Conceptual Validation of Project Based Learning in Buffer Solution

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ABSTRACT

This research was applied to the project learning model of supporting learning materials at high school SMAN 3 Jambi City. The learning model in the 2013 curriculum must fulfill the five steps scientific approach namely Observing, Asking, Experimenting, Collecting data, and Communicating, which is the goal of a learning model like this to make students understand learning well, educational design-based research that adopts the substance of the formative evaluation type with the characteristics of substance experts in procedural assessment, one-on-one evaluation, small group evaluation and field presentation. The concept of formative evaluation can be integrated with research and development method. The Project Based Learning (PjBL) model in Buffer Solution was using a development process type with a hybrid theory-based approach and directing eight-step practice. The theoretical steps are identifying data sources, collecting data and analyzing data, while the practical steps are generating model ideas, describing models, validating concepts and practitioners and formulating recommendations for testing models. The product was validated by a team of experts which includes practitioner validation to see the practicality of using the product being developed. A small group test was carried out to see the application of the product being developed. The results showed that learning chemistry using the PjBL model could increase the activity and results of students' chemistry learning on the concept of buffer solutions. The increase in student chemistry learning outcomes in the buffer solution concept can also be observed based on the value in general of the learning outcomes obtained by students in cycle I of 68.09 increased to 74.81 in cycle II and % completion in the classical way from 39.39 percent increased to 87.88 percent and this fulfills the marker of success is classical completeness reaching 85 percent with Minimum Completeness Criteria of 70.

Keywords: *Project Based Learning, Buffer Solution, Scientific Approach.*

INTRODUCTION

One of the components that determine the success of learning is learning outcomes. Learning outcomes can be known through various forms of evaluation, namely the process of collecting data so that what part of the learning objectives is known, how far, and in terms of what has been achieved. For educators, the results of this evaluation are very useful in the context of self-reflection. The results of reflection can be used to improve learning that will be carried out in the future. Based on the analysis of the results of the learning evaluation, it is known that the students find it difficult to answer the material correctly. While studying chemistry in high school, one of the materials that was considered difficult and confusing for students was buffer solutions. One reason is the abstract nature of the support material as it is at the microscopic level. The use of the PjBL model that takes place in class has a positive impact on students' skills. This cannot be separated from the advantages of the PjBL learning model, namely increasing students' abilities and skills in critical thinking creativity, being more actively involved in learning, and being able to integrate knowledge into the projects they are working on (Parmani, Sumiati, & Meliasari, 2019). Skills

and creativity are needed by students to complete projects, critical thinking is needed in the process of finding various informations and supporting references. Through learning the PiBL model according to improve students' abilities in terms of science skills and science processes.

Learning based project is approach effective education that focuses on thinking creative, solving problems, and interactions student with colleagues they for create and use knowledge new. This thing conducted specifically in context learning active, scientific dialogue with lecturer active mentor as researchers. Based on opinion that, learning based project is a learning strategy developed based on learning constructivist demanding school participant educate gather his knowledge themselves Constructivism is theory learning that gets Support broad based on ideas that participant educate construct knowledge that alone in context the experience alone. Approach learning based project could see as one approach creation environment learn what you can push participant educate reconstruct knowledge and skills personal mentions that learning based project have characteristics, namely: (a) participants educate as taker decisions, and make framework work, (b) there is problem whose solution no determined more first, (c) participant educate as a process. for reach results, (d) participants educate responsible answer for acquire and manage information collected, (e) perform evaluation Keep going continuously, (f) participants educate by regular see return what is usual they do , (g) result end in the form of product and quality evaluated, and (h) class have atmosphere that gives tolerance errors and changes.

Learning based project have potency big for create experience interesting and meaningful learning for student for enter the world of work. According to in learning based project applied for develop competence after participant educate work at a company, participant educate Becomes more active in learn, and much Skills for succeed built from projects in its class, such as build team, skills, taking decision cooperative, solving problem, and team management group. Skills the value when already enter environment work and is difficult skill taught through learning traditional.

