



Project-Based Learning E-Module: Analysis of Student Response and Its Correlation to Responsible and Independent Characters

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Abstract: This research aims to examine students' responses to implementing PjBL-based e-modules and their correlation with responsible and independent characters. A quantitative approach was employed, involving a sample of 68 eighth-grade students from SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi, selected through purposive sampling. The study utilized research instruments such as student response questionnaires regarding PjBL-based e-modules, responsible character questionnaires, and independent character questionnaires. Data were analyzed using t-tests and correlation tests. The findings indicate significant differences between the two schools regarding student responses to PjBL-based e-modules, responsibility, and independence. A significant correlation was found between students' responses to PjBL-based e-modules and their responsible characters, responses to PjBL-based e-modules and independent characters, and between responsible and independent characters within each school. The study concludes that student responses to PjBL-based e-modules correlate with their character development. These results enhance teaching and learning through technology, ultimately fostering positive character formation among students.

Keywords: e-module; independent character; project-based learning; responsible character; student responses

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INTRODUCTION

In the 21st century, technological developments have proliferated, significantly impacting various aspects of human life, including education (Iqbal et al., 2022; Jan 2017; Meyer & Norman, 2020). As an important component of further educational development, technology provides students with opportunities to improve their problem-solving skills and supports teachers in optimizing their learning processes (Asrial et al., 2023; Makarova et al., 2019). The success of technical integration in education depends mainly on the teacher's ability to adapt it to the teaching method. With effective implementation in schools, technology plays an important role in improving the quality of teachers and students by supporting educational goals (Andriani et al., 2018; Sanova et al., 2022; Sima et al., 2020). In addition, technology promotes innovation in learning experiences that positively improve the overall quality of education (Aldila et al., 2022). One of the most effective applications of technology in education is the development of digital educational materials to enrich the learning process.

Educational materials are important in supporting educational and learning activities in schools. For educators, educational materials function as a means of designing and structuring learning, but for students, educational materials contribute to skill development (Arani, 2017; Lawrence & Tar, 2018; Uerz et al., 2018). One of the influential innovations in educational materials is the electronic module (e-module), a digital-based learning media that can be accessed anytime, anywhere through various platforms (Fahmi et al., 2021; Sumarmi et al., 2021). As a modern learning resource, the electronic module combines multimedia elements such as photography, audio, animation, and video to make learning more interactive and engaging (Prasetya, 2021; Rahayu et al., 2022). In addition, electronics can be integrated into various learning models, such as project-based learning (PjBL), to enhance students' learning experiences' effectiveness. Based on previous studies, Prihatiningtyas and Sholihah (2020) found that students responded very positively to the E-module based on project-based learning (PjBL). Similarly, Rendra et al. (2018) concluded that teachers and students reacted favorably to developing PjBL-based e-modules. Additionally, Astiti et al. (2015) stated that using PjBL-based e-modules can enhance students' motivation and enjoyment of learning. Furthermore, Rahimah et al. (2022) emphasized that developing these modules helps students better understand and apply physics concepts in real-life situations, particularly in studying sound waves.

In this study, PjBL-based e-modules are utilized to support science learning. Science, as described by [Susilowati \(2017\)](#), is an integrated discipline that includes products, processes, attitudes, and technology. It involves understanding complex natural phenomena and their applications in daily life ([Ismiyanti, 2020](#); [Jufrida et al., 2019](#); [Zidny et al., 2020](#)). Science education introduces scientific concepts that students can relate to real-world situations ([Aldila, Matondang et al., 2020](#); [Wulandari et al., 2020](#)). In schools, science learning provides students with direct experiences utilizing scientific attitudes and process skills through technology. One of the key topics in eighth-grade science is "effort and simple machines," where effort refers to a force that causes an object to move in the same direction, while simple machines are tools designed to make human tasks easier. [Arif \(2017\)](#) emphasized that science learning is inherently connected to character development, involving objectivity, accuracy, precision, truth-seeking, and problem-solving. Therefore, science education is expected to cultivate character values in students. Character education plays a crucial role in shaping students' behavior, influencing how they apply knowledge, develop awareness, and take action in daily life ([Hermino & Arifin, 2020](#); [Suhara et al., 2022](#)). In this study, the use of e-modules in project-based learning aims to foster students' responsibility and independence. Responsibility in learning refers to students' commitment to completing tasks and fulfilling academic obligations, while independence reflects their ability to work and learn without relying on others. Integrating e-modules can enhance students' ability to learn independently and take responsibility for their understanding of the material ([Indira et al., 2020](#); [Muzijah et al., 2020](#)).

