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Development of Peer-Scaffolding-Based Learning Program to Train the Performance Assessment Ability of Prospective Science Teacher

Tri Jalmo[1,*], Neni Hasnunidah[1], Noor Fadiawati[2], Median Agus Priadi[1]

[1]Department of Biology Education, Universitas Lampung, Indonesia

[2]Department of Chemistry Education, Universitas Lampung, Indonesia

Abstract: The aim of the research is to develop a peer scaffolding-based learning program to equip prospective science teacher students with the ability to develop performance appraisals. This program was developed using a 4D model (Define, Design, Develop, and Disseminate), the development of which has reached the stage of feasibility testing (Develop). Data collection techniques with questionnaires to measure the validity of the feasibility of learning programs and essay tests for the ability to develop performance appraisals. The results of this study indicate that the learning program developed got an average score of 4.00 (very valid category) in all aspects of feasibility. The results of the program trial show that there is an increase in student abilities seen from their N-gain (0.41: moderate criteria). Improvement in the aspect of the ability to understand the scope of the assessment with "low" criteria (0.036), planning an assessment with "medium" criteria (0.72). Based on this, it is concluded that the program developed is quite effective in providing performance appraisal skills for prospective science teacher students.

Keywords: learning program, peer scaffolding, performance assessment.

Abstrak: *Penelitian bertujuan mengembangkan program pembelajaran berbasis peer scaffolding untuk membekali kemampuan mahasiswa calon guru IPA dalam mengembangkan penilaian kinerja. Program ini dikembangkan dengan model 4D (Define, Design, Develop, dan Disseminate), yang pengembangannya sampai pada tahap uji coba kelayakan (Develop). Teknik pengumpulan data dengan kuesioner untuk mengukur validitas kelayakan program pembelajaran dan tes esai untuk kemampuan mengembangkan penilaian kinerja. Hasil penelitian ini menunjukkan bahwa program pembelajaran yang dikembangkan mendapat skor rata-rata 4,00 (katagori sangat valid) pada keseluruhan aspek kelayakan. Hasil ujicoba program menunjukkan bahwa terjadi peningkatan kemampuan mahasiswa dengan kriteria sedang (N-gain = 0,41). Peningkatan pada aspek kemampuan memahami ruang lingkup penilain berkriteria rendah (N-Gain = 0.036), merencanakan penilaian dengan kriteria sedang (N-gain = 0.72). Berdasarkan hal tersebut disimpulkan bahwa program yang dikembangkan cukup efektif membekali kemampuan penilaian kinerja bagi mahasiswa calon guru IPA.*

Kata kunci: *pembelajaran fisika, permainan, temperature dan kalor.*

▪ INTRODUCTION

Indonesia is still experiencing a very serious educational problem, namely the low quality of education. This fact was revealed from the results of international studies in Science and Mathematics through TIMMS (Trends in International Mathematics and Science Study) and PISA (The Program for International Student Assessment) that the competence of Indonesian students is still far from the world average competence (Tohir, 2019; Nizam, 2016). World Competitiveness Ranking also shows that in 2019 Indonesia was in position 32 of 63 countries, and in 2020 it fell to position 40. When compared to ASEAN countries, Indonesia is below Singapore, Malaysia, and Thailand (Nino, 2020). These facts are inversely proportional to the demands of the 21st century and the

Tri Jalmo
*Email: tri.jalmo@fkip.unila.ac.id

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industrial era 4.0 that education must equip students with critical thinking skills, creative thinking, communication and collaboration (Gibson et al., 2010; Pacific Policy Research Center, 2010; NEA, 2010).

