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Development of PBL Based E-Student Worksheet Using an Ethnoscience Approach to Improve Students' Character Values and Conservation Attitudes on Redox Material

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Abstract: The study aimed to develop a PBL Integrated Ethnoscience-Based e-Student Worksheet focused on redox material, ensuring its validity, and to determine its impact on enhancing students' character values and conservation attitudes. Utilizing the Research and Development (R&D) approach with the Plomp model, the study incorporated various data collection methods such as interviews, student questionnaires, validation sheets, and user response surveys. Validation involved assessments from three material experts and media specialists. Initial trials encompassed one-on-one assessments with students of varying abilities and feedback from teachers and students. The larger-scale trial adopted a pre-experimental Pretest-Posttest Control Group design. The outcomes revealed that the e-Student Worksheet achieved high validation scores from both material and media experts, while feedback from users indicated its effectiveness. Importantly, significant improvements in students' character values and conservation attitudes were observed post-implementation of the e-Student Worksheet, as confirmed by paired t-tests. In summary, the use of the Flip Builder application in crafting the E-Student Worksheet, grounded in PBL and ethnosciences, not only received strong validation but also positively impacted students' character development and conservation perspectives.

Keywords: E-student worksheet; Ethnoscience; PBL; Redox

Introduction

The purpose of national education is to give birth to a generation with a concrete and intact national personality, who has the spirit of nationalism and has a sense of pride in the ownership of a national culture as a national identity (Dodi, 2019; Triyanto, 2020). Learning planning in the curriculum cannot be separated from the values that exist and are held by the community (Andrian et al., 2019). Education is a process of bringing what is learned in school to what is happening in the community (Hashim, 2018; O'Flaherty et al., 2018; Salmon, 2019).

Schools are the second institution after the family which plays an important role in instilling life values in individuals which refers to the implementation of character education. At school, individuals are taught how these life values must be realized in everyday life (Nantara, 2022). Schools are required to be able to shape the character of students through learning activities in class and outside the classroom, as well as having programs that are able to shape the character of students at school (Kholifah, 2020). The role of school as a place for the formation of students' character is considered important and has quite a big influence. Teachers are required to continue to develop themselves and be able to be role models for students to form good character (Saleh, 2022). One of the school activities that can shape and develop the character of students is learning activities. With learning activities, teachers can help shape and develop the character of students through the process and evaluation of learning activities (Aprilia, 2023).

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Based on initial observations, researchers found that the character values of class Students tend to be indifferent to existing surrounding problems. This can be caused by a lack of implementation of character values in the learning process. According to Suparno (2015) character education aims to help students experience, obtain and have the desired strong character, however there are still many school institutions that have not implemented character values, especially the value of caring for the environment in learning so it is not surprising that Graduates of school institutions have good academic grades, adequate skills, but attitudes and behavior as a reflection of positive character are still questionable.

One effort that can be taken is to develop learning models that suit the curriculum and student characteristics. Ethnoscience is a new breakthrough in the world of education. Ethnoscience is indigenous knowledge that belongs to a particular tribe or group (Sudarmin, 2014). In another sense, it is explained that ethnoscience is the knowledge or beliefs community groupsfrom one generation to the next that can influence the interpretation and understanding of society (Fasasi, 2017). Based on the opinions of the two previous experts, it can be synthesized that ethnoscience is the activity of integrating the original knowledge of a community or tribe passed down from generation to generation with scientific knowledge. According to Wati et al. (2021) with ethnoscience-based learning students will find it easier to find facts and phenomena that exist in a group of people and can be combined with scientific science. So that the results of ethnoscience can be utilizes as a source of student learning in culture-based science learning in schools (Syazali et al., 2022).

Apart from that, learning science using an ethnoscience approach can instill character values and make students care more about the surrounding environment (Ratna, 2018). The character of caring for the environment can be developed by applying conservation values as an effort to overcome the problem of environmental damage. These conservation values can be achieved through a continuous learning process and implemented from an early age (Harianti, 2017). One example of an attitude that is not in accordance with conservation values is littering (Helida et al., 2019). Environmental damage has occurred in schools and the surrounding environment, because the character of child conservation is still very minimal, seen from facts in the field such as the large number of children who still throw rubbish carelessly, scribble on tables or walls, do not turn off the tap after washing their hands, etc. able to water and care for plants, and not yet able to tidy up tools and materials after carrying out learning activities (Nisa et al., 2021). This is because the teacher is too passive, does not emphasize the importance of conservation character towards children, the rules given by the teacher are not clear enough, and the teacher does not tell enough about the consequences of the deviant behavior above, and the teacher does not give children the opportunity to explore their own knowledge (Nisa et al., 2021).

