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Analysis of Learning Motivation and Engagement of Physics Education Students in Self-Determination Theory-Based Learning

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Abstract

This study aims to analyze the relationship between learning motivation and student engagement in digital learning based on Self-Determination Theory (SDT). The study used a quantitative descriptive design involving 76 Physics Education students from a total of 94 students at the University of Jambi. Data were collected through a 16-item questionnaire to measure learning motivation and student engagement. Data analysis was conducted descriptively and using a Pearson correlation test. The results showed that learning motivation was in the high category with an average score of 27.29 out of 35, while student engagement was also high with an average score of 34.79 out of 45. Furthermore, the Pearson correlation test showed a positive relationship between learning motivation and student engagement (r= 0,998), indicating that higher motivation is associated with higher engagement. These findings suggest that SDT-based digital learning can support students' intrinsic motivation and increase their engagement in learning activities.

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1. Introduction

Learning in the physics education study program not only aims to equip students with mastery of physics concepts, but also to develop pedagogical, analytical, and reflective abilities as future educators. To achieve these learning outcomes, students are required to have strong learning motivation and a high level of engagement in every lecture activity. According to [1], who states that learning motivation is the overall driving force within students that creates enthusiasm for learning so that the objectives of the learning can be achieved. Engagement is the level of interaction, involvement, or active response of an audience to content, brands, or individuals on social media. According to [2], stated that although academic engagement showed a positive relationship, the effect was not statistically strong enough. This finding indicates that learning satisfaction, although important, is not the only factor determining student academic engagement in a hybrid system. It is likely that there are other variables that also influence engagement, such as learning motivation, environmental factors, or academic load. Therefore, analysis of the factors that influence motivation and engagement is important in efforts to improve the quality of learning.

Conceptually, self-determination theory is a motivation from an individual that encourages him to do something based on his own desires (results of his decisions), to determine control over himself (control) and make decisions to achieve the expected goals, where this is in line with the opinion [3], Self-Determination Theory (SDT) offers a comprehensive theoretical framework for understanding

motivation in learning. According to [4], which states that intrinsic motivation is an internal drive within an individual to pursue certain goals. Furthermore, it is characterized as a motive that is activated and operationalized autonomously, regardless of external stimuli, due to the drive inherent in the individual to engage in certain activities.

In the context of physics learning, lecturers can design strategies that provide space for concept exploration (autonomy), provide constructive feedback (competence), and build collaborative interactions (relatedness). According to [5], who stated that autonomy is a concept that describes the level of freedom and authority that a person or group has in making decisions, acting, and managing themselves. Competency-based learning is a model designed to integrate planning, implementation, and evaluation of learning with a focus on managing student competencies. This is in line with the opinion of [6]. According to [7], that constructive feedback is needed to provide direction, suggestions for improvement, and guidance for skill development. According to [8], collaborative learning is a pedagogical approach that emphasizes cooperation between students to achieve learning goals. With the advancement of digital technology, this method has experienced substantial evolution. The digital era provides a platform that facilitates interaction and collaboration between geographically dispersed students. Digitalization has changed the paradigm of collaborative learning by eliminating the limitations of space and time. Fulfillment of these three aspects is believed to be able to increase student involvement cognitively, emotionally, and behaviorally.

In accordance with the learning objectives of the course, students are expected to demonstrate the ability to explain motivation theory, identify factors that influence engagement, and design strategies to increase motivation in learning. According to [9], motivation theory describes human needs that are so complex that educators are encouraged to create a curriculum that meets their own needs. Motivation theory is basically divided into two, namely: satisfaction motivation theory and process motivation theory. The satisfaction theory of motivation is related to factors within a person that motivate them. While the process theory is related to how motivation occurs or how behavior is driven, which is in line with the opinion of [10]. According to [11], learning motivation mainly comes from two key factors: (1) internal factors, which include physiological and psychological dimensions. Physiological factors involve physical health and sensory conditions, while psychological factors include talent, interest and attention, learning intelligence, motivation, and cognitive abilities; (2) external factors that come from outside the learner, which consist of social influences, non-social elements, and instructional approaches. According to [12], achievement motivation is influenced by several key factors, including: (1) intrinsic motivation, which consists of (a) interest and (b) aspirations; and (2) extrinsic motivation, which includes leadership, remuneration, environmental conditions (such as facilities and infrastructure, academic guidance, and work climate), among other elements.

