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Validity of Project Based Integrated Environmental Science Problem Learning (PBIESPL) Model with Authentic Assessment

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Abstract: This study aims to develop a learning model that can improve students' collaboration and communication skills. The learning model developed is called the PBIESPL (Project Based Integrated Environmental Science Problem Learning) with authentic assessment. This study used research and development methods with reference to Borg and Gall consisting of preliminary study, development, and testing. The validity of the learning model was carried out by 20 science learning experts and analyzed using the Lawshe method. The results of the validity test of the PBIESPL learning model with authentic assessment showed an average CVR = 0.99, which means it is very valid. Based on the results of this study, it is known that the PBIESPL learning model with authentic assessments can be implemented by educators in their classroom learning because it can improve students' collaboration and communication skills and then can facilitate educators in assessing student skills.

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Introduction

Education aims to prepare students to face the challenges of real-life situations and global competition (Quieng, Lim, & Lucas, 2015;Hidayah, Salimi, & Susiani, 2017). Innovation in education is needed to make the world a better place, which depends on educators' quality as the main actors(Wijayanti & Hartati, 2018). Educators are not enough to form students into intelligent individuals, but students need to be equipped with various skills to be independent, superior, tough, and able to face various challenges in the 21st century.

Skills in communicating and collaborating are essential for students because they will make it easier for individuals to face global competition in the 21st century(Redhana, 2019). Collaboration and communication skills can be developed by educators using an active learning model because active learning can strengthen and expedite the stimulus and response of students. Learning becomes something exciting and entertaining (Larasati & Rasid, 2018). These two skills support each other in-group team discussions. Communication between discussion group members will not be effective unless the message can be received and understood. It means that to collaborate effectively, functional communication skills are necessitated; and, effective communication can be carried out to facilitate collaboration.Communication skills are needed in learning because communication in the learning process involves building relationships or interactions that share thoughts, knowledge, and understanding between educators and students (Chung, et al., 2014). Based on these beliefs, there is no reason for educators not to integrate collaboration and communication skills in learning.

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Vol. 8, No. 2 : June 2022
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pp. 341-354
Email: jklppm@undikma.ac.id

The 2013 curriculum requires educators to carry out learning and assessments relevant to the challenges of the 21st century. Learning experiences from simple to complex can be applied by educators in learning to develop the potential and competencies of students. In 2013 Curriculum learning, educators can package learning by utilizing various facts or problems in the environment around students (Hairida & Setyaningrum, 2020). Science learning cannot be separated from the community environment. A lot of knowledge and skills obtained by students in science learning can be related to the environment. The findings of the preliminary study indicate that educators have implemented project-based learning, but their find it difficult to guide students in finding solutions to problems that exist around the community. Therefore the educators need a model that can help them to overcome these problems.

The development of a learning model by integrating project-based community problems with authentic assessments was developed with reference to active learning and the findings of preliminary studies at SMPN 2 Pontianak, MTsN 2 Pontianak, and SMPN 16 Pontianak. The learning model developed consists of 5 (stages) consisting of *read and see*, *sharing sessions with experts*, *discussion teams*, *presentations*, and *product revisions*. The stages of this learning model are organized in such a way that educators have no difficulty in guiding students to work together to complete a project, conduct assessments, and develop collaboration and communication skills. Each stage contains an operational description of the activities of educators in learning so that it will make it easier for educators to prepare for learning. The purpose of this research is a learning model suitable for use in science learning in junior high schools, so that collaboration and communication skills of students can be improved.

Research Method

This research is part of the research on developing an integrated learning model for project-based environmental problems (PBIESPL) with an authentic assessment. Research and development were a series of processes or procedures to develop a new product or improve existing products so that they can be accounted for The development in this research was an integrated learning model of project-based environmental problems with by authentic assessments to develop collaboration and communication skills. The stages of research carried out in this development research were adapted from the development procedure according to Borg & Gall (1989) consisting of preliminary study, development, and testing. The preliminary study stage was conducted to study the facts about science learning and the needs of educators and students at SMPN 2 Pontianak, MTs Negeri 2 Pontianak, and SMPN 16 Pontianak. Then, it was continued with a theoretical study relevant to the study results at school. This activity analysis was carried out as a basis for the development phase, namely conceptual formulation and drafting of the learning model guide, which contained the background, supporting theory, and phases of the learning model. The testing phase was conducted with content and empirical validation activities of the developed product.