The low conservation value in the learning process can result in students only working around their school. Without feeling that there is something that needs to be saved for conservation and long-term use. In general, students are aware that there are problems around them, but the lack of support and the low nature of existing conservation means that students only accept it without taking action to carry out reforms (Nuhraha, 2023). Such situations require teachers to be able to design the learning process and present material creatively and innovatively by implementing various learning models that can explore and improve students' conservation values and behavior in a lesson such as chemistry learning (Fitria, 2020).

Instilling character values and conservation attitudes in students through the surrounding community which is specifically coordinated with the scientific ideas they learn, so that students can reflect on the wonders that exist in the general environment can be done by providing ethnoscience-based learning. Because ethnoscience is a study of societal culture and phenomena related to nature that exist in society. This learning will invite students to observe and examine their traditional environment through the lens of modern science (Susanti, 2018).

According to Imansari et al. (2018), the use of local cultural aspects in learning (ethnoscience) is also known to be able to bridge students with aspects of science and everyday life. Moreover, it is also known that ethnoscience can increase students' motivation and interest in learning (Sudarmin et al., 2015). Through ethnoscience, students are introduced to local wisdom in the surrounding environment related to chemical materials, so they are expected to be able to train their character values and caring attitude towards the environment (Asrial et al., 2021).

Based on the results of initial observations with teachers and students at SMA Negeri 6 Pekanbaru, they think that redox reaction material is material that is difficult for students to understand compared to other materials, this is proven by the students' learning results. Based on the daily test scores for redox reactions, it is known that students' incompleteness shows that the average percentage of incompleteness in redox reaction material is very large, 60%. This difficulty is because redox reaction material is material that deals with the increase and decrease of oxidation numbers which is abstract in nature. According to research by Faudah (2021), one of the teaching materials containing

ethnoscience on redox reaction material that is suitable for use as teaching material is Student Worksheet. Moreover, the presence of learning tools (such as Student Worksheet) is known to influence the smooth process of delivering learning to students (Wijayanti et al., 2015).

Student Worksheet combined with the PBL model makes students more able to explore their abilities in finding their own concepts, while also helping students to solidify the concepts of the material they are studying (Jasperina et al., 2019). Problem-based learning is a learning approach that uses real-world problems to teach students critical thinking and problem-solving skills. They also learn theory and concepts from class material or physical subjects (Anazifa et al., 2017; Yew et al., 2016). Problem-based learning emphasizes learning as a process involving problem solving and critical thinking in a real-world context (Demirel et al., 2016). The problems presented in PBL-based Student Worksheet should be contextual/real so that students have an interest in the material they are studying (Yuliandriati et al., 2019). This can be done by utilizing aspects of local wisdom that exist in society or known as ethnoscience. According to Haspen et al. (2021) ethnoscience found in the environment around students will help them understand lesson material easily because they can see and feel the original science contained in society.

Student Worksheet can be made in electronic form, so it becomes e- Student Worksheet (Farkhati et al., 2019). Using e- Student Worksheet is one way to enrich students' mastery of material. In current technological developments, the majority of students who are generation Z think that teaching materials based on other media such as computers/laptops and smartphones are more interesting than print-based teaching materials such as printed Student Worksheet (Wardani et al., 2022). Apart from that, the content in e-Student Worksheet is more diverse, not only in the form of narratives, images and graphics like printed Student Worksheet, but also contains various features such as audio, music, animation, video and links that can be clicked directly. The diverse content makes e- Student Worksheet interactive which will attract students' attention and make them more comfortable using it during learning (Fajriani et al., 2021).

The results of a literature review from several relevant studies, including those conducted by Yasin (2020) and Faudah (2021), regarding research into the development of teaching materials in the form of e-Student Worksheet based on PBL integrated ethnoscience on redox material, received a positive response from students. Then Andayani et al. (2021) also researched that the ethnoscience approach in chemistry lessons can help form students' character values. Apart from that, ethnoscience research by Andayani et al. (2021) found that ethnoscience-based chemistry teaching materials can support students' conservation behavior.