The implementation of learning models such as Project Based Learning (PjBL) is one of the relevant alternative strategies because it encourages active involvement, collaboration, and reflection. According to [13], Project Based Learning is a form of learning by providing various learning materials to students and then assigning students so that learning objectives can be achieved well. Project Based Learning prioritizes learning activities that are continuous, holistic, and student-centered, integrated into authentic practices and the real world. According to [14], Project Based Learning (PjBL) is a student-centered learning model that positions students as the core of the learning process. It emphasizes active engagement, where students independently plan their activities, collaborate on projects, and produce tangible outcomes in the form of real world products. Consequently, the model's success heavily depends on students' initiative and participation. According to [15], In the Project Based Learning (PjBL) approach, students must actively engage in the planning process, implementing, and evaluating the project, so that they can deepen their understanding of the material being studied. Through this approach, students not only understand the theory conceptually, but are also able to simulate and evaluate its application in the context of physics learning.

Drawing from this overview, the article seeks to examine the learning motivation and engagement of physics education students in self determination theory based instruction, while proposing tailored improvement strategies aligned with the course's unique features. These findings are anticipated to provide a foundation for fostering more participatory approaches, reflective, and quality-oriented learning for prospective physics educators.

Based on the explanation above, this study aims to analyze the relationship between learning motivation and student engagement in SDT-based digital learning. The results are expected to provide insights into the implementation of digital learning strategies that can increase student motivation and engagement.

2. Methods

This study used a quantitative approach with a descriptive research design. The population consisted of 94 Physics Education students at the University of Jambi, of which 76 students served as respondents. This discrepancy in the number of respondents indicates that not all students completed the questionnaire, potentially introducing non-response bias and becoming a limitation of this study. Data were collected through a 16-item questionnaire: 7 items measuring learning motivation and 9 items measuring student engagement. The instrument used a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The data collection process was conducted online through a digital platform, allowing students to respond flexibly according to their learning circumstances. Data analysis was performed by calculating the average score for each variable to determine the level of student learning motivation and engagement. Additionally, Pearson correlation analysis was applied to examine the relationship between learning motivation and student engagement.

3. Results and Discussion

The descriptive analysis presented in this study includes an analysis of respondent characteristics and the number of students willing to complete the instrument. The research sample consisted of eleven males, representing 27%, and eighty-three females, representing 73%. The difference between male and female respondents was seventy-two. Based on these data, the majority of respondents were female, representing 73%. This indicates that the PMIPA Physics Education study program comprises more females than males. 76 students agreed to provide feedback out of a total sample of 94 students. That means that 18 physics education students did not provide their responses to the research instrument. Student response to learning motivation on digital learning shows in Table 1.

Table 1. Student Responses to Learning Motivation in Digital Learning

No	Statement	STJ	TJ	N	S	SS
1.	I feel motivated to take part in digital learning.	2.7%	0%	16%	54.7%	26.7%
2.	I feel I have the freedom to organize my learning style during digital learning.	1.3%	0%	21.3%	49.3%	28%
3.	I am confident that I can understand the material well through digital learning.	1.3%	1.3%	28%	50.7%	18.7%
4.	The digital learning materials provided by the lecturer were useful for me.	1.3%	1.3%	12%	61.3%	24%
5.	I still try to study even though learning is done online.	2.7%	1.3%	18.7%	56%	21.3%
6.	I feel the goals of digital learning suit my needs.	1.3%	1.3%	22.7%	56%	18.7%
7.	My learning efforts in digital learning are commensurate with the results I get.	1.3%	1.3%	30.7%	40%	26.7%

Information: STJ = Strongly disagree S = Agree; TJ = Disagree; SS = Strongly agree; N = Neutral

Based on Table 1 regarding student responses to learning motivation in digital learning, the findings revealed that most students provided positive responses to each statement. For the first statement, "*I feel motivated to participate in digital learning*," 54.7% of students agreed and 26.7% strongly agreed. This indicates that more than 80% of students are well motivated to participate in digital learning. For the second statement, regarding freedom to determine how to learn, 49.3% of students agreed and 28% strongly agreed. This finding indicates that digital learning provides students with perceived flexibility in managing their learning process.

Furthermore, for the third statement, regarding confidence in understanding material through digital learning, 50.7% of students agreed and 18.7% strongly agreed. Although there were 28% neutral responses, the majority of students still expressed a positive perception of the effectiveness of digital learning in helping them understand the material. The fourth statement showed higher results, where 61.3% of students agreed and 24% strongly agreed that the digital learning materials provided by lecturers were useful for them. This confirms that digital learning content is considered relevant and helps students' learning process. In the fifth statement regarding learning efforts despite online learning, 56% of students agreed and 21.3% strongly agreed. This demonstrates students' commitment to maintaining learning motivation despite the digital learning system.

