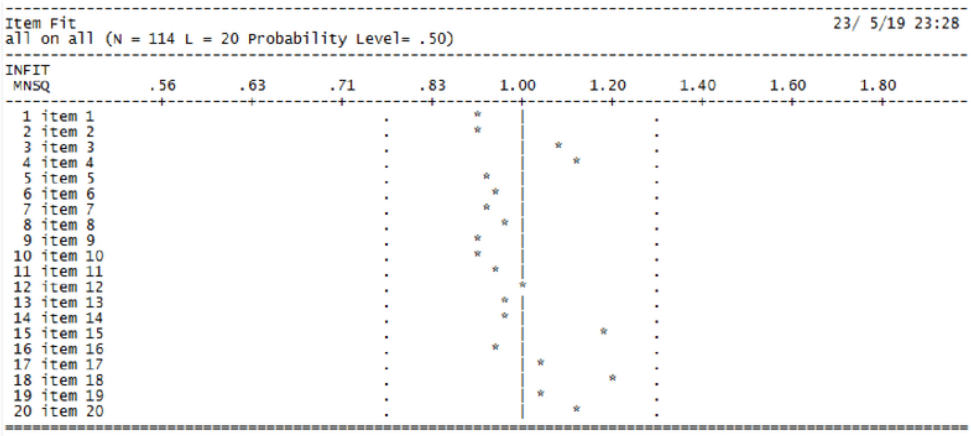

Figure 1. Critical Thinking Skill Test Results on the Implementation of the SGIL Model

Figure 1 shows the average total value of the three aspects, the majority of which are in good category, because betwen -2 to +2. Based on the results of the test, it shows that the critical thinking test is fit (valid) for SGIL models, used to use in learning the basic concepts of Natural Sciences in energy material.

The results of reliability with Quest program on the critical thinking skills test can be seen in Figure 2.

Case Estimates
all on all (N=114 L – 20 Probability Level= .50

Summary of case Estimates	
Mean	.71
SD	.54
SD (adjused)	.42
Reliability	.61

Figure 2. Results of reliability with Quest program

The criteria of Realibility coefficient consist of 5 categories. The coefficient 0.90 <r <1.00 shows very high realibility level. Coefficient of 0.70 <r <0.89 shows high reliability. Coefficient of 0.40 <r <0.69, shows medium reliability. Coefficient of 0.20 <r <0.39, shows low reliability value, and a coefficient of 0.00 <r <0.19 shows very low reliability. A diagram showing the percentage results of the analysis of the difficulty of the questions with Quest is shown in Table 1.

Table 1. Results of the Analysis of the Difficulty of the Questions with Quest

No	Criteria	Prosentase (%)
1	Verry easy	0,0
2	easy	5,0
3	Enough	85,0
4	Good	10,0
5	Verry good	0,0

The reliability of energy material critical thinking skills tests in PGSD students amounted to a coefficient value of 0.61. Based on the criteria of reliability value, it can be categorized as medium. The magnitude of the difficulty index for a good test item is in the range of 0.30 to 0.70 (Mapeala & Siew, 2015). Afterward, the results of the item analysis are used to measure the effectivity of the SGIL in improving critical thinking skills

c. Recapitulation of SGIL effectiveness results at Sebelas Maret University (UNS), Muhammadiah Surakarta University (UMS) and PGRI Madiun University (UNIPMA)

The achievement of students' critical thinking skills of students is measured by using a critical thinking skills test for energy material. Data analysis results in critical thinking skills test scores before and after treatment (pretest and posttest). The average score is obtained by the standard gain (N-gain) increase in students' critical thinking skills in certain categories (Pandiangan et al., 2017). The results of the analysis of critical thinking skills scores of UNS students are presented in Table 2.

Table 2. Results of Critical Thinking Skills Tests

	Syntax SGIL	N	Mean	Std. Deviation	Std. Error Mean
Critical Thinking Skill	Before	218	3.0674	.27309	.01850
	After	200	2.8033	.25682	.01816

Critical thinking skills test results show an increase in the value of Gain (N-Gain) in the three places where the SGIL model are applied. UNS Gain Score shows three sub material which is in the high category. N-Gain scores for UMS and UNIPMA show two sub-materials that are in the high catego The results of the lisrel t-value at the pretest are shown in Figure 3.