This study is limited to eighth-grade students at SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi. Additionally, the research focuses solely on student responses to PjBL-based e-modules and the development of responsible and independent characters. The study employs a quantitative approach, collecting data through questionnaires. However, it does not include an in-depth analysis of external factors that may influence the research findings. This study presents a new approach by analyzing student responses to PjBL-based e-modules and focusing on the correlation between responsible and independent characters, which are rarely considered in junior high school science learning. This study aims to compare the results of two different schools. We compared SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi and provided new findings on how variations in learning environments affect the effectiveness of PjBL modules. Although previous studies have mainly examined the effectiveness of electrical modules in improving conceptual understanding, this study highlights the role of project-based e-modules in promoting the development of educational traits ([Zidny et al., 2020](#)). Therefore, this study aims to contribute to developing science learning strategies that integrate cognitive aspects and character formation through technology-based education. Given this perspective, research is needed to explore how using PjBL-based e-modules relates to students' responsible and independent characters. Science learning through these modules encourages students to take ownership of their learning process, fostering independence and responsibility as they engage with the instructional materials teachers provide. Consequently, this study analyzes student responses to PjBL-based e-modules and their influence on character development. The research will address key questions, including (1) differences in student responses to PjBL-based e-modules and responsible and independent characters between the two schools; (2) the correlation between student responses to PjBL-based e-modules and their responsible character; and (3) the correlation between student responses to PjBL-based e-modules and their independent character.

METHODS

This study represents the implementation phase of the Research and Development (RnD) model, which focuses on developing e-modules for science learning. The RnD model is applied to design, develop, and evaluate instructional materials, such as e-modules, to enhance learning effectiveness ([Muzijah et al., 2020](#)). The product created is a Project-based Learning (PjBL)-based e-module implemented in science education. This research follows a quantitative approach, which involves the analysis of numerical data ([Aldila, Yuda et al., 2020](#)). Quantitative research emphasizes data analysis through statistical methods to derive meaningful conclusions ([Henson et al., 2020](#); [Queirós et al., 2017](#)). The collected numerical data is then analyzed to determine the study results ([Fitriani et al., 2021](#)). The research subjects comprised eighth-grade students enrolled at SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi during the 2022/2023 academic year. A population refers to the entirety of individuals, entities, or components that share specific characteristics and are of interest for investigation ([Asiamah et al., 2017](#); [Rahi, 2017](#)). It serves as the overarching group from which conclusions are drawn. Conversely, a research sample represents a subset of this population, carefully chosen to accurately represent the overall attributes of the larger group ([Taherdoost, 2017](#)). The sampling procedure is crucial in ensuring that selected participants provide meaningful insights applicable to the broader population under study.

This study included a random sample containing 136 participants: 68 from SMP Dharma Bharmha Jambi and 68 from SMP Adhyaksa 1 Jambi. In purposive sampling, the participant selection process follows carefully formulated criteria consistent with the research objectives, ensuring that the sample accurately represents the

target population and produces meaningful and reliable data (Campbell et al., 2020; Elfil & Negida, 2017). In this study, the criteria used for purposive sampling were based on student engagement in science learning, especially in topics related to work and simple machines. The rationale behind this selection was to include participants who actively participated in discussions and assignments related to the subject matter, as their involvement would contribute significantly to the research findings. To collect data, this study utilized several research instruments, including questionnaires that assessed students' responses to PjBL-based e-modules, a questionnaire on responsible character, and another on independent character. Research instruments play a crucial role in data collection and analysis, requiring validation to confirm the reliability of the obtained information (Rini et al., 2021). Table 1 presents the questionnaire framework, which includes aspects related to students' responses to e-modules, responsibility character, and student independence character.