Furthermore, in the sixth statement regarding the suitability of digital learning objectives with student needs, 56% agreed and 18.7% strongly agreed. This indicates that students feel the designed learning objectives are aligned with their academic needs. In the seventh statement regarding the suitability of learning efforts with the results obtained, 40% of students agreed and 26.7% strongly agreed, although there were 30.7% neutral responses. This indicates that some students are still in the adjustment stage to the digital learning system. Overall, the average percentage of "agree" and "strongly agree" responses for each item indicates that student learning motivation in digital learning is in the high category. This aligns with the descriptive analysis results, which indicated an average motivation score of 27.29 out of a maximum of 35. The research results show that the majority of students have a positive perception of digital learning. The high percentages of "agree" and "strongly agree" responses reflect a generally positive attitude toward the learning process.

Table 2. Student Responses to Student Engagement in Digital Learning

No	Statement	STJ	TJ	N	S	SS
1.	I actively participate in digital learning activities.	1.3%	1.3%	18.7%	49.3%	18.7%
2.	I enjoy the learning process using digital media.	1.3%	1.3%	17.3%	53.3%	26.7%
3.	I try to understand the material in depth in digital learning.	1.3%	2.7%	22.7%	57.3%	16%
4.	I try to think critically about the material presented digitally.	1.3%	2.7%	21.3%	50.7%	24%
5.	The digital learning media used by the lecturer increased my interest in learning.	1.3%	2.7%	24%	52%	20%
6.	The varied digital learning methods make me more engaged in learning.	1.3%	2.7%	18.7%	58.7%	18.7%
7.	I have a desire from myself to learn using digital media.	1.4%	1.4%	23%	47.3%	27%
8.	I use various digital resources to support my learning process.	1.4%	1.4%	12.2%	56.8%	28.4%
9.	I participate when there are discussions or activities in digital learning.	1.4%	0	23%	54.1%	21.6%

Information: STJ = Strongly disagree; S = Agree; TJ = Disagree; SS = Strongly agree; N = Neutral

Based on Table 2 regarding student responses to student engagement in digital learning, it was found that the majority of students gave positive responses to all statements asked. For the first statement, "*I actively participate in digital learning activities*," 49.3% of students agreed and 18.7% strongly agreed. This indicates that most students are actively involved in digital learning activities. For the second statement, 53.3% of students agreed and 26.7% strongly agreed that they enjoyed the learning process using digital media. This finding indicates that digital media can create an enjoyable learning experience for students. For the third statement regarding efforts to understand the material in depth, 57.3% of students agreed and 16% strongly agreed. This indicates that digital learning encourages students to be more active in exploring the material being studied. Furthermore, for the fourth statement regarding efforts to think critically about material delivered digitally, 50.7% of students agreed and 24% strongly agreed. This indicates that digital learning not only increases participation but also encourages students' critical thinking skills.

In the fifth statement, 52% of students agreed and 20% strongly agreed that the digital learning media used by lecturers increased their learning interest. This indicates that the variety of media used contributes to increased student engagement. In the sixth statement, 58.7% of students agreed and 18.7% strongly agreed that varied digital learning methods made them more involved in learning. This emphasizes the importance of method variation in increasing student engagement. In the seventh statement regarding the desire to learn independently using digital media, 47.3% of students agreed and 27% strongly agreed. This indicates an intrinsic drive for students to learn independently through digital media. In the eighth statement, 56.8% of students agreed and 28.4% strongly agreed that they use various digital resources to support the learning process. This indicates that digital learning encourages broader exploration of learning resources. Finally, in the ninth statement regarding participation in discussions or digital learning activities, 54.1% of students agreed and 21.6% strongly agreed. This indicates that digital learning can increase student participation in academic activities. Overall, the average percentage of "agree" and "strongly agree" responses for each item indicates that student engagement in digital learning is high. This aligns with the descriptive analysis, which showed an average engagement score of 34.79 out of a maximum score of 45. However, the existence of a neutral response shows that some students still experience it, especially in understanding the material and presenting their learning outcomes.