Based on existing phenomena, researchers conducted research with the aim of finding out and describing that the implementation of education that is oriented towards character values and conservation behavior greatly influences student behavior. Researchers describe character education as instilling and developing noble characters in students, so that they have good behavior to apply in their lives. The implication of this study is that an ethnographic science approach can encourage teachers and educational practitioners to teach science based on local culture, wisdom, and existing problems in society. , so that students can understand and apply the science they learn in the classroom that can be used to solve problems.

Method

The research on the development of the PBL integrated Etnosains e-Student Worksheet was designed using a research and development (R&D) design using the Plomp model. The Plomp model consists of three phases, namely preliminary research phase, development or prototyping phase and assessment phase (Plomp, 2013). Implementation study development this held in Postgraduate Program in Chemistry Education, FKIP, Riau University. The trials were carried out at S MAN 6 Pekanbaru, SMAN 1 Pekanbaru and SMA N 14. The sampling technique used in this study is purposeful sampling. The purposeful sampling method is the sampling methodused by taking into account certain considerations (Aldila et al., 2022; Campbell et al., 2020; Etikan, 2016). Certain considerations in the purposive sampling technique were carried out to obtain a research sample that was in accordance with the needs of the researcher. This study took an experimental class by paying attention to the characteristics of students. Sugiyono (2018) state that technique *purposive sampling* is technique taking sample source data with certain considerations. Population is the entire object observed in the study (Barus et al., 2018; Casteel et al., 2021; Charles-Edwards et al., 2020). In the development stage, the entire population of students in class XI IPA S MAN 6 Pekanbaru, SMAN 1 Pekanbaru and SMAN 14 Pekanbaru who had studied redox material was used . For the purposes of small-scale product testing, namely one-on-one testing involving 3 students from class XI Science at SMAN 6 Pekanbaru who have high, medium and low academic levels. User responses involved 3 teachers and 30 people students of class XI S MAN 6 Pekanbaru, SMAN 1 Pekanbaru and SMAN 14

Pekanbaru. Then the population in the large-scale trial was all students in class X at SMAN 6 Pekanbaru. After that, a research sample was obtained. The sample is part of the population that has the same properties and characteristics so that it can represent the entire population under study (Anderson et al., 2017; Mohammadi et al., 2021; Natsir, 2017). The samples used were students in classes X Science 3, X Science 4, X Science 5 and X Science 6 at SMAN 6 Pekanbaru.

The data collection techniques used were interviews, questionnaires, validation sheets, teacher response questionnaires, student response questionnaires, character values questionnaires and redox material conservation attitude questionnaires and documentation.

Validation Sheet Analysis

The validation assessment was carried out by 6 expert lecturers as validators, namely 3 material experts and 3 media experts. Giving meaning and making decisions about product quality *e*-Student Worksheet based PBL integrated ethnoscience using the *flip builder application* in redox will use the achievement level conversion in Table 1.

Table 1. Validity Criteria for Validator Assessment Questionnaire Data (Arikunto, 2019)

Percentage (%)	Criteria
81-100	very valid
61-80	valid
41-60	invalid
21-40	invalid
< 20	very invalid

Analysis of Teacher Response Questionnaires

The teacher response questionnaire assessment was carried out by 3 chemistry teachers to obtain teachers' responses to the use of PBL-based Ethnoscience-based e-Student Worksheet teaching material products on redox material in the chemistry learning process. The results of the average score from the teacher response questionnaire that were obtained were then converted into qualitative data to determine the criteria for using PBL-based Ethnoscience based e-Student Worksheet which can be seen in Table 2.

Table 2. Questionnaire Response Criteria Interval (Arikunto, 2019)

Percentage (%)	Criteria
81-100	Very good
61-80	Good
41-60	Pretty good
21-40	Not good
< 20	Very not Good

Analysis of the Influence of Teaching Materials

After the data is collected, the next stage is analyzing the data and interpreting the results. Data analysis was carried out with the aim of seeing whether the hypothesis proposed was accepted or rejected. The data analysis stage includes the normality test aims to see whether the data is normally distributed or not. The normality test can be carried out using the *Kolmogrov-Smirnov test* using SPSS 26.