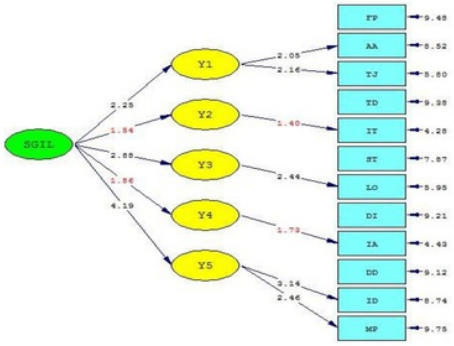

Figure 3. Pretest Results of Researcher's Processed Lisrel t-value

Model fit criteria in the pretest problem can be seen in the fit index value, compared to the standard value <0.05. The fit index results can be observed from Table 3.

Table 3. Result of fit index

No	Fit Index	Value	Standard Value	Explanation
1	Chi Square p	66.54(df = 49. p = 0.0452)	<0.05	Poor Fit
2	RMSEA	0.042	<0.08	Fit
3	NFI	0.66	>0.90	Poor Fit
4	NNFI	0.81	>0.90	Poor Fit
5	CFI	0.92	>0.90	Fit
6	IFI	0.91	>0.90	Fit
7	GFI	0.95	>0.90	Fit
8	AGFI	0.92	>0.90	Fit

Table 3 shows that about 75% of indexes are categorized as fit. These results indicate that the theoretical model of the SGIL variable is fit with empirical data. Based on the results of the analysis of the construct validity and the construct reliability, all aspects and items that make up the SGIL are declared valid and reliable so that all aspects and indicators are able to reflect and shape the SGIL.

The effectiveness of critical thinking skills is shown by an increase in posttest results. The results of the processed t-value researchers at posttest can be seen in Figure 4.

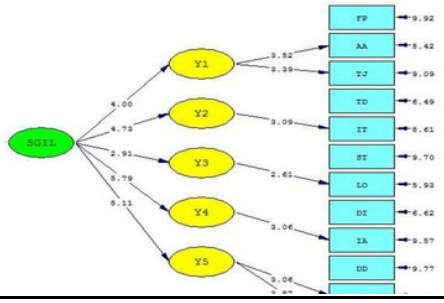

Figure 4. Posttest Results of Researcher's Processed Lisrel t-value

In Figure 4 it can be seen that from the aspect of critical thinking skills it is stated to be fit with 12 indicators of critical thinking skills. The processed results in Figure 4.11 are supported by the calculation of fit criteria analysis. The fit criteria analysis shows that 87.5% were declared fit. The results of the comparison of the fit index between values and standard values can be observed in Table 4.

Table 4. Comparison of Fit Index between Value and Standard Value

No	Indeks Fit	Nilai	Nilai Standar	Keterangan
1	Chi Square p	88.03 (df = 49. p = 0.003)	<0.05	Kurang Fit
2	RMSEA	0.061	<0.08	Fit
3	NFI	0.97	>0.90	Fit
4	NNFI	0.93	>0.90	Fit
5	CFI	0.93	>0.90	Fit
6	IFI	0.92	>0.90	Fit
7	GFI	0.94	>0.90	Fit
8	AGFI	0.91	>0.90	Fit

The effectiveness of the SGIL Model in improving critical thinking skills is demonstrated through Lisrel

a. Pretest Results of Implementing the SGIL Model on a Large Scale

The first level of analysis is started from the latent constructs of aspects (Y1, Y2, Y3, Y4, and Y5) to its indicators. Based on the results of the analysis above, it shows that all factor loading values> 0.5 and all t-values are required to test the Significance of factor loading values are greater than 1.96, except for the indicators FP, TD, ST, DI, and DD. This means that the 12 items that measure the SGIL are valid and significant for SGIL.

The second level of analysis is resulted from the latent construct (SGIL) to its aspect constructs (Y1, Y2, Y3, Y4, and Y5). Based on the test results above, it shows that the factor loading values are all> 0.5 and all the calculated t values needed to test the significance of the factor loading values are greater than 1.96. This means that of the 5 aspects that measure SGIL are valid and significant aspects of SGIL.