Table 1. Instrument Grid

Questionnaire	Indicator	Question Number
Student response to PjBL-based e-modules	E-Module Display	1, 2, 3, 4, 5
	Presentation of Material in the E-Module	6, 7, 8, 9, 10
	Benefits of the E-Module	11, 12, 13, 14, 15
Responsible Character	Obey the school rules	1, 2, 3
	Maintain school facilities	4, 5, 6
	Keep the environment clean	7, 8
	Carry out pickets according to a set schedule	9, 10
	Carry out obligations	11, 12, 13, 14, 15, 16, 17
	Carry out tasks according to ability	18
	Doing assignments and homework well	19, 20, 21
Independent Character	Independent study at home	1, 2, 3, 4, 5, 6, 7, 8
	Independent learning at school	9, 10, 11, 12, 13
	Learning motivation and assignments	14, 15, 16, 17, 18, 19, 20
	Actively looking for references or learning resources	21, 22, 23, 24

The collected data were categorized using a Likert scale. Student response questionnaires regarding the use of e-modules are classified into four scales, while questionnaires on responsible and independent characters were categorized into five scales. The classification of the collected data results is presented in Table 2.

Table 2. Categories of research data results

Questionnaire	Score Intervals	Category
Student response to PjBL-based e-modules	15.00 – 26.25	Very Bad
	26.26 – 37.50	Bad
	37.51 – 48.75	Good
	48.76 – 60.00	Very Good
Responsible Character	21.00 – 36.75	Very Bad
	36.76 – 52.50	Bad
	52.51 – 68.25	Good
	68.26 – 84.00	Very Good
Independent Character	24 – 42	Very Bad
	43 – 60	Bad
	61 – 78	Good
	79 – 96	Very Good

The data analysis techniques utilized in this study involved two types of statistical methods: descriptive and inferential statistics. Descriptive statistics are employed to systematically present data using frequency (count and percentage), mean, median, mode, minimum, and maximum scores (Kaur et al., 2018; Mishra et al., 2019). Meanwhile, inferential statistics are used to test hypotheses, which must first undergo prerequisite tests (Nikpour, 2017). The hypothesis tests applied in this study include the T-test and correlation test. Therefore, hypothesis testing must precede prerequisite tests, including normality, homogeneity, and linearity tests. After data collection, the Data Analysis stage was conducted using descriptive and inferential statistical methods, including normality, homogeneity, linearity tests, T-tests, and correlation tests to examine the correlation between variables. Finally, the study reached the Conclusion and Interpretation of Results, which

offered insights into the effectiveness of PJBL-based e-modules in enhancing students' responsibility and independence in science learning. This process is illustrated in Figure 1.

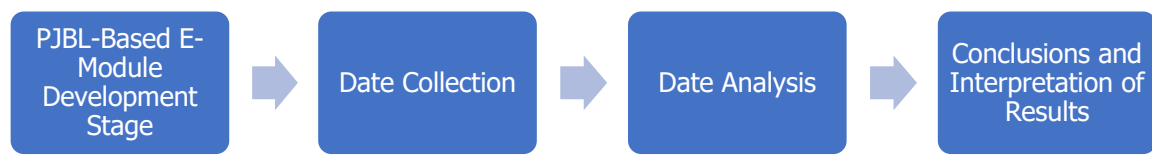


Figure 1. Research procedure

RESULT AND DISCUSSION

The findings of this research, which encompass student responses to implementing Project-Based Learning (PjBL) e-modules in the study of work and simple machines, are presented in Table 3.