Experts validated the draft of the developed learning model guide in the Focus Group Discussion (FGD) activity. The validation carried out is content validity. This activity was attended by 20 (twenty) experts,namely five assessment experts, ten science learning experts, and five science/chemistry material experts. The expert came from FKIP Tanjungpura University Pontianak, FKIP Muhammadiyah University Pontianak, and junior high school science educators.The purpose of the FGD activity was to discuss aspects of supporting theory, phases and learning activities, and the language in the PBIESPL model's syntax. FGD participants responded and filled out the assessment format for each aspect and

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

the comments column provided. Furthermore, the readability test was administered by providing a draft learning model guide to 10 junior high school educators. The results of the readability test were utilized to improve the draft of the learning model guide so that it becomes a suitable learning model guide for use in learning.

This research product is a learning model guide that contains the background for developing learning models, supporting theories, and phases of learning model activities. The activity phases in the learning model were developed based on field studies and constructs that were synthesized from supporting theories. For this reason, it is crucial to carry out validation of the research product. The first activity carried out theoretical validity in the form of content validity. The accuracy or suitability of the product developed with field studies and supporting theories were tested for content validity.

Measurement of content validity can be done using the Lawshe method (Lawshe, 1975; Hairida, 2017; Bashooir &Supahar, 2018). Lawshe (1975) proposed a method called content validity ratio, which is measured by the rater or rater on his agreement to content validity. This method is quite detailed because its validity is influenced by the number of raters and the rating scale used. The more detailed the description of the measuring instrument, the more it will be believed that the measuring instrument is precise(Kevin Murphy & Davidshofer, 2005).This method is employed to measure the understanding of 20 raters about the product developed from supporting theory, phases of learning activities, and the language contained in the model syntax. Scoring uses three rating scales, namely essential (score = 3), valuable but not essential (score = 2), and unnecessary (score = 1) with statistical techniques of understanding among raters. The formula used is as follows:

$$CVR = \frac{2ne}{n} - 1$$

Notes:
CVR : Content Validity Ratio
n_e : number of SME (Subject Matter Expert) who evaluates an “essential” item
n : number of SME who performs the assessment
The calculated CVR value was then compared with the minimum table CVR value based on the one-sided significance test with p = 0.05. If the calculated CVR is greater than or equal to the table CVR, the item is declared important or valid. The methods section must be able to explain the research methods used, including how they are carried out. Research tools, materials, media or instruments must be well explained. If there is a statistical formula that is used as part of the research method, it is better not to write a formula that is generally accepted.

Results and Discussion

The research and data collection activities results through field and literature studies indicate problems with educators and students in science learning in junior high schools, especially in project-based learning. Educators have not utilized the problems surrounding the students' environment in science learning, and educators have not maximally developed collaboration and communication skills in learning. The complete results of the first phase of activities can be seen in Table 1.

Table 1. The Research Findings and Information Gathering Phase Activities

No	Tools of Data Collecting	Activity Findings
1.	Interview guidelines for	1. Educators have linked early learning activities with problems found from textbooks but did not choose problems that are

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Vol. 8, No. 2 : June 2022
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pp. 341-354
Email: jklppm@undikma.ac.id

	educators and a checklist for reviewing the Learning Implementation Plan (RPP) for educators.	close to the environment or already known by students. 2. Educators have designed and implemented project-based learning however the problems did not come from the surrounding environment. 3. The dominant teacher's learning resources are the textbooks used. 4. Students often do not respond to questions asked by educators in learning. 5. Students have carried out group discussion activities with heterogeneous group divisions, but group discussions have not been optimized, so the learning objectives are not achieved. Some dominate, and some do not speak during group discussions. 6. Educators have not carried out an assessment of the process or students' performance in learning. 7. Educators find it difficult to guide students in finding solutions to problems (projects).
2.	Interview Guidelines for Students	1. Students find it difficult to find problems in the environment nearby and find solutions. 2. The educator has not explained the division of tasks for each member of a group. 3. There are no rules in group discussions. 4. A challenging task, so that they have to work hard to complete it together with the team that is rarely given by educators. 5. They are not responding well to reading assignments or other tasks given by science educators at the end of each lesson. 6. Lack of guidance from educators in completing projects given by educators. 7. During group discussion, there is no assessment by the educators. Students have difficulty in designing project activities

The results of the field study data analysis were compared with the synthesis of the relevant theoretical studies used as the basis for the next research activity, namely product development, in the form of a draft PBIESPL learning model with authentic assessment (Table 2).