The preparation of competent human resources through education is closely related to teacher competence, especially pedagogic competence, namely competence in managing learning (Permendiknas, 2007). So that it can be ascertained that the low learning achievement of students is correlated with the low competence of teachers, especially in planning and implementing learning and assessment. In terms of planning and implementing a performance appraisal, the survey found that of the 32 science teachers in Pringsewu Regency, Lampung, almost all (96.9%) had done a performance appraisal and almost all (93.8%) had difficulty. The difficulties experienced by the teachers in the preparation of tasks and rubrics (65.6%). A survey on the ability to develop performance appraisals was also conducted on 27 alumni of the Master of Science Education Program, FKIP, University of Lampung. The surprising finding is that almost all (92.6%) alumni have difficulty in compiling performance appraisals. The difficulties experienced varied, namely in compiling tasks (18.5%), rubrics (33.3%), or assignments and rubrics (48.1%). It was found that a small percentage (37%) of alumni stated that the science education assessment and evaluation courses taken during college had not been able to equip students' abilities to carry out performance assessments.

Based on the facts above, it is necessary to develop a learning program that is able to equip performance appraisal skills for prospective science teachers based on peer scaffolding. This program is based on Vygotsky's learning theory that learning is an interaction between students and learning resources, and/or with educators who have the required qualifications and competencies (Stuyf, 2002; Hardjito, 2010). Because learning is an interaction process, the development of this program is designed to increase the intensity of student interaction in order to achieve their potential competencies. This is what Vygotsky (1978) calls scaffolding. The essence of the scaffolding is the provision of assistance from more competent people (the more knowledgeable other) (Shin, 2014; Ismail, et al., 2015; Yarbrough, 2018), hence students reach their potential competencies. The more knowledgeable other is not only a teacher, but also older people and even peers who have more experience (Shin, 2014; Yarbrough, 2018, Towvn & Bepukois, 2020). Peers who acts as the more knowledgeable other are called peer scaffolding. Peer scaffolding was chosen as a learning strategy considering that college students are adults. Learning in adults (andragogy) is characterized by having many and varied experiences about the material to be studied (Yusri, 2017). Thus, in the learning process between students, social interaction will occur (Maybin, et al. 1992), more intensive interaction because it is based on the knowledge that has been possessed before learning. With this interaction led by students who have a higher initial teaching provision than other group members, it is hoped that all group members will achieve their potential competencies.

▪ METHOD

This study uses a 4 D model which includes Define, Design, Develop, Dissemination (Thiagarajan, 1994). The define is carried out by field studies and literature studies to reveal (1) the ability of teachers and alumni in developing performance appraisals and the effectiveness of learning programs, (2) performance appraisals, and (3) scaffolding strategies, focused on the roles and tasks of group members at the groupdoes

it. The results of the study at the define are used as the basis for development at the develop, namely (1) designing a learning program based on the scaffolding developed by Jalmo and Rustaman (2010), (2) compiling learning tools that include learning scenarios and teaching materials, and (3) compile an assessment instrument, namely a written test and a self-assessment. At the development stage, validation was carried out by 4 (four) experts in the field of science assessment and education.

The validated learning program is then tested at the disseminate. Trials using Quasi-experimental research (Millan & Schumacher, 2001). The sample was taken by purposive sampling, namely all students of the Master of Science Education Program at the University of Lampung in the even semester of 2020/2021 who were taking the Science Education Evaluation and Assessment course, especially on performance appraisal material. The research design used was One-Group Pretest-Posttest Design. The trial peer scaffolding was carried out in 2 meetings, each for 100 minutes (2 x 50 minutes). The learning steps are in accordance with the validated scenario. Learning is done online, using the Zoom meeting. Before treatment, the sample was given a pretest and self-assessment to determine the students' initial abilities. Then the results of the pretest are used to form groups so that the group is heterogeneous in terms of academic ability. Students with high academic scores are expected to become MKOs who can help group mates to improve their abilities (actual abilities) to reach their potential abilities. After the pretest and group division were carried out, learning was carried out according to the steps developed, namely based on peer scaffolding. Emphasis on treatment at the group stage does it. After the treatment was completed, students were re-measured their ability to develop performance appraisals through posttest and self-assessment. At the end of the lesson, students were asked to fill out a questionnaire about the effectiveness of the learning program.

The instruments used are (1) questionnaires: to analyze the initial problems and needs of the learning program, validation, and student responses about the learning program. (2) test: test of the ability to develop performance appraisal and self-assessment (self-assessment). Questionnaire data were processed descriptively and categorized, while data on the ability to develop performance assessments were analyzed using N-gain (Hake, 1998).