Table 3. Student Responses to PjBL-based E-modules

School	Category	f	%	Mean	Median	Mode	Min	Max
SMP Adhyaksa 1 Jambi	Very Bad	0						
	Bad	1	1.47					
	Good	19	27.94	53.56	53	52	43	56
	Very Good	48	70.59					
SMP Dharma Bhakti 3 Jambi	Very Bad	0						
	Bad	2	2.95	50.19	52	49	41	54
	Good	23	33.82					
	Very Good	43	63.23					

Table 3 shows that the frequency comparison in the very good category at SMP Adhyaksa 1 Jambi is higher than SMP Dharma Bhakti 3 Jambi. Thus, student responses to PjBL-based e-modules at SMP Adhyaksa 1 Jambi are superior to SMP Dharma Bhakti 3 Jambi. Furthermore, the description of the students' responsible character is shown in Table 4.

Table 4. Students' Responsible Characters

School	Category	f	%	Mean	Median	Mode	Min	Max
SMP Adhyaksa 1 Jambi	Very Bad	0	-					
	Bad	1	1.48					
	Good	29	42.64	69.65	71	71	67	82
	Very Good	38	55.88					
SMP Dharma Bhakti 3 Jambi	Very Bad	0	-					
	Bad	0	-	74.24	72	72	67	82
	Good	27	39.70					
	Very Good	41	60.30					

Table 4 demonstrates that the "very good" category appears more frequently at SMP Dharma Bhakti 3 Jambi than at SMP Adhyaksa 1 Jambi. This suggests that students at SMP Dharma Bhakti 3 Jambi exhibit a higher level of responsibility than those at SMP Adhyaksa 1 Jambi. The findings concerning students' independent characters are also displayed in Table 5.

Table 5. Students' Independent Characters

School	Category	f	%	Mean	Median	Mode	Min	Max
SMP Adhyaksa 1 Jambi	Very Bad	0	-					
	Bad	1	1.47					
	Good	20	29.41	83.16	81	82	56	92
	Very Good	47	69.12					
SMP Dharma Bhakti 3 Jambi	Very Bad	0	-					
	Bad	3	4.41	78.37	79	79	48	84
	Good	21	30.88					
	Very Good	44	64.71					

Table 5 shows that the frequency comparison in the "very good" category at SMP Adhyaksa 1 Jambi is higher than at SMP Dharma Bhakti 3 Jambi. This suggests that students at SMP Adhyaksa 1 Jambi demonstrate a stronger independent character than those at SMP Dharma Bhakti 3 Jambi. Additionally, prerequisite tests were conducted, including normality, homogeneity, and linearity tests. The results of the normality test are presented in the following table.

Table 6. Normality Test

Variable	School	Sig.
Student response to PjBL-based e-modules	SMP Adhyaksa 1 Jambi	0.137
	SMP Dharma Bhakti 3 Jambi	0.181
Responsible Characters	SMP Adhyaksa 1 Jambi	0.88
	SMP Dharma Bhakti 3 Jambi	0.77
Independent Characters	SMP Adhyaksa 1 Jambi	0.204
	SMP Dharma Bhakti 3 Jambi	0.184

Table 6 presents student responses to the use of PjBL-based e-modules and the characteristics of student responsibility and independence at SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi. The data follows a normal distribution, with a significant value greater than 0.05. The results of the homogeneity test are shown in Table 7.

Table 7. Homogeneity Test

Variable	School	Sig.
Student response to PjBL-based e-modules	SMP Adhyaksa 1 Jambi	0.78
	SMP Dharma Bhakti 3 Jambi	0.87
Responsible Characters	SMP Adhyaksa 1 Jambi	0.107
	SMP Dharma Bhakti 3 Jambi	0.127
Independent Characters	SMP Adhyaksa 1 Jambi	0.113
	SMP Dharma Bhakti 3 Jambi	0.146

Based on Table 7, it can be concluded that the student response data regarding the use of PjBL-based e-modules, as well as the characteristics of responsibility and independence among students at SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi, are homogeneous. This conclusion is drawn based on a significance value greater than 0.05. Furthermore, the results of the linearity test are presented in the table below.