Table 2. Draft Phases and Activities of the PBIESPL Learning Model with Authentic Assessment

Fase	Activity
Read and See	1. Educators divide heterogeneous groups and send video material about environmental pollution (pre-activity). 2. Students make observations on the state of the community environment (real-life) and determine one of the problems used as a project. Educators guide students in determining the selected project. 3. Students make videos of observations of surrounding problems and collect them for educators.

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

	4. Educators conduct authentic assessments (video rubric from observations).
Sharing session with Expert	1. Educators invite experts/resource persons (project planning, graphic/video design, manufacture of products (e.g., soap, water purification equipment, posters, videos, etc.) in accordance with the project theme (pollution) to assist students in designing and making projects selected. 2. Learners and experts conduct discussions guided by educators in designing project plants and making project products. 3. Students work collaboratively in their respective group's design projects and manufacture project products. 4. Educators conduct authentic assessments.
Discussion team	1. Educators distribute LKPD to each team. 2. Each team is asked to discuss collaboratively and actively use LKPD to make project reports and improve the project's product based on input from experts under the guidance of educators. 3. Educators conduct authentic assessments in the form of process assessments, namely assessing activeness in group discussions and collaboration skills using observation sheets of activeness in discussions and self-assessment of collaboration skills assessments.
Presentations	1. Students (group representatives) are asked to explain/answer questions (presentations) related to the project they are working on. 2. Educators conduct authentic assessments. 3. Educators reinforce the results of each group's presentation.
Product Revisions	1. Students discuss in groups to improve the project product. 2. Educators go around observing and guiding groups that have difficulties/errors in improving the product. 3. Educators conduct authentic assessments

The testing phase was validated by an *expert* using a questionnaire. Before the questionnaire was used to assess the product, qualitative content validation was carried out first with 4 validators who had expertise in the field of evaluation (Table 3).

Table 3. Results of Qualitative Product Development Questionnaire Validation

Validator	Suggestion	Revision
1	It is better to replace item number 7 with another 21st-century skill because item 9 already implies group work in collaboration.	The PBIESPL learning model contains activities to develop critical thinking skills
2	The principle of the project-based learning model has not been included	The principle of the project-based learning model, namely student-centered learning that involves tasks in real life, is clearly stated.
3	The concept of “project assignment” is different from the experiment that has not been included in the aspects assessed.	Project assignments emphasize research activities based on a clearly stated theme or topic in the lesson.

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

4	In the aspects that are assessed, it is necessary to add the outcomes produced in learning.	The PBIESPL learning model produces products from project activities in the form of reports and products.

Suggestions from experts are constructive to improve the validation questionnaire of the integrated learning model around project-based problems. Furthermore, the revised questionnaire was used to carry out the third activity, namely testing the developed product. The test was handled quantitatively by 20 experts who have expertise in the field of science learning. Then, the results were analyzed using Lawshe's formula (Table 4).

Table 4. The Calculation Results of the Lawshe Formula Testing the PBIESPL Learning Model with Authentic Assessment

Aspects	Rated aspect	CVR	Criteria
Supporting Theory	1. The PBIESPL learning model phase is relevant to the theory of student centered learning and project based learning.	0,99	VV
	2. The PBIESPL phase is relevant to constructivist theory	0,99	VV
	3. The skills or behaviors expected in the PBIESPL learning model phase are relevant to 21st century skills theory.	0,99	VV
PBIESPL Learning Model Structure	1. The PBIESPL learning model contains activities that must be carried out by educators	0,99	VV
	2. The PBIESPL learning model contains activities that students must complete	0,99	VV
	3. The PBIESPL learning model contains a scientific approach	0,99	VV
	4. The PBIESPL learning model contains surrounding problems that students must solve	0,99	VV
	5. The PBIESPL learning model contains activities to construct students' knowledge.	0,99	VV
	6. The PBIESPL learning model contains authentic assessments that must be carried out by educators at each phase of the activity.	0,99	VV
	7. The PBIESPL learning model contains activities to develop critical thinking skills	0,99	VV
	8. The PBIESPL learning model contains activities to develop collaboration skills.	0,99	VV
	9. The PBIESPL learning model contains activities to develop students' communicative skills	0,99	VV
	10. The principle of the project-based learning model, namely learner-centered learning that involves real-life tasks, is clearly stated	0,99	VV
	11. Project assignments emphasize research activities based on a clearly stated theme or topic in the lesson.	0,99	VV