▪ RESULT AND DISSCUSSION

Validation of the Learning

a. Strategy

Study aims to produce a peer-scaffolding- that is implemented using a strategy adapted from the scaffolding that Jalmo and Rustaman (2010). Development is carried out at the group does it, namely by strengthening communication between group members as the implementation of peer scaffolding (Figure 1).

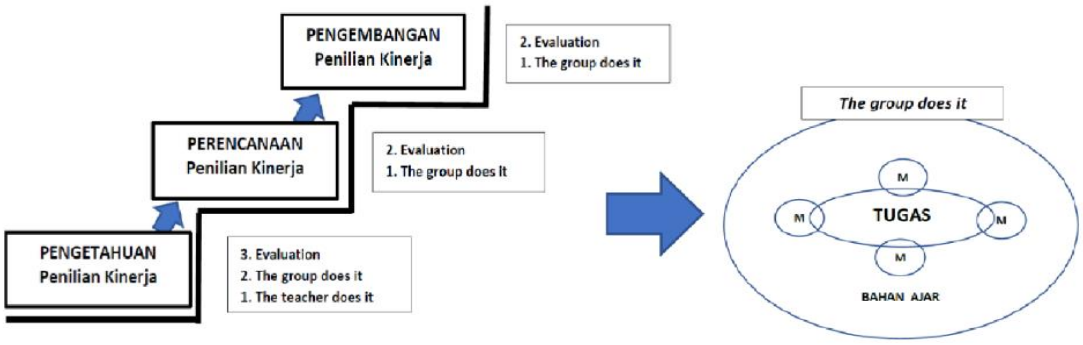

Figure 1. Peer scaffolding-based learning strategy

In implementing the learning program using a scaffolding through 3 (three) stages, namely

1. *The teacher does it* or can be equated *teacher scaffolding*, namely students are assisted by lecturers to initiate understanding of the material being studied. Lecturers provide general insight about performance assessment material at the beginning of the lecture. In the next stage, the lecturer only acts as a discussion facilitator and confirms the tasks presented by students.
2. *The group does it*, at this stage *peer scaffolding*, where students in small groups study together certain materials. At this stage the division of groups is based on the ability of students. Students with high abilities can help their friends with medium and low abilities so that all students can achieve learning goals (potential abilities). When students work in groups, they are accompanied by teaching materials as *hard scaffolding.*
3. *Evaluation.* At the end of each assignment, an evaluation is always carried out to determine the development of student abilities. At the end of the evaluation stage, in the form of a post test.

b. Learning Program

Expert validation results show that the learning program that includes learning scenarios, teaching materials, and assessment instruments developed is considered very appropriate and belongs to the "very valid" category (Ratumanan & Laurens, 2011). The learning scenario contains the objectives/competencies to be achieved by students, the steps are in accordance with the competencies to be achieved, it contains peer scaffolding, and is expected to be effective in achieving the learning objectives. Teaching materials are made to be realistics, the content of teaching materials helps students understand the teaching materials and develop performance assessments. The assessment instrument is in accordance with the grid, material, learning objectives, and serves to measure the ability to develop performance appraisals and is in accordance with the rules of developing questions.

Learning Program Trial

Dissemination carried out to test the effectiveness of the developed learning program. Heterogeneous grouping in academic ability turned out to be able to liven up discussion in groups. The highest ability students succeed in playing himself as a mentor for his friends in the group. The results of the study (Table 1) illustrate that highest ability students works effectively, which is indicated by the active participation of all group members and the occurrence of discussions. This is in accordance with the statement of Sundararajan, (2010) that highest ability students have a role to activate discussion in groups. Student activity asking questions with highest ability students at the group does it is the key to the success of this learning program. As stated by Satrock (2004) that asking is one form of effort that can be made to improve students' abilities to the ZPD level.