Table 8. Linearity Test

Variable	School	Sig
Student response to PjBL-based e-modules *	SMP Adhyaksa 1 Jambi	0.174
	SMP Dharma Bhakti 3 Jambi	0.094
Responsible Characters	SMP Adhyaksa 1 Jambi	0.124
	SMP Dharma Bhakti 3 Jambi	0.078
Independent Characters	SMP Adhyaksa 1 Jambi	0.143
	SMP Dharma Bhakti 3 Jambi	0.087

Table 8 shows the linear correlation between both schools and the variables. This conclusion is based on significant values above 0.05 in the decision-making process. After the data is usually confirmed and there is a uniform and linear distribution, hypothesis testing is carried out using the t-test. The results of the t-test are shown in Table 9.

Table 9. T-test

Variable	Sig	Sig. (2 tailed)
Student response to PjBL-based e-modules	0.612	0.002
Responsible Characters	0.517	0.001
Independent Characters	0.545	0.001

Table 9 indicates significant differences in student responses to e-modules and their responsible and independent characters between SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi. This conclusion is based on the decision-making criteria, where the Sig. (2-tailed) value is less than 0.05. Additionally, the correlation test results for SMP Adhyaksa 1 Jambi are presented in Table 10.

Table 10. Correlation test of SMP Adhyaksa 1 Jambi

		Student response to PjBL-based e- modules	Responsible Characters	Independent Characters
Student response to PjBL-based e-modules	Pearson	1	.768**	.806**
	Correlation			
	Sig. (2-tailed)		0.002	0.002
	N	68	68	68
Responsible Characters	Pearson	.768**	1	.867**
	Correlation			
	Sig. (2-tailed)	0.002		0.001
	N	68	68	68
Independent Characters	Pearson	.806**	.867**	1
	Correlation			
	Sig. (2-tailed)	0.002	0.001	
	N	68	68	68

Table 10 indicates a significant correlation between student responses to e-modules and their responsible character and between student responses to e-modules and their independent character. Additionally, a significant correlation is observed between the character of responsibility and student independence at SMP Adhyaksa 1 Jambi. The decision-making criterion is based on a Sig. (2-tailed) value of less than 0.05. Furthermore, the correlation results for SMP Dharma Bhakti 3 Jambi are presented in Table 11.

Table 11. Correlation test results at SMP Dharma Bhakti 3 Jambi

		Student response to PjBL-based e- modules	Responsible Characters	Independent Characters
Student response to PjBL-based e-modules	Pearson	1	.808**	.874**
	Correlation			
	Sig. (2-tailed)		0.001	0.002
	N	68	68	68
Responsible Characters	Pearson	.808**	1	.925**
	Correlation			
	Sig. (2-tailed)	0.001		0.002
	N	68	68	68
Independent Characters	Pearson	.874**	.925**	1
	Correlation			
	Sig. (2-tailed)	0.002	0.002	
	N	68	68	68

Table 11 shows a significant correlation between student responses to PjBL-based e-module, responsible characters, and independent characters at SMP Dharma Bhakti 3 Jambi. This study examines the use of educational innovation in response to technological advances. The innovation in question is the development of a PjBL-based e-module. This study examines how the use of this module is related to students' emotional aspects, especially those of responsibility and independence. The use of the PjBL-based e-module is assessed using student responses. Therefore, the specific objectives of this study are (1) to identify the differences in student responses to PjBL-based e-modules and responsible and independent characters between the two schools; (2) to evaluate the correlation between student responses to PjBL-based e-modules and their responsible character; and (3) to evaluate the correlation between student responses to PjBL-based e-modules and their independent character.

Research on students' responses to PjBL-based e-modules aligns with [Vanorika et al. \(2016\)](#), who developed e-modules using project-based learning, although their study focused on network operating system subjects. Similarly, [Rusmanto and Rukun \(2020\)](#) developed project-based learning e-modules. However, the lack of project-based learning e-modules for business materials and simple machines in senior high schools prompted this study to investigate students' responses to PjBL-based e-modules in these subjects. Based on Table 3, the frequency comparison in the "very good" category was higher at SMP Adhyaksa 1 Jambi than at SMP Dharma Bhakti 3 Jambi, indicating that students' responses to PjBL-based e-modules were more favorable at SMP Adhyaksa 1 Jambi compared to SMP Dharma Bhakti 3 Jambi. Indicate a significant impact of