Trend the start responded by the world of education in Indone0073ia which since year 2000 apply four approach education, namely (1) skill - oriented education life skills, (2) curriculum and learning based competence, (3) production - learning based, and (4) education based broad (broad-based education). Orientation new education that want to make institution as institution skills live, with purposeful education reach competence (next called based competence), with learning authentic and product contextual that can produce value and meaning for participant educate, and give service education based large through various paths and paths medium flexible multi in multi out. context of active learning, scientific dialogue with supervisors who are active as researchers. Based on this opinion, project-based learning is a learning strategy developed based on school constructivist learning which requires students to collect their own knowledge. Constructivism is a widely supported learning theory that rests on the idea that students construct knowledge themselves in the context of their own experiences. The project-based learning approach can be seen as an approach to creating a learning environment that can encourage students to reconstruct their personal knowledge and skills. stated that project-based learning has characteristics, namely: (a) students as decision makers, and makes a framework, (b) there are problems whose solutions are not determined in advance, (c) students as a process. to achieve results, (d) students are responsible for obtaining and managing the information collected, (e) carry out continuous evaluations, (f) students regularly review what they usually do, (g) the final results are in the form of products and quality is evaluated, and (h) the class has an atmosphere that tolerates error and change.

RESEARCH METHODS

In the context of educational design-based research that adopts the substance of the formative evaluation type from Tessmer with procedural substance characteristics of expert assessment, one-on-one evaluation, small group evaluation and field testing. Evaluation concept formative can be integrated with Analysis, Design, Development, Implementation, and Evaluation (ADDIE) framework development research.

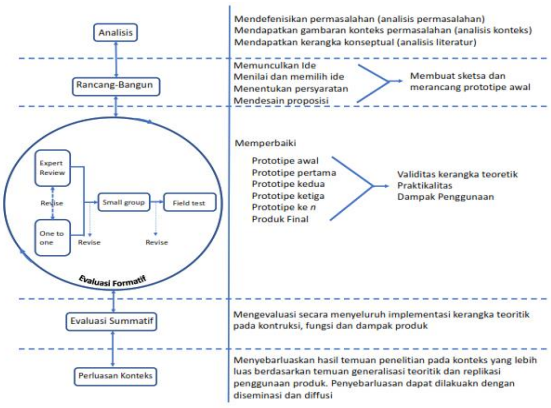

Figure 1. The design in the ADDIE

Analysis

Conceptual Model Development includes model development and product development. This study of the development of learning model procedures is included in the category of model development. Model development is development carried out to build and validate a model related to education to achieve certain goals

The stages of the scaffolding development process in the PjBL model are explained as follows:

1. Identify data sources
   The first step is to define data sources to support the development of scaffolds in the PjBL model. Identification of data sources is carried out to identify data that can facilitate process based on the PjBL model to first analyze development needs. The data includes curriculum, constructivist learning models and material characteristics of acid and base solutions and their learning procedures.
2. Data collection
   The data collection stage was carried out by reviewing the literature from books, journals, articles and other relevant sources related to the development of the scaffolding process in the PjBL model. The data collection stage also aims to obtain data as information to support the development of scaffolding in the survey model. The data includes curriculum, constructivist learning models, proximal development zone (ZPD), various types of scaffolds, PjBL learning models, PjBL model syntax. The advantages and disadvantages of the PjB model. scientific process skills, indicators of scientific process skills and documentation of acids and bases as well as related learning and research processes.
3. Data analysis
   This data analysis step is carried out by associating information from the data that has been obtained. Then check this data so that each approach can be linked based on the information needed to develop the scaffolding process in the PjBL model.
4. Generate ideas
   The idea stage is carried out by finding an integration model from the data obtained, then turning it into steps that provide scaffolding in the PjBL model. In addition, a review was also carried out on the process of providing scaffolding in the PjBL model to ensure the completeness of one approach to another. Scaffolding products in the PjBL model were developed to be applicable in the learning process in the form of algorithmic plots and teacher and student worksheets as learning media. The creation of this flow aims to make it easier for prospective educators to implement the education system in the learning process. In line with this, the purpose of making Student Worksheets (LKPD) as learning media is also to make it easier for educators to apply scaffolding during the learning process.