Hypothesis testing in this research was carried out on data on students' character values and conservation attitudes. Hypothesis testing in this research is the t test which can be carried out if the data obtained is normally distributed. *Independent sample t-test* hypothesis testing was carried out with the help of SPSS V 23**.**

Result and Discussion

Results and discussion in every phase model development Plomp will be explained further.

Preliminary Research

Front end analysis was carried out by interviewing three chemistry teachers in SMAN 6 Pekanbaru, SMAN 1 Pekanbaru and SMAN 14 Pekanbaru. The interview results showed that chemistry lessons were considered difficult and less interesting. This can be caused because chemistry is related to abstract, complex material and requires intellectual intelligence and greater effort to understand it (Susilaningsih et al., 2019). According to Akram et al. (2017) the lack of student interest in chemistry can be caused by several factors, including the methods used by teachers in the learning process that are not in accordance with the methods preferred by students. This problem is a challenge that teachers must face in presenting chemistry lessons to students, so that the selection of teaching materials, methods and learning models is an important thing that must be considered.

Based on interviews, the teaching materials used by teachers in chemistry lessons, especially redox materials, are printed teaching materials, such as textbooks and worksheets. The only electronic-based teaching materials used by teachers so far are in the form of PPTs. The results of the interview show that teachers have been able to integrate technology in chemistry learning, but this has not been maximized due to limited electronic teaching materials that can be used, so there are still obstacles in trying to meet the challenges of the industrial era 4.0 and the 21st century, as is expected in the implementation of the curriculum. 2013. For example, several technology-based learning media in the 21st century are starting to be widely used in academic circles. In line with the argument put forward

by Karno (2015) "E-learning is used during the learning process.

Student analysis was carried out with the aim of knowing the condition of the students' learning process before conducting the research. The subjects of this research were students in class Jean Piaget in the theory of cognitive development stated that at adolescence , a person is already in the formal operational thinking stage. This means that teenagers are able to think logically and draw conclusions from formal theoretical reasoning based on ratios and hypotheses. At this stage, teenagers can think flexibly, effectively and can handle complex problems. He can see all the elements and possibilities that exist and know which ideas are suitable for the problems he faces (Ibda, 2015). This statement is taken into consideration in preparing material concepts in the teaching materials being developed.

Development or Prototyping Phase

The prototype phase is the core stage of the Plomp development model because there is a design for an e-Student Worksheet prototype based on PBL integrated Ethnosains using the flip builder application as a form of solving problems found in the preliminary research phase . There are two stages carried out in this phase, namely content design and prototype appearance design.

The contents of the e-Student Worksheet prototype based on integrated Ethnoscience PBL are prepared referring to indicators achievement of competencies and learning materials that have been described in the material analysis stage. The contents of the e -Student Worksheet are taken from sources, namely high school/MA chemistry books, college chemistry books and the internet which are relevant to redox material . The learning activities prepared in PBL-based Ethnoscience based e-Student Worksheet refer to aspects of Problem Based Learning (PBL), namely the orientation of students on problems that contain ethnoscience aspects.

The e-Student Worksheet display based on PBL integrated Ethnoscience is carried out by compiling n storyboards (Appendix 7). A storyboard is a series of diagrams that show the sequence of displays and visualization of ideas from the prototype created, so that it can provide an overview of the resulting prototype (Widyaningrum et al., 2021).

The prototyping process is the process of realizing the design in a storyboard that has been previously designed into a PBL integrated Ethnosains based e-Student Worksheet prototype in its actual appearance. The application used is the flip builder application. This application has advantages, namely that users can insert various content in the form of audio, music, flash animation, video and hyperlinks in teaching materials. Flip builder can also be published with many options other than flash based, such as html and exe which can be accessed both offline and online.

Assessment Phase

Material validation by validators aims to assess PBL-based Ethnoscience-based *e-* Student Worksheet based on aspects of appropriateness of content, pedagogy, appropriateness of language and graphics. Material validation by 3 validators was carried out twice for each aspect which will be explained further . The average percentage results for each aspect of the material validation assessment can be seen in Table 3.