implementing Project-Based Learning (PjBL)-based e-modules on developing students' responsibility and independence at SMP Dharma Bakti 3 Jambi. The study highlights a positive correlation between students' responses to PjBL-based e-modules and their increased sense of responsibility and independence. This aligns with the growing need for educational innovations integrating technological advancements to enhance students' affective behaviors. By comparing students' responses from two schools—SMP Adhyaksa 1 Jambi and SMP Dharma Bakti 3 Jambi—this study underscores the effectiveness of PjBL-based e-modules in fostering these essential character traits, contributing to the broader goal of improving student learning outcomes in an increasingly technology-driven era.

Research on students' independent character variables aligns with [Kartina and Subani \(2020\)](#), which explores students' independent character in science subjects. Similarly, [Asrial et al. \(2022\)](#) investigated students' perceptions of web-based character assessments, encompassing aspects of student independence. However, no previous studies have examined the correlation between students' responses to PjBL-based e-modules and their independent character. Therefore, this study complements prior research. Based on Table 5, the frequency of responses categorized as "very good" is higher at SMP Adhyaksa 1 Jambi than at SMP Dharma Bakti 3 Jambi. This suggests that students at SMP Adhyaksa 1 Jambi demonstrate a stronger independent character than those at SMP Dharma Bakti 3 Jambi. In addition, this study also conducted tests, including normality, uniformity, and linearity tests. The normality test was conducted to determine whether the distribution of research data was followed by a normal pattern ([Darmaji et al., 2021](#); [Putri et al., 2022](#)). The significant value exceeds 0.05. The uniformity test was then conducted to assess whether the research data could be taken from the same variant ([Darmaji, Astalini et al., 2022](#)). As shown in Table 7, the third variable was declared to have a significant value of 0.05 or higher. In addition, a linearity test was conducted to determine whether two or more variables had a linear correlation ([Darmaji, Kurniawan et al., 2022](#)). Table 9 shows three variables with a linear correlation with a significant value below 0.05 (2 sales), the basis for decision-making. In this study, hypothesis testing was carried out using T-T and correlation tests. The t-test is used to determine the difference between variables. It shows a significant difference (2 sales) in a significant value below 0.05 ([Matondang et al., 2020](#)). As shown in Table 9, we have many PjBL-based electronic modules (two sales), responsible character variables, student response variables when using variables 0.002, 0.001, and 0.001, and character values. This study's results indicate a significant difference in student responses to the PjBL-based e-module at SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi. In addition, there is a significant difference between the types of responsibility and independence of students in both schools.

A correlation analysis is performed to assess the association between variables, using a significance threshold below 0.05 as the criterion for decision-making ([Kholilah et al., 2020](#); [Yolviansyah et al., 2021](#)). This study's correlation assessment investigates the connection between students' perceptions of e-module utilization and their traits of responsibility and independence at SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi. Based on Table 10, there is a significant correlation at SMP Adhyaksa 1 Jambi between student responses to PjBL-based e-modules and responsibility character, between student responses and independence character, and between responsibility and independence character, with significance values (2-tailed) of 0.002, 0.002, and 0.001, respectively. Similarly, at SMP Dharma Bhakti 3 Jambi, Table 11 shows a significant correlation between student responses to PjBL-based e-modules and responsibility character, between student responses and independence character, and between responsibility and independence character, with significance values (2-tailed) of 0.001, 0.002, and 0.002, respectively. Using PjBL-based e-modules in learning is practical, effective, and successful as a learning medium ([Priatna et al., 2017](#); [Rahayu & Sukardi, 2021](#)). [Nisrina et al. \(2021\)](#) developed e-modules based on a project-based learning model for two-dimensional and three-dimensional animation subjects to enhance student learning outcomes. The findings indicate that implementing e-modules based on project-based learning positively impacts student achievement by improving learning outcomes. This aligns with [Siregar and Harahap \(2020\)](#), who found that project-based learning e-modules enhance learning outcomes and create a more meaningful learning experience. Similarly, [Karnando et al. \(2021\)](#) concluded that integrating e-modules with the PjBL learning model effectively improves learning quality and yields optimal results.