RESULTS AND DISCUSSION

In the Lee, J., L and Jang, S model in Rusdi (2018) by applying the following stages:

1. Define data sources

The purpose of determining the data source is to support the development of the Project Based Learning model. The data obtained are: the curriculum used in this study uses the revised 2013 curriculum. Based on the impact of Vygotsky's concept in children generally learn through interaction, the curriculum must be designed to emphasize the interaction between the learner and the learner's task. Therefore, the researchers chose basic competencies (KD) 3.12 Explaining working principles, pH calculations, and the role of buffer solutions in living organisms and KD 4.12 Making buffer solutions with a certain pH. The constructivism learning paradigm is needed to help students overcome problems in learning, because in the 2013 curriculum students are required to be independent in developing the information received. Yamin (2012) states that there are three emphases in constructivist theory. First; the active role of students in constructing knowledge meaningfully, second; the importance of making connections between ideas in constructing meaningfully. Third; linking new ideas and information received. Constructivism learning theory is based on two theories, Piaget's theory and Vygotsky's theory. In this study the characteristics of the students were in class XI MIPA with an average age of 16 years. Based on this age, it is known that students are included in the formal operational stage category. According to Piaget's theory in Slavin (2011), formal operations are around the age of 11 to adulthood, in which case abstract and purely symbolic thinking is possible. the active role of students in constructing knowledge meaningfully, second; the importance of making connections between ideas in constructing meaningfully. Third; linking new ideas and information received. Constructivism learning theory is based on two theories, Piaget's theory and Vygotsky's theory. In this study the characteristics of the students were in class XI MIPA with an average age of 16 years. Based on this age, it is known that students are included in the formal operational stage category. According to Piaget's theory in Slavin (2011), formal operations are around the age of 11 to adulthood, in which case abstract and purely symbolic thinking is possible. the active role of students in constructing knowledge meaningfully, second; the importance of making connections between ideas in constructing meaningfully. Third; linking new ideas and information received. Constructivism learning theory is based on two theories, Piaget's theory and Vygotsky's theory. In this study the characteristics of the students were in class XI MIPA with an average age of 16 years. Based on this age, it is known that students are included in the formal operational stage category. According to Piaget's theory in Slavin (2011), formal operations are around the age of 11 to adulthood, in which case abstract and purely symbolic thinking is possible. Constructivism learning theory is based on two theories, Piaget's theory and Vygotsky's theory. In this study the characteristics of the students were in class XI MIPA with an average age of 16 years. Based on this age, it is known that students are included in the formal operational stage category. According to Piaget's theory in Slavin (2011), formal operations are around the age of 11 to adulthood, in which case abstract and purely symbolic thinking is possible. Constructivism learning theory is based on two theories, Piaget's theory and Vygotsky's theory. In this study the characteristics of the students were in class XI MIPA with an average age of 16 years. Based on this age, it is known that students are included in the formal operational stage category. According to Piaget's theory in Slavin (2011), formal operations are around the age of 11 to adulthood, in which case abstract and purely symbolic thinking is possible. Riyanto (2010) also states that formal operational theory is referred to as the hypothetical-deductive operational stage which is the highest stage of intellectual development. Meanwhile, Vygotsky's theoryemphasizes more on the assistance that educators can provide to students to overcome problems that students are unable to answer. This is in

accordance with the opinion of Konzulin et al., (2003) that the emphasis lies on Vygotsky's theory, namely on mediated learning which plays an important role in modern constructivism thinking. Scaffolding is an aid so that students can get rid of the problems that arise in the Zone of Proximal Development (ZPD). According to Vygotsky every child has what is called the Zone of Proximal Development, which is said to be the distance between the actual level of development and a higher level of potential development. In this case Vygotsky argued that students would be able to reach the maximum area if they were assisted sufficiently. If students study without assistance,

In applying KD 4.12, the researcher uses the PjBL learning model which consists of 6 stages. Project-based learning steps were adapted from Keser and Karagoca in Hosnan (2014), namely; (1) Determining basic questions, (2) Designing project plans, (3) Arranging schedules, (4) Monitoring students and project progress, (5) Testing results and (6) Evaluating experiences. Science process skills are one of the skills that arise from the application of the PjBL model. According to project-based learning is effective for developing students' science process skills and science attitudes. The results of the analysis in the research of Suhanda & Suryanto (2018) show that the application of a project-based learning model can improve KPS in all aspects. The achievements of each aspect of the PPP are interrelated. Good observing skills will have an impact on improving aspects of asking questions and predicting Improvement of aspects of asking questions and predicting affect improving aspects of formulating hypotheses and designing experiments. The results of the increased implementation of project work resulted in increased skills in applying concepts, communicating results well.