The study results show that students' learning motivation and engagement in digital learning fall into the high category. This is demonstrated by the predominant "agree" and "strongly agree" responses across nearly all statement items for both motivation and engagement variables. This indicates that the implemented digital learning is able to create a learning experience that encourages active involvement while increasing students' internal drive to learn, internal drive refers to the intrinsic motivation that propels individuals to engage in activities aimed at achieving their goal. This is also explained by [16], who posits that internal drive serves as a motivator for individuals to pursue activities toward goal attainment. Regarding motivation, the majority of students reported feeling driven to engage in digital learning, had the freedom to organize their learning methods, and felt the usefulness of the material provided. The high percentage of the learning freedom indicator indicates that flexibility is an important factor in increasing student motivation. This is also in line with the opinion of [17], that flexibility is a key element in creating effective learning despite operational constraints. Digital learning allows students to access materials independently, manage their study time, and adjust learning strategies according to their individual needs. This condition strengthens students' intrinsic motivation because they feel they have control over their learning process. This is also clarified by the opinion according to [18], that self-control in online learning provides freedom to learn and increases students' internal motivation.

Furthermore, students also demonstrated a commitment to continuing their learning efforts even though learning was conducted online. This was also explained by [19], who stated that students were able to maintain their learning persistence due to the encouragement of personal goals, parental support, and previous experiences of academic success. This indicates persistence in learning. However, there was a percentage of neutral responses on the indicators of confidence in understanding the material and the suitability of effort to learning outcomes. This can be interpreted as meaning that although motivation is in the high category, some students still need support in increasing academic self confidence and the effectiveness of digital learning strategies. This is also discussed by [20], that student learning motivation supports the distance learning process and good self regulation will raise self motivation to learn and achieve the desired goals, conversely low self regulation will ultimately reduce self-motivation so that students become less consistent in achieving their goals and ideals. According to [21], selecting learning strategies in the digital era requires a strong theoretical foundation. Approaches oriented towards active participation, problem solving, collaboration, and continuous evaluation have been proven to improve the relevance and quality of learning. In terms of engagement, research results show that students are not only motivated but also actively involved in the digital learning process. Students reported actively engaging in learning activities and enjoying the process of using digital media for instruction, and participated in discussions or academic activities. The high percentage of indicators for the use of various digital sources indicates that students have good cognitive engagement, namely efforts to understand the material in depth and seek additional sources to enrich their understanding. High engagement is also evident from the statement that varied digital learning mothods make students more involved. This shows that interactive and varied learning designs play an important role in increasing student engagement. Appropriate media and methods can stimulate students' attention, interest, and active participation during learning.

Conceptually, motivation and engagement are two interrelated aspects. According to [22], engagement has a moderate or sufficient relationship with student learning motivation, that learning motivation is an individual's self-drives students to learn, whil engagement is a concrete manifestation of that motivation in the form of active participation, efforts to understand the material, and involvement in discussions. The findings of this study reveal that high student motivation, their engagement in digital learning also tends to be high. This is evident from the consistency of the results on both variables which are both in the high category. However, there are still some neutral responses on several engagement indicators, such as critical thinking and discussion participation. This indicates that not all students have the same level of engagement. This difference can be influenced by factors of technological readiness, digital literacy skills, and individual student characteristics. Overall, the findings of this study confirm that digital learning that is designed systematically, interactively, and relevant to student needs can increase student motivation and engagement. According to [23], technology plays an important role as a bridge between activities outside and inside the classroom, facilitating more systematic, interactive, and relevant learning tailored to the needs of contemporary students. Digital learning not only functions as a medium for delivering material, but also as a means of encouraging independent learning, active participation, along with the enhancement of students' critical thinking skills. Therefore, the ongoing development of innovative, student-centered digital learning strategies is essential to sustain and further boost student motivation and engagement in future learning experiences.

This study has several limitations. First, the number of respondents was limited and not fully representative of the entire population. Second, the instrument consisted of only 16 items, which may not fully capture the complexity of motivation and engagement variables. Third, the study was conducted within a specific context, which may limit the generalizability of the findings

4. Conclusion

The results of this study indicate that Physics Education students have high levels of learningmotivation and engagement in SDT-based digital learning. The findings also reveal a positive relationship between motivation and engagement, with students with higher motivation tending to be more actively involved in learning activities. Practically, these findings suggest that lecturers design digital learning environments that support autonomy, provide constructive feedback, and encourage collaboration. Future research is recommended to involve larger samples and more comprehensive instruments to gain deeper insights into student motivation and engagement

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