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Aspects	Rated aspect	CVR	Criteria
	12. The PBIESPL learning model has provided information to educators to prepare teaching materials / learning resources needed in learning	0,99	VV
	13. The PBIESPL learning model produces outcomes from project activities in the form of reports and products.	0,99	VV
	14. The PBIESPL learning model has taken into account the problems often faced by educators in the classroom.	0,99	VV
	Average CVR	0,99	VV

Note : VV = Very Valid

The average CVI value is 0.99, which means it is very valid. Thus, the PBIESPL learning model is profoundly proper for science learning to improve students' collaboration and communication skills, although there are still some revisions. Revision of the model is carried out by considering suggestions from experts. A summary of suggestions from experts qualitatively can be seen in Table 5.

Table 5. The Validation Results of PBIESPL Learning Model with Qualitative Authentic Assessment

Expert	Suggestions	Revisions
1,5,7,8,9,10, and 20	Phase 1 is added with plan activities, namely designing project plans, so that when guided by experts, students already have a picture of the project to be worked on. In addition, to deal with the issue of time if it is carried out during the discussion phase in class. This activity is often a complaint of educators because the time used by students is always insufficient.	Phase 1 was originally only a "read and see" activity, becoming a "read, see, and plan" phase.
2,3,4,7,10, 11,15, and 19	To make it easier for students to design project plans, educators make simple project plan examples and distribute them to each group. It will encourage educators to learn about "projects" in science learning in junior high schools before designing and implementing project-based learning.	In the explanation of the activities of educators, it is added: "The teacher prepares a simple sample project plan and distributes it to all groups to discuss at home".
3,5,6,8,12, 13,14,16, and 18	The type of authentic assessment that must be designed by educators has not been included in the activity	It is necessary to add the type of authentic assessment in the description of educator activities.

The draft phase of the PBIESPL learning model with authentic assessment after testing byshown *experts* underwent revisions asin Table 6.

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

Table 6. Phases of the PBIESPL Learning Model After Revision

Phase	Activity
Read, See, and Plan	1. Educators form teams by dividing heterogeneous groups with the tasks of each member and team leader, as well as sending video materials about environmental pollution and examples of simple project plans. 2. Each team observes and discusses videos and examples of simple project plans. If there are difficulties, the team can contact educators to gain access to guidance. 3. Each group team observes the condition of the community environment (real-life) and determines one of the problems that will be used as a project. 4. Each team discusses collaboratively making videos of observing activities around problems and designing simple project plans from observations. Then send videos and simple project plans to educators. 5. Educators conduct authentic assessments of videos and simple project plans using the product assessment rubric (videos and simple project plans).
Sharing session with Expert	1. Educators invite experts (project planning, graphic/video design, manufacture of products, e.g., soap, water purification equipment, posters, videos, etc.) in accordance with the project theme to assist students in perfecting the project plant and making products from the project. 2. Teams and experts discuss guided by educators in perfecting project plants and product manufacturing. 3. Educators conduct authentic assessments in the form of process assessments, namely the assessment of attitudes of cooperation and responsibility through self-assessment and assessment of communication skills during team discussions with experts using the observational assessment rubric.
Discussion team With Teacher	1. Educators distribute LKPD to each team. 2. Each team was asked to discuss collaboratively and actively use LKPD to make project reports and refine the project's product based on input from experts under the guidance of educators. 3. Educators conduct authentic assessments in the form of process assessments, namely assessment of activity in group discussions and collaboration skills using observation sheets of activeness in discussions and self-assessment of collaboration skills assessments.
Presentations	1. Each team (representative of the group) is asked to present a project report and the project's product. 2. The other teams were asked to submit suggestions or questions to the team that made the presentation. All team members are asked to be active. 3. Educators conduct authentic assessments in the form of process assessments, namely assessing presentation skills using observation sheets and assessment rubrics.