The increase in science process skills occurs because project-based learning focuses on concepts that involve students in project work activities, provides opportunities for students to work autonomously, constructs the knowledge they have and ultimately produces products and then presents them (Siwa et al., 2013). Students are also more confident in doing practicum and demonstrating more professional observational skills as well, so that it has an impact on increasing the value of other KPS indicators (Suhanda & Suryanto, 2018) The instructional design used in this study is the instructional design of Morrison et al., (2013) which consists of 9 elements, namely (1) recognizing the need for learning, (2) analysis of students and the environment, (3) learning sequence,

2. Collecting data

The data collection stage is carried out by reviewing the literature from books, journals, articles and other sources that are relevant and related to the development of scaffolding procedures in the PjBL model. As for the data obtained at this stage can be seen in Table 1.

Table 1. Literature Study Results

Data	Results
curriculum	2013 revision
Constructivism learning paradigm	Constructivism is a psychological theory of knowledge which states that humans construct and interpret knowledge from their own experiences (Danarjati, et al, 2014). There are two supporting theories 1. Piaget's theory of constructivism explains that a person's knowledge is formed by the person himself (Rahyudi, 2012). 2. Vygotsky's theory explains that learning occurs through social interaction in the development of one's learning (Baharudin and Esa, 2015).
PjBL Research	Project Based Learning (PjBL) is a learning model that uses projects/activities as media. Students carry out exploration, assessment, interpretation, synthesis, and information to produce various forms of learning outcomes. Characteristics of Project Based Learning (PjBL) 1. Learners make decisions about a framework; 2. There are problems or challenges posed to students 3. Students design a process to determine the solution or problem or challenge given;

	4. Students are collaboratively responsible for accessing and managing information to solve problems; 5. The evaluation process is carried out continuously; 6. Learners periodically reflect on the activities that have been carried out. 7. The final product of the learning activity is evaluated qualitatively; and 8. The learning situation is very tolerant of mistakes and changes.
Buffer solution	1. Based on the results of the misconception analysis conducted by Parastuti et al., (2016) it was concluded that there were five main causes of misconceptions, namely 1) weak initial knowledge, 2) problems with symbols and mathematical formulas, 3) difficulty understanding the context in buffer solutions, 4) problems and generalize the concept. 2. The nature of a buffer solution is a solution that can maintain its pH even if a little acid or a little base is added. 3. The composition of a buffer solution consists of a weak acid and its conjugate base or a weak base and its conjugate acid. Chemical reaction equation, Bronsted Lowry acid-base concept. 4. The working principle of a buffer solution has components that can withstand increases and decreases in the pH of a solution.

3. Analyze data

The data analysis stage is carried out by associating information from the data that has been obtained. Then examine these data so that each approach can be related according to the information needed in developing scaffolding in the PjBL model. As for the results of this data analysis, it was found that there is a relationship between the syntax of the PjBL model, scaffolding and science process skills. Of the six PjBL syntaxes, each syntax must be given an example of four types of scaffolding that educators can use. In each of these syntaxes, their relationship with the improvement of students' science process skills is also analyzed which can be raised. The results of the relationship between the PjBL model syntax, scaffolding and science process skills can be seen in Figure 4.1. The use of scaffolding also helps improve students' science process skills. Based on research conducted by Tasiwan (2014) project-based learning is effective for developing students' science process skills and science attitudes. Suhanda & Suryanto (2018) added that students are also more confident in doing practicums and will also show more professional observation skills, which will result in an increase in the value of KPS indicators. So that the impact that occurs on students according to Parmani et al., (2019) is that they can be motivated in learning, increase the creativity of students in producing products from the projects they work on, can improve critical thinking skills through activities to seek information from many sources and materials, science process skills and science attitudes. Suhanda & Suryanto (2018) added that students are also more confident in doing practicums and will also show more professional observation skills, which will result in an increase in the value of KPS indicators. So that the impact that occurs on students according to Parmani et al., (2019) is that they can be motivated in learning, increase the creativity of students in producing products from the projects they work on, can improve critical thinking skills through activities to seek information from many sources and materials, science process skills and science attitudes. Suhanda & Suryanto (2018) added that students are also more confident in doing practicums and will also show more professional observation skills, which will result in an increase in the value of KPS indicators. So that the impact that occurs on students according to Parmani et al., (2019) is that they can be motivated in learning, increase the creativity of students in producing products from the projects they work on, can improve critical thinking skills through activities to seek information from many sources and materials,

4. Come up with ideas

The stage of generating ideas is carried out by looking for integration patterns from the data obtained and then transforming them into the stage of providing scaffolding to the PjBL model in the form of products that can be used in the learning process. Scaffolding products in the PjBL model were developed to be applicable in the learning process in the form of algorithmic plots and teacher and student worksheets as learning media.