Beyond cognitive aspects such as academic achievement, the affective aspects of students must also be considered when implementing PjBL-based e-modules in learning. Using these e-modules is expected to increase student engagement in their studies ([Wijayanti et al., 2016](#)). Thus, applying PjBL-based e-modules is associated with developing responsibility and independence in student learning. The development of PjBL-based e-modules aligns with the intention to foster students' sense of responsibility and initiative in recognizing their learning needs while motivating them to take responsibility for their work ([Putra et al., 2017](#)). Moreover, e-modules promote student independence in learning, as they can be used autonomously even in the absence of a teacher ([Ayu et al., 2021](#); [Farawansah & Makmur, 2022](#)). Therefore, implementing PjBL-based e-modules is expected to enhance students' affective attributes, shaping them into individuals with strong character. Based on previous research on the responsibility character variable, [Sari and Bermuli \(2021\)](#) explored developing

students' responsibility through character education. [Raqzitya and Agung \(2022\)](#) also developed a character education-based e-module as a science learning resource. This study extends previous research by comparing the two schools' responsibility characteristics and analyzing the correlation between student responses to PjBL-based e-modules and their responsible character. According to Table 4, the frequency ratio in the "very good" category at SMP Dharma Bhakti 3 Jambi is higher than at SMP Adhyaksa 1 Jambi. Therefore, it can be concluded that students at SMP Dharma Bhakti 3 Jambi demonstrate stronger responsible characters compared to those at SMP Adhyaksa 1 Jambi. No prior research has specifically investigated the application of project-based learning (PjBL) e-modules concerning the affective domain, particularly in shaping student character. Therefore, the uniqueness of this study lies in its exploration of the connection between students' engagement with PjBL-based e-modules and their character development, emphasizing responsibility and independence within the context of junior high school science education, specifically in the topic of business and simple machines. This research offers a deeper understanding of how students' interactions with PjBL-based e-modules relate to cultivating responsibility and independence.

Enhancing educational quality, especially in science learning, by providing fresh perspectives on developing instructional materials in the form of PjBL-based e-modules as an alternative learning tool. The distinctiveness of this research is evident in the design and implementation of PjBL-based e-modules for science education, particularly in teaching business and simple machines at the junior high school level, an area that has not been widely explored. Unlike previous studies that developed PjBL-based e-modules for subjects such as network operating systems ([Vanorika et al., 2016](#)) and electric motor installation ([Rusmanto & Rukun, 2020](#)), this study focuses on students' affective aspects—particularly responsibility and independence—within the context of science learning. Additionally, this study provides a new perspective by comparing the effectiveness of PjBL-based e-modules in shaping student character in two different schools, SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi, while also analyzing the correlation between students' responses to e-modules and their responsibility and independence.

This research has significant implications for science education in junior high schools, particularly at SMP Adhyaksa 1 Jambi and SMP Dharma Bhakti 3 Jambi. The use of PjBL-based e-modules plays a crucial role in the learning process, as it trains students to solve problems through project-based activities, supported by e-modules as an innovative learning tool. Beyond enhancing cognitive skills, implementing PjBL-based e-modules also benefits the affective domain by fostering and strengthening student character, particularly regarding responsibility and independence. These e-modules encourage students to tackle problems independently while instilling responsibility in learning. Thus, integrating PjBL-based e-modules into classroom learning can enhance the overall quality of education, promoting a more effective and character-driven learning experience.

CONCLUSION

Modules and students' responsibility and independence show a significant correlation with a p-value of less than 0.05. These findings indicate a strong correlation between students' responses and developing responsibility and independence in character building and using e-modules. The study has practical implications for educators by highlighting how technology-based learning innovations, such as PjBL-based e-modules, can effectively enhance students' critical character traits. Furthermore, it contributes to the broader objective of integrating technology into science education while fostering responsible and independent learners. However, the study is limited to only two character traits, and further research is recommended to explore the correlation between PjBL-based e-modules and a broader range of characters.

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