Table 3. Percentage of Material Expert Validation Results

Rated aspect	Percentage (%)	
	Validation I	Validation II
Content Eligibility	77	95
Pedagogy	86	96
Language Assessment	63	92
Graphics	81	95
Average	79	95

The material validation stage was carried out twice. In the first validation, the average percentage obtained from the 4 aspects was 79% with the valid category. Even though valid results were obtained, in the first validation, suggestions were also obtained from each material validator to improve the e-Student Worksheet, so that the researcher carried out a second revision and validation in order to obtain an even better PBL-integrated Ethnoscience-based e-Student Worksheet. After revisions were made based on suggestions from the validator, in the second validation the percentage rose to 95% with a very valid category.

Media validation by validators aims to assess Ethnoscience-based e-Student Worksheet integrated PBL redox materials based on aspects of e - Student Worksheet size , cover design and e - Student Worksheet content . Media validation by 3 validators was carried out twice for each aspect which will be explained further. The average percentage results for each aspect of the media validation assessment can be seen in Table 4.

Table 4. Media Expert Validation Results

Rated aspect	Percentage (%)	
	Validation I	Validation II
Size of e- Student Worksheet	79	88
Cover design e- Student Worksheet	71	92
Design e-Student Worksheet content	79	93
Average	77	92

The media validation stage was carried out twice. In the first validation, the average percentage obtained for the 3 aspects was 77% with the valid category. Even though valid results were obtained, in the first validation, suggestions were also obtained from each media validator to improve the e-Student Worksheet, so the researchers carried out a second revision and validation in order to obtain an even better Ethnoscience based e-Student Worksheet integrated with redox material PBL. After revisions were carried out according to the validator's suggestions, in the second validation the percentage rose to 92% with a very valid category.

A small-scale trial was carried out after the Ethnosains based e-Student Worksheet integrated PBL redox material was assessed for its validity based on the material and media until it was declared very valid. Small-scale testing consists of 2 methods, namely one-on-one testing and user response.

The one-on-one test of Ethnoscience-based e-Student Worksheet integrated PBL redox material involved 3 class XI students at SMAN 6 Pekanbaru who had studied redox material in class low. Based on interviews with students in one-on-one tests, clarity the learning on e-Student Worksheet is considered to be good, it's just that there is limited vocabulary not standard so it must be corrected. In the aspect of impact for users, participants students assess that e-Student Worksheet has a positive impact on them because it can make them better understand the material presented in various content multimedia and e-Student Worksheet given Also easy used as well as in accordance with mindset participant educate.

User responses with chemistry teacher response questionnaire data at 3 schools, namely SMAN 6 Pekanbaru, SMAN 1 Pekanbaru and SMAN 14 Pekanbaru. User responses involving teacher assessment are carried out by first providing e-Student Worksheet based on PBL integrated Ethnoscience material redox, then the teacher is given time to look at the e-Student Worksheet carefully before giving an assessment using a response questionnaire.

Table 5. Teacher Response Questionnaire Data

Respondent	Percentage (%)	Criteria
Teacher 1	83.3	Very good
Teacher 2	87.5	Very good
Teacher 3	91.7	Very good
Average	87.5	Very good

The teacher's response to Ethnoscience based e-Student Worksheet integrated PBL redox material was overall considered very good with an achievement percentage of 87.5%. These results are in line with research on the development of e-Student Worksheet by Apriani et al. (2021) who obtained teacher response assessment results with an average percentage of 90% which was categorized as very good.

The stage of obtaining user responses from the results of the student response questionnaire involved 30 class XI Science students with 10 people each from 3 different schools, namely SMAN 6 Pekanbaru, SMAN 1 Pekanbaru and SMAN 14 Pekanbaru. Data collection for response questionnaires involving students is carried out by giving e-Student Worksheet to students, then they are given time to assess the e-Student Worksheet using a response questionnaire. The results of the student response questionnaire can be seen in Table 6.

Table 6. Student Response Questionnaire Data

School	Percentage (%)	Criteria
SMAN 6 Pekanbaru	91.8	Very good
SMAN 1 Pekanbaru	90.4	Very good
SMAN 14 Pekanbaru	92.3	Very good
Average	91.5	Very good

Based on Table 6, it can be seen that the results of distributing questionnaires to obtain student responses at 3 schools obtained an average of 91.5%. This means that Ethnoscience-based e-Student Worksheet integrates redox material PBL which has been developed has received a very good response from students. These results are in accordance with research on the development of e - Student Worksheet by Apriani et al. (2021) who obtained student response assessment results with an average percentage of 87% in the very good category.