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

	4. Educators reinforce the results of each team's presentation.
Product Revisions	1. The team discusses improving the project report and the product of the project. 2. Educators observe and mentor teams that experience 3. difficulties/mistakes in perfecting project reports and project products. 4. Educators carry out authentic assessments in product assessments, namely the project report assessment rubric and the project product assessment rubric..

The illustration of the five-phase flow in the PBIESPL learning model phase above can be shown in Figure 1.

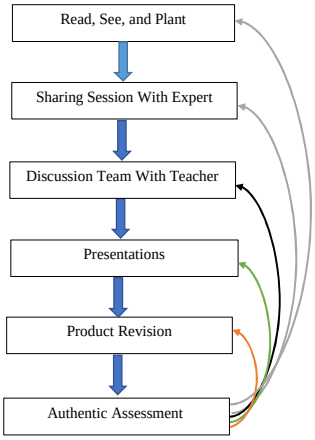

Figure 1. PBIESPL Learning Model Phase Flow

Discussion

Research activities are generally divided into three stages of activity, namely introduction, development, and testing. The findings of the activities in the preliminary stage of research, namely from field studies and theoretical studies, show that educators have the difficulties in implementing project-based learning, as well as in carrying out assessments. Students also experience problems in designing plans for projects to be implemented.

The analysis of the first stage is used as a reference in product development activities so that the learning model product developed refers to project-based learning. Project activities can train students' critical thinking skills because students are allowed to use their knowledge critically and creatively to produce products (Robinson, 2013). Project-based learning is suitable to facilitate students in developing 21st-century skills. Project-based learning is based on constructivism, which means prioritizing the active activities of students in developing learning experiences educators are generally only an assessment of the final learning activity. The assessment carried out is not under the performance of students in learning on the grounds of difficulties in carrying out authentic assessments. Authentic assessment is not easily carried out by educators, because of the habit of educators who have often used traditional assessment as the only tool to assess the competence of students (Handrianto & Rahman, 2018). Project-based learning (PBL) is a learning method that uses problems as the first step in collecting and integrating new knowledge based on experiences in actual activities (Pérez, Hernáiz, et al., 2021; Ricaurte & Viloria, 2020). The result of the preliminary stage is the PBIESPL learning model which consists of phases, namely: *read and see, sharing sessions with experts, presentations, and product revisions*. Each phase in learning activities is based on constructivism and authentic assessment carried out.

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

The first phase of the PBIESPL learning model consists of two activities: *read and see*. In this phase, students are invited to be active through reading activities first, learning resources and examples of *plant projects* simple through videos before observing the state of the environment around the community *(real life)* to determine a problem as a project. Project activities can develop students' critical thinking skills because students are allowed to implement their critical and creative knowledge to produce something or a new product (Asdarina & Johar, 2019). Active learners are characterized by activities such as reading, writing, asking questions, observing, exploring attitudes and values, by developing higher-order thinking skills through analysis, synthesis, or creation exercises (Felder & Brent, 2009).Through reading learning resources about the material to be taught and examples from planning a project, both provided by educators and looking for themselves, it is hoped that students will understand the activities to be carried out. Reading activities are not enough in this 21st century; students must be trained to be sensitive to the surrounding environment. Furthermore, students are asked to do "see" activities, namely observing the environment nearby. The most widely used science learning resource as a science learning resource is from the surrounding community. Community activities can be observed directly by students (Hadi, et al., 2020).

The second phase is a sharing session with experts through discussions with experts to solve problems, followed by the third phase of a team discussion guided by educators with the help of LKPD (Student Worksheet). In active learning, the strategy of learning by listening alone will make students forget quickly. However, by hearing and seeing, they will remember a little; by listening, seeing, and discussing with other students, they will understand; and by listening, seeing, discussing, and doing activities, students will gain knowledge and skills (Fatimah & Hidayah, 2021).The problems faced by society in the 21st century are very complex, so team discussions to collaborate in solving problems are very important in learning.Collaborative emphasis on teamwork in realizing a common goal (Hairida, et al., 2021). Knowing how to solve problems, work collaboratively, and think innovatively is something that needs to be considered in this 21st century learning (Efstratia, 2014).