Table 1. Learning activities

No	Lecture Activities	1st Meeting (%)	2nd Meeting (%)	Average	
				(%)	Criteria
1	Actively involved in learning	100	94	97	Very High
2	Friends in one group ask	100	94.11	97.06	Very High
3	Ask with friends in a group	100	88.23	94.12	Very High
4	Ability to answer questions from friends in the group	82.35	82.35	82.35	Very high

Learning activity is thought to be caused because all components of the learning program developed are "very valid". The very high learning activity finally had an impact on increasing his understanding and skills in developing performance appraisals (Table 2). These results are in line with research conducted by Shin et al (2020) and Shin, S. et al (2020) that the interaction between peers improves performance and learning outcomes.

Table 2. Student ability in performance assessment

No	Competency	Value (x ± SD)		N-gain (Criteria)
		Pre test	Post test	
1	Understand the scope of performance appraisal	72.55 ± 8.72	73.53 ± 10.72	0.036 (low)
2	Planning Performance	appraisal 55.29 ± 12.35	78.04 ± 15.05	0.51 (medium)
3	Develop performance	appraisal 52.48 ± 48.32	86.76 ± 28.82	0.72 (high)
	Total	61.48 ± 10.04	77.42 ± 9.34	0.41 (medium)

From the research data in table 2, it can be seen that the lowest increase in student ability is in the ability " understand the scope of performance appraisal" (N-gain: 0.036, low criterion) while the highest is the ability to "develop performance appraisal" (N-gain: 0.72, high criterion). These results explain that peer scaffolding for students (adults) are still effective for increasing "skills" and less effective for increasing "knowledge". These results reinforce previous research that peer scaffolding increases engagement in student learning and performance (Rahmani et al., 2013), helps friends improve their understanding and cognitive development (Haider & Yasmin, 2015), and as a means to increase proficiency in skills. language (Abune, 2019). Peer scaffolding increases engagement in student learning and performance (Rahmani et al., 2013). The increase in students' abilities in this study was only categorized as "moderate" which is a natural thing to happen because the learning approach for adults (andragogi) is different from the approach to learning in adolescents and children (pedagogy) (Knowles, 1970). Adult students already have a mature self-concept, many and varied experiences, readiness to learn, and a more focused perspective on time (Tahar & Enceng, 2006). This is what causes "skills" to be more easily improved in students as adults compared to "knowledge".

The effectiveness of the learning program is recognized by students through self-assessment (Table 3). In table 3 it can be seen that before learning none of the students dared to state their abilities were "very good", but after learning almost all indicators there were students who claimed to have "very good" abilities. The situation happened the other way around, before learning, it was found that students stated that their abilities on several indicators were "poor" but after learning none of the students stated that their abilities were "poor". The self-improvement which was acknowledged by the students showed that the peer scaffolding going well. As stated by Towvn & Bepukois (2020) that students who have more abilities can help their friends in discussion groups. Furthermore, it was stated by Mitchell & Assadi, (2021) that the experience gained previously had a significant effect on student confidence and confidence. Thus, at the end of learning through self-assessment, students feel that their abilities have increased.

Table 3. Self-assessment of students' abilities

No	Abilities	Before (%)					After (%)				
		SB	**B**	**SDG**	**KRG**	**BR**	**SB**	**B**	**SDG**	**KRG**	**BR**
1	Understanding about performance appraisal	0.0	23.5	64.7	5.9	5.9	5.9	64.7	23.5	5.9	0.0
2	Determining the type of competence which can be measured by performance appraisal	0.0	17.6	58.8	23.5	0.0	5.9	70.6	17.6	5.9	0.0
3	Determine the type of performance appraisal	0.0	11.7	52.9	29.4	5.8	11.7	58.8	29.4	0.0	0.0
4	Describe competence into	0.0	11.7	41.2	29.4	17.6	5.9	41.2	47.1	5.9	0.0

	aspects of ability										
5	Preparing *task*	0.0	23.5	29.4	41.2	5.9	11.8	52.9	35.3	0.0	0.0
6	Preparing *rubrik*	0.0	11.8	23.5	64.7	0.0	0.0	52.9	47.1	0.0	0.0
7	Preparing observation sheet	0.0	11.8	41.2	47.1	0.0	0.0	58.8	35.3	5.9	0.0

Description: SB = very good; B = good; SDG = moderate; KRG = less; BR = poor

Based on the analysis of the tasks given, with this learning program students have been able to arrange tasks well. The following is an example task made by students which was developed from certain basic competencies shown in Figure 2. In Figure 2 it can be seen that task made is complete because the learning objectives have been written, the steps that students must take, and the time limit for processing. task has included aspects/criteria that become indicators of competency assessment, making it easier to create rubrics. In compiling rubrics, students also have good abilities. Aspects/criteria that are made are in accordance with the indicators of students' ability to conduct experiments is shown in Figure 3.