Test try scale big is stage implementation from material teach Which developed. This stage is carried out with the aim of knowing effectiveness and the influence of Ethnoscience based e-Student Worksheet integrated PBL material redox that has been developed towards character values and environmental conservation. Influence e-Student Worksheet to character value will see through data pretest-posttest participant educate use instrument questionnaire Which made based on character indicators while the influence of e-Student Worksheet on the environment will seen through data pretest-posttest participant educate use environmental indicators.

Character value data was obtained from the results of a questionnaire given to students to determine the level of character values before and after using Ethnoscience based e-Student Worksheet integrated PBL redox material. This data can be seen in Table 7.

Table 7 shows that the character scores of students in experimental classes one and two got a combined average percentage of 62% and 58% before using e-Student Worksheet and increased to 77% and 83% after using e-Student Worksheet based on Etnosains integrated PBL redox material. Meanwhile, control

classes one and two got a combined average percentage of 61% and 60% before learning and it can be said that there was no improvement after learning the redox material. This data shows that students' character values increased after taking part in learning using Ethnoscience based e-Student Worksheet integrated PBL redox material.

Table 7. Data on Student Character Value Results

Learning interest indicators	Percentage (%)							
	Before				After			
	E-1	E-2	K-1	K-2	E-1	E-2	K-1	K-2
Responsibility	62	58	59	59	79	80	61	60
Discipline	60	57	68	60	79	85	60	62
Polite	64	62	62	62	78	81	63	63
Cooperate	63	58	59	60	76	83	61	58
Honest	60	55	58	58	73	84	65	57
Composite Average (%)	62	58	61	60	77	83	62	60

Information:
E-1 : Experimental Class 1
E-2 : Experimental Class 2
K-1 : Control Class 1
K-2 : Control Class 2

The normality test was carried out using the SPSS version 24 application by looking at the results of the Kolmogorov-Smirnov test with a significance level of 0.05. The Kolmogorov-Smirnov method is a normality test method that is effective and valid for large samples. Regarding the number of samples to be tested, "If the number of samples tested is >50, Kolmogorov-Smirnov is used, whereas if <50 samples are tested, Shapiro-Wilk is used" (Dahlan, 2010). Data from the normality test results of character value data can be seen in Table 8.

Table 8. Normality Test Results for Character Value Data

Character Value Data	Kolmogorov-Smirnov		
	Statistics	df	Sig.
experiment-1 before	0.128	32	0.200
experiment-1 after	0.150	32	0.064
experiment-2 before	0.132	36	0.118
experiment-2 after	0.147	36	0.057
control-1 before	0.136	36	0.089
control-1 after	0.128	36	0.146
control-2 before	0.159	34	0.059
control-2 after	0.139	34	0.096

Table 8 shows that the data values for students' character values before and after using e-Student Worksheet each obtained a significance value of > 0.05. This means that the data on students' character values is normally distributed because it has a value of sig> 0.05. Based on these results, test the character value hypothesis will be carried out with parametric statistics using the independent sample t test.

Paired t test carried out with the help of the SPSS version 24 program. Hypothesis testing criteria using paired t test is that if the sig value is >0.05 then H0 is accepted and Ha is rejected, but if the sig value is <0.05 then Ha is accepted and H0 is rejected. The results of hypothesis testing on student character value data can be seen in Table 9.

Table 9. Hypothesis Test Results Character Value Data

		F	Sig.	t	df	Sig. (2-tailed)
Mark	Equal variances assumed	41.355	0.000	4.689	62	0.000
	Equal variances not assumed			4.689	40.913	0.000

Table 9 shows that the results of the hypothesis test are character value data with paired t test obtained a significance value of 0.000. This means that Ha is accepted because the sig value is < 0.05, so it can be stated that there is a significant difference from the implementation of PBL based Ethnoscience based e-Student Worksheet on character values. Class X students at SMAN 6 Pekanbaru. Based on this statement, it can be concluded that e-Student Worksheet based on Ethnoscience integrated PBL has an effect on character values students on redox material. The results of this research are in line with research by Hulandari et al. (2022) that the implementation of PBL integrated e-Student Worksheet has an effect on character values students who are seen from character values which increased after participants used e-Student Worksheet in chemistry learning. Then research by Widyaningrum (2018) shows that the application of Ethnoscience-based e-Student Worksheet has an effect on character values students who are seen from character values which increased after participants used e-Student Worksheet in chemistry learning.