These results indicate that the theoretical model of the SGIL variable is fit with empirical data (Garrison et al., 2001; Leijen et al., 2014; Tiruneh et al., 2016). Based on the results of the analysis of the construct validity and the construct reliability, all aspects and items that make up the SGIL are declared valid and reliable so that all aspects and indicators are able to reflect and shape the SGIL.

b. Posttest Results of the Implementation of the SGIL Model on a Broad Scale

The first level of analysis conducted from the latent constructs of aspects (Y1, Y2, Y3, Y4, and Y5) to their indicators. Based on the results of the analysis above shows that all factor loading values> 0.5 and all t-values required to test the significance of factor loading values are greater than 1.96, except for the indicators FP, TD, ST, DI, and DD. This means that 12 items that measure the SGIL, all items are valid and significant for SGIL.

The second level of analysis was carried out from the latent construct (SGIL) to its aspect constructs (Y1, Y2, Y3, Y4, and Y5). Based on the test results above shows that the factor loading values are all> 0.5 and all the calculated t values needed to test the significance of the factor loading values are greater than 1.96. This means that of the 5 aspects that measure SGIL are valid and significant aspects of SGIL.

Based on analysis, 7 out of 8 indexes found that the model was fit. These results indicate that the theoretical model of the SGIL variable is fit with empirical data. Based on the results of the analysis of the construct validity and the construct reliability, all aspects and items that make up the SGIL are declared valid and reliable so that all aspects and indicators are able to reflect and shape the SGIL.

The development of the syntax of the Scientific Group Inquiry Learning (SGIL) model consists of 5 stages: 1) problem identification and topic selection, 2) experimental planning, 3) implementation, 4) data collection, 5) analysis and synthesis, and 6) conclusions and communication. In stage 1 problem identification and topic selection, problem identification can be developed by topic selection. Energy material in the Energy course is divided into 8 topics. Time limitations which are weaknesses of inquiry can be minimized by forming groups by sharing energy topics. Each group has responsibility to identify problems in each topic that they will solve together.

In stage 2 (experimental planning), students who are already divided into work groups plan problem solving through an experimental plan. At this stage students are given opportunities to establish social communication, share ideas in making experiments.

Phase 3 (implementation) students conduct experimental planning that has been planned in an experiment in a group that has been formed. Through this experiment social interaction can occur. Every student has the same role. They can exchange opinions and provide input while working on assignments (Gunes et al., 2015). Every data generated is collected and recorded as one part of the learning phase.

Phase 4 (data collection) Data generated in the implementation activities are grouped according to their respective topics. After the data collection is done, it continues to step 5 (analysis and synthesis). Existing data are analyzed and synthesized with a group of friends. At the analysis stage each student is free to argue.

Data are analyzed whether it is in accordance with the theory or not. They seek answers through group discussions. The results of the discussion are synthesized and written in the form of a report. At this stage it can be seen that students are increasingly challenged to raise their arguments (Stapleton & Amy, 2015). Students are encouraged to improve their critical thinking skills. Based on oral interviews, students do this because they feel the experiment is a self-planning.

Stage 6 conclusions and communicates, each group draws conclusions of their work then communicates in the presentation. UNS students on average make presentations with teaching aids and demonstrations. UMS students make presentations using power points and LCDs. UNIPMA students make a live presentation, two groups are formed to show demonstration to support their conclusions. As an individual assignment, each student makes a report based on the experiments that have been conducted (Özarslan et al., 2013). The series of stages of learning in the three sample universities, supports the discovery and extensive social interaction (Gyllenpalm, 2017).

Learning from the results of the study shows that what has been done is in accordance with the theory of constructivism which is the basis of SGIL. Knowledge can be developed by students so that they can create science learning strategies effectively (Nadelson et al., 2011; Torre et al., 2017). Students will be more active in developing accepted concepts, so they are able to develop critical thinking skills on the material being studied (Demİrhan, 2014; Semwal & Bhatt, 2013)

CONCLUSION

The SGIL model is a cooperative learning based problem solving which is designed to improve critical thinking skills for prospective elementary school teachers. The five-phase SGIL model includes: (1) problem identification and topic selection, (2) experimental planning, (3) implementation (4) data collection, (5) analysis and synthesis and (6) The results of the study show the SGIL model with valid content average - average (3.83), construct validity (3.96), with the validity of each aspect statistically in (rα = 1.00) and reliability in (α = 1.00). It can be concluded that the SGIL model meets the requirements (valid in content and construction, and can be declared feasible and appropriate by experts. The implication of this research is that the SGIL Model is a model characterized by cooperative findings. The SGIL model can improve the critical thinking skills of PGSD students, where lecturers act as a facilitator with a few modifications during the learning process. Contextual learning with learning resources, varied media, and widely formed social systems.

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