Student worksheets for educators and students are in the form of practicum implementation procedures for identifying

buffer solutions. However, the LKPD of educators and students has quite significant differences, the difference is in the LKPD of educators for each PjBL model syntax that can be used. Whereas in student worksheets, each PjBL model syntax contains activities that must be carried out during the learning process. The material in LKPD educators and students is made the same. this aims to make it easier for educators to provide explanations related to the subject matter. In the final stage, the LKPD is equipped with an evaluation using questions to test students' understanding after implementing the learning process using the PjBL model.

The next stage after the product has been made is to validate its eligibility and usability. Feasibility validation was carried out to a team of experts while applicability to practitioners.

Practitioner/educator validation is an assessment of the usability and practicality of the developed LKPD. This validation aims to obtain an assessment of the suitability of each approach used in the procedures in the PjBL model based on the experiences of educators carrying out the learning process. The assessment was carried out by the three educators who taught at SMA N 3 Jambi City.

Based on the evaluation of the product, the results obtained are; for the accuracy of the assistance provided for flow and LKPD, it can already help students in the learning process because it is in accordance with the syntax of the PjBL model. Experimental procedures are arranged and implemented coherently and using language that is easy to understand. So that the product is easy to implement and accessible to as many users as possible and can save time and effort during the learning process. This will have an impact on increasing student understanding

In terms of material, it can be understood because the material and illustrations presented are in accordance with reality and are relevant to the material buffer solution. This can reduce the learning load to be smaller for students, but the success of its use depends on the situation, conditions and character of the child when learning. Therefore educators provide suggestions for more flexible or easy sample materials such as acids, bases and colloids.

Based on the results of the three educators' assessment of usability and practicality, it can be concluded that it is good. However, it is necessary for researchers to carry out training in further use for educators. This is what researchers realize because explaining the procedures for using LKPD for educators is limited by time, due to the activities of educators in schools.

After evaluating the product by validators and practitioners, the researchers conducted a small-scale test to see usability and accuracy.

The research focuses on the 6 syntaxes of the PjBL model and looks at the problems experienced in class and finds the right help to help solve the problems encountered. This research was conducted in four meetings, in this case each meeting discussed the syntax. The first meeting focused more on discussing syntax 1, determining fundamental questions, followed by an explanation of the buffer solution material and explaining tasks for the next meeting. The second meeting focused on discussing syntax 2 designing project planning and syntax 3 arranging schedules. The third meeting focuses on syntax 4 monitoring students and project progress. The fourth meeting focuses on discussing syntax 5 testing results and syntax 6 evaluating experience.

For syntax (1) determining basic questions, there are 3 questions in the LKPD At this stage, questioning assistance was chosen to be an effective aid of 60% because it was the most widely used. This is because students do not understand and have not been able to connect material that has been studied previously with a buffer solution. Because students are just entering the buffer solution material, for this reason the role of educators is more in this activity to help students understand the buffer solution material as well as helping students recall the pre-requisite material for learning buffer solutions.

Based on the results of the study, students were able to answer the questions asked. Because this question is an open-ended question, students can find information from books, the internet and other sources. This question is also to practice improving students' science process skills, namely observing where students collect as much relevant information as possible. Then

students interpret and relate the results of their observations and answer the questions provided. Furthermore, students are able to ask questions again or ask for further explanations to the educator.

Frey and Fisher (2010) argues that student responses provide educators with insight into what the learner knows and does not know at the time. An educator with content knowledge and a deep understanding of how novice learners approach new concepts - quickly hypothesizes the learner's current state and responds with encouragement, cues, or direct explanations and modeling when needed. The ability to expose a learner's understanding or partial understanding requires anticipating misunderstandings and asking powerful questions.

CONCLUSION

Researchers have created a more specific conceptual framework by using buffer solution material in the PjBL model which aims to improve science process skills in each syntax of the model. The research focuses on the six syntaxes of the PjBL model and looks at the problems experienced in class and finds the right way to solve the problems encountered. The increase in student chemistry learning outcomes in the buffer solution concept can also be observed based on the value in general of the learning outcomes obtained by students in cycle I of 68.09 increased to 74.81 in cycle II and % completion in the classical way from 39.39 percent increased to 87.88 percent that fulfills the marker of success is classical completeness reaching 85 percent with minimum completeness criteria of 70.

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