Conservation attitude data was obtained from the results of a questionnaire given to students to determine the level of conservation attitude before and after using Ethnoscience based e-Student Worksheet integrated PBL redox material. This data can be seen in Table 10.

Table 10 shows that the conservation attitude of students in experimental classes one and two got a combined average percentage of 58% and 62% before using e-Student Worksheet and increased to 80% and 82% after using e-Student Worksheet based on Etnosains integrated PBL redox material. Meanwhile, control classes one and two got a combined average percentage of 62% and 60% before learning and it can be said that there was no significant improvement after learning the

redox material. This data shows that students' conservation attitudes increased after participating in learning using Ethnoscience based e-Student Worksheet integrated PBL redox material.

Table 10. Data on the Results of Students' Conservation Attitudes

Learning interest indicators	Percentage (%)							
	Before				After			
	E-1	E-2	K-1	K-2	E-1	E-2	K-1	K-2
Environmental Protection	55	62	61	56	83	85	66	61
Environmental Preservation	57	62	60	58	79	79	64	63
Environmental Utilization	63	61	65	65	78	82	69	69
Composite Average (%)	58	62	62	60	80	82	66	64

Information:
E- 1 : Experimental Class 1
E- 2 : Experimental Class 2
K- 1 : Control Class 1
K- 2 : Control Class 2

The data from the normality test for conservation attitude data can be seen in Table 11.

Table 11. Normality Test Results for Conservation Attitude Data

Conservation attitude data	Kolmogorov-Smirnov		
	Statistics	df	Sig.
experiment-1 before	0.111	32	0.200
experiment-1 after	0.171	32	0.058
experiment-2 before	0.126	36	0.162
experiment-2 after	0.143	36	0.061
control-1 before	0.098	36	0.200
control-1 after	0.103	36	0.200
control-2 before	0.137	34	0.105
control-2 after	0.115	34	0.200

Table 11 shows that the data values for students' conservation attitudes before and after using e - Student Worksheet each obtained a significance value of > 0.05. This means that the data on students' conservation attitudes is normally distributed because it has a sig value> 0.05. Based on these results, the conservation attitude hypothesis test will be carried out with parametric statistics using the independent sample t test.

The results of hypothesis testing on students' conservation attitude data can be seen in Table 12. Table 12 shows the results of hypothesis testing for conservation attitude data using the paired t test obtained a significance value of 0.000. This means that Ha $_{is}$ accepted because the sig value is < 0.05, so it can be stated that there is a significant difference in the implementation of e-Student Worksheet based on integrated PBL Ethnoscience on the conservation attitudes of class X students at SMAN 6 Pekanbaru. Based on this statement, it can be concluded that e-Student Worksheet based on Ethnoscience integrated PBL has an effect on students' conservation attitudes towards redox material. The results of this research are in line with research by Utari et al. (2021) that the application of the PBL integrated e-Student Worksheet developed can be used to instill environmental conservation attitudes in students.

Table 12. Hypothesis Test Results Data on Conservation Attitudes

		F	Sig	t	df	Sig. (2-tailed)
Conservation attitude	Equal variances assumed	6.461	0.014	9.940	62	0.000
	Equal variances not assumed			9.940	49.375	0.000

Conclusion

Utilizing the Flip Builder application, the E-Student Worksheet designed based on the PBL and ethnosciences approach has successfully achieved very satisfactory validation. This validation covers various crucial aspects such as content validity, instructional approach, language use, and the graphical presentation of the redox material. Moreover, the technical aspects of the E- Student Worksheet, including its size, cover design, and content, have also been acknowledged to possess excellent quality based on assessments. Furthermore, the implementation of this e-Student Worksheet has received positive feedback from its users, including teachers and students, indicating the effectiveness of the approach adopted. Data collected from surveys indicate a significant improvement in students' character values after using this e-Student Worksheet. Further analysis using paired t-tests also confirms that the PBL approach combined with ethnosciences effectively enhances students' character. Additionally, a positive impact is also observed in the increase of students' conservation attitudes, evidenced by a notable rise in survey results regarding conservation attitudes post e-Student Worksheet implementation, as further supported by the paired t-tests conducted.

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