The use of project-based worksheets in team discussions is beneficial for educators in guiding students. Educators face obstacles when implementing project-based learning because project-based student worksheets (LKPD) are not well prepared (Yusriani, Arsyad, & Arafah, 2020). In addition, learning also runs less smoothly because educators will be stuck with activities that do not lead to the main learning or activity phase (Kosasih, 2017). Educators can develop LKPD from daily activities or community habits (Hairida & Setyaningrum, 2020). Therefore, project-based worksheets developed from surrounding problems are particularly suitable for direct students in group discussion activities. In group discussions, the role of educators in guiding is also vital. The supervisor directs in discussing strategies for collaborating to achieve common goals, communicate effectively, respect friends when talking, and not dominate in discussions, collaborating, so those common goals are successfully achieved. During group discussions, students always want to be directed by educators, are less able to work independently, not all group members are actively working, only one or two people are actively working, and cannot complete projects on time (Wahyuni, 2016).Successful learning depends on adequate communication skills (Fredericks & Alexander, 2021).Thus, communication and collaboration skills in group discussion activities can be developed through the guidance of educators.

The fourth phase is presentations to communicate the results of the project reports that have been discussed. In this phase, the role of educators in guiding the discussion is

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

emphasized. Educators guide students to make project reports to become confident when presenting presentations (Hairida & Junanto, 2018). On the other hand, the fifth phase focuses on product revisions through project product improvement activities resulting from discussions with the guidance of educators.

The research findings of the third stage, namely product testing, are used to improve the draft of an integrated learning model for project-based environmental problems. Suggestions from experts to add a planned activity in the model phase is appropriate because project-based learning educators often experience excessive learning time constraints in discussion activities to design project plans in class. On the other hand, the weakness of the project-based learning model is the use of a relatively long time in its activities so that it passes the available lesson hours (Asmi, Hasan,& Safitri, 2017; Yusriani, Arsyad,& Arafah, 2020). The plan of the project was pre-designed by the group team at home. It overcomes the problem of time in project-based learning. Educators first design a simple sample project plan to be distributed to each group in a video before observing the surrounding environment. This activity provides benefits for students and educators. In addition, the videos that must be studied will make students try to read a lot and be sensitive to the surrounding environment (Khadijah & Nursakiah 2020). Designing this simple project plan will also "force" educators to read and understand project-based learning. Researchers also found that educators were still not familiar with the phases and were less able to determine projects that were in accordance with the project-based learning model (Yusriani, Arsyad, & Arafah, 2020).

Authentic assessment in the PBIESPL learning model is critical because the activities carried out by students vary during the learning process. This resulted in each phase of the PBIESPL model asking educators to develop authentic assessments. Experts suggest that authentic assessment in project-based learning based on the performance carried out by students in learning includes the type of assessment because it will reduce the difficulty of educators in determining the type and example of the assessment. Techniques that can be applied in project-based learning are test (description) and non-test techniques through observation (portfolio of practicum activities, projects, and presentations) (Saputra, Abdullah,& Hakim, 2013). Project assessment is an activity of assessing group project assignments in preparing project plans, compiling project schedules, project work processes, project reports, and testing products produced by students from project assignments. In the project design, assessment criteria and rubrics are also required (Roessingh & Chambers, 2011). So for the type of authentic assessment in the PBIESPL learning model, cognitive assessment types can be used using HOTS description questions with scoring guidelines, assessment of attitudes, skills, and products along with their respective rubrics.

Conclusion

This study has resulted a PBIESPL learning model with authentic assessment using research and development method. Based on the result of content validity with average CVI value is 0,99 which belong to the “very valid” category, so that this model can be applied in learning to improve students' collaboration and communication skills in SMPN 2 Pontianak, MTsN 2 Pontianak, and SMPN 16 Pontianak. This research can be developed to determine the practicality and effectiveness of the PBIESPL learning model with authentic assessment.

Recommendation

Recommendations that can be made when teachers implement the PBIESPL learning model are choosing appropriate learning materials such as environmental pollution materials on science subjects because not all materials can be applied to this model. This is for the

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Vol. 8, No. 2 : June 2022
E-ISSN: 2442-7667
pp. 341-354
Email: jklppm@undikma.ac.id

purpose of making authentic assessment optimally possible and can improve students' collaboration and communication skills.

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