KD 1:

1. Menyajikan hasil percobaan tentang pembentukan bayangan pada cermin dan lensa

Melalui tugas ini kamu diharapkan dapat:

1. Mengetahui bayangan apa saja yang dapat dihasilkan dari cermin dan lensa.
2. Menyajikan laporan secara tertulis dan lisan terkait dengan hasil pengamatan pembentukan bayangan pada cermin dan lensa.

Lakukan kegiatan sebagai berikut:

1. Lakukan percobaan pembentukan bayangan menggunakan cermin dan lensa.
2. Catatlah sifat-sifat bayangan yang terbentuk pada cermin dan lensa.
3. Berdasarkan hasil yang kamu catat buatlah laporan sesuai format yang telah ditentukan.
4. Buatlah PPT untuk pesentasi dan diskusi.
5. Tugas ini diberi waktu 1 minggu.

Figure 2. Example task made by students

Tingkat Kemampuan	Skor	Aspek/Kriteria Penilaian				
		Menentukan sifat-sifat bayangan	Menjelaskan Dasar Teori	Menentukan alat dan bahan	Mengomuni-kasikan data	Menyusun kesimpulan
Sangat baik	4	Sifat bayangan yang dituliskan sudah lengkap dan benar.	Dasar teori sesuai, benar dan lengkap	Alat dan bahan tepat dan lengkap	data tentang sifat pembentukan bayangan sudah lengkap	Lengkap, berdasarkan data dan bahasa yang benar
Baik	3	Sifat bayangan yang dituliskan sudah benar.	Dasar teori sesuai, benar tetapi tidak lengkap	Alat dan bahan tepat tetapi tidak lengkap	Tabel data sistematis tetapi deskripsinya kurang lengkap	Lengkap, berdasarkan data namun bahasa yang kurang benar
Cukup	2	Sifat bayangan yang dituliskan sudah lengkap	Dasar teori sesuai, namun tidak benar dan lengkap	Alat tepat dan lengkap tetpi bahan tidak lngkap	Tabel data kurang sistematis dan deskripsinya kurang lengkap	Kurang lengkap, berdasarkan data namun bahasa yang kurang benar
Kurang	1	Sifat bayangan yang dituliskan belum lengkap dan tidak benar.	Dasar teori tidak sesuai, tidak benar idak lengkap	Alat dan bahan tidak tepat dan tidak lengkap	Tabel data tidak sistematis dan deskripsinya tidak lengkap	Tidak lengkap, kurang berdasarkan data dan bahasa yang kurang benar

Figure 3. Example of a rubric created by students

At the end of the learning program trial, students were asked for their opinions through a questionnaire. All students stated that the developed learning program made it easier for them to understand the subject matter, improve their ability to plan performance appraisals and improve their skills in developing performance appraisals (Table 4).

Table 4. Student opinions about the effectiveness of learning programs

No.	Student Opinions	Percentage	Reasons
1	The learning program makes it easier to understand the performance appraisal course material	100	Two-way communication and more flexible language from each group also add comfort when discussing understanding the material.
2	Learning programs improve the ability to plan performance appraisals	100	
4	Learning programs improve the ability to develop performance appraisals	100	

▪ CONCLUSION

This development research has resulted in a peer scaffolding-based learning program that is very valid in all its components i.e learning scenarios, teaching materials, and assessment instruments. This research concluded that peer-scaffolding based learning program was proven to be quite effective which is in the moderate criteria in improving students' abilities in developing performance appraisals. The product developed in this research is expected to be used by instructors, teachers and education stakeholders for educational purposes in the future.

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