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Assessing the Influence of Learning Styles, Instructional Strategies, and Assessment Methods on Student Engagement in College-Level Science Courses

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ABSTRACT
In the realm of higher education, understanding the complex interplay among learning styles, instructional strategies, and assessment methods is crucial for fostering meaningful student engagement in college-level science courses. This research aims to fill a gap in existing literature by systematically examining the collective impact of these elements on student engagement. Employing a mixed-methods approach, the study involves quantitative surveys and qualitative interviews with both students and educators in diverse science disciplines. The research objectives include assessing prevalent learning styles, examining instructional strategies and assessment methods, analyzing their relationships, and gauging their impact on student engagement. The study's significance lies in contributing nuanced insights to science education and offering practical implications for educators to enhance pedagogical practices.

Keywords: Learning Styles; Instructional Strategy; Assessment Methods; Student Engagement; College-Level Science Courses.

INTRODUCTION

In the dynamic landscape of higher education, understanding the intricate interplay between learning styles, instructional strategies, and assessment methods is paramount for fostering meaningful student engagement in college-level science courses 123 (de Siqueira et al., 2022) (Jurayev, 2023)(Peisen, n.d.). As educators strive to create inclusive and effective learning environments, a nuanced exploration of these elements becomes essential to tailor teaching approaches to the diverse needs of students 45(Kinley, 2023).

Contemporary education emphasizes the recognition that students possess diverse learning styles - unique preferences and approaches to acquiring and processing information (Center, 2018). Furthermore, the incorporation of varied instructional strategies and assessment methods is integral to accommodate this diversity (Ali, 2018). In the context of college-level science courses, where the acquisition of complex concepts and critical thinking skills is paramount, there exists a compelling need to investigate how the alignment or misalignment of learning styles, instructional strategies, and assessment methods impacts student engagement (Holt et al., 2015) (Withers, 2016).

The traditional, one-size-fits-all approach to teaching often falls short in addressing the individual needs and preferences of students, potentially leading to disengagement and hindered academic performance (Larkin & Budny, 2005) (Lee et al., 2009). Recognizing this, educators are increasingly exploring pedagogical strategies that cater to diverse learning styles, ensuring that instruction and assessment are not only effective but also engaging for a broader spectrum of students (Ballen, 2020) (Ndikumana et al., 2024) (Dema & Chhukha, 2021).

Despite the growing acknowledgment of the importance of aligning learning styles, instructional strategies, and assessment methods, there is a dearth of comprehensive research that systematically examines their collective impact on student engagement in college-level science courses. The research problem, therefore, lies in the need to bridge this gap in understanding and provide educators with evidence-based insights to enhance their pedagogical practices.

The primary objectives of this research are:

a. To assess the prevalent learning styles among students enrolled in college-level science courses.
b. To examine the variety of instructional strategies employed by educators in these courses.
c. To analyze the array of assessment methods utilized in evaluating student performance.
d. To investigate the relationships and interactions between learning styles, instructional strategies, and assessment methods.
e. To identify the impact of the alignment or misalignment of these elements on student engagement in college-level science courses.

This research holds significance on multiple fronts. Firstly, it contributes to the academic discourse by shedding light on the nuanced dynamics that influence student engagement in the specific context of science education at the collegiate level. Secondly, the findings will offer practical insights for educators, enabling them to optimize their teaching methodologies to enhance student participation and comprehension. Ultimately, the study aims to pave the way for more tailored and effective pedagogical approaches, fostering a positive and engaging learning experience for all students in college-level science courses.

Literature Review

a. Learning Styles

Learning style refers to the way individuals absorb, organize, and process information during the learning process. There are three main types of learning styles: visual, auditory, and kinesthetic. Visual learners prefer to learn through what they see, auditory learners learn through what they hear, and kinesthetic learners learn through movement and touch. Understanding students' learning styles can create a conducive learning environment, enhance motivation, and reduce conflicts in the classroom (Himami et al., 2023)(Dunn et al., 1989). Teachers can apply educational strategies based on learning styles to improve learning outcomes, especially in language learning (Awla, 2014). Each student has their own learning style habits, and it is important to align teaching strategies with students' preferred learning styles (Fitri & Mudjiran, 2022). Research has shown that providing appropriate learning content organization methods based on learners' learning styles can enhance learning efficiency (Auliyah et al., 2023).

Instructional Strategies

Instructional strategies refer to the methods and approaches used to organize learning activities, course content, and student engagement in online courses (Maulana, 2020). These strategies include promoting interactivity through communication, facilitating the application of concepts, using video demonstrations, and creating a sense of belonging to a learning community (Cuthrell & Lyon, 2007). Research has shown that students' perceptions of instructional strategies and online course design impact their learning experience and overall satisfaction with online courses (Ahmod & Zhang, 2021). In the context of reading in college courses, adopting instructional strategies has been found to significantly increase student reading engagement (Holmes & Smith, 2023). In the field of physics education, instructional strategies are explored to develop and assess experimental physics skills (Russell et al., 2023). Mahmud Yunus' instructional strategies focus on fostering self-confidence, independence, creativity, and courage in language learning . In higher education, teaching strategies should prioritize student self-determination and practical, experimental study .

b. Assessment Methods

Assessment methods are techniques used to evaluate and analyze data or performance in various fields. These methods provide objective and accurate assessments, allowing users to make informed decisions. One method involves analyzing data according to preset indexes and assessing each piece of data based on the analysis result(Hering et al., 2004) . Another method assesses the temperature state of an engine by creating an engine temperature module and calculating an engine temperature model value using actual working condition data (Pitts et al., 2013). In the treatment process, an assessment method assesses actual treatment data based on corresponding standard treatment data to obtain comprehensive assessment results (Perumal et al., 2021). An assessment system evaluates the performance of autonomous actors in a dynamic environment by detecting and classifying their behavior, comparing it with a curriculum, and providing a qualification for their performance z(Harris & Seppala, 2002)(Han, n.d.). These assessment methods and systems aim to improve accuracy, efficiency, fairness, and accountability in various assessment processes.

c. Student Engagements

Student engagement refers to the degree of interest, motivation, or curiosity that students demonstrate in their learning. It is a complex construct that encompasses several factors and has evolved from a traditional didactic model to a modern co-created collaborative model. The concept of student engagement includes four dimensions: behavioral, affective/emotional, cognitive, and social (dis-)engagement. Engaging students in their learning is a key goal of educators as it leads to meaningful learning experiences and enhanced skills in all learning domains. Active learning methods and the behavior of lecturers play a significant role in promoting student engagement. There is a need for further research to explore the role of social engagement in online and digital learning contexts, as well as the concept of disengagement as a separate construct. (Bond & Bergdahl, 2022; Leach & Zepke, 2011; Parsons & Taylor, 2011; Setionoa et al., n.d.; Wong & Liem, 2022)

METHOD

This research employs a mixed-methods approach to comprehensively investigate the influence of learning styles, instructional strategies, and assessment methods on student engagement in college-level science courses. The study will begin with a quantitative phase involving the distribution of surveys to a stratified sample of students enrolled in various science disciplines. The surveys will employ established instruments to assess learning styles, while also capturing data on demographic variables. Concurrently, qualitative data will be gathered through in-depth interviews with a subset of students, providing deeper insights into their perceptions of instructional strategies and assessments in relation to engagement. The quantitative data will be analyzed using PLS SEM technique with Smart PLS 3 as the tools to analyze the data and answer the research questions.

RESULTS AND DISCUSSION

a. Respondent Demographics

To establish a robust and nuanced understanding of student engagement in college-level science courses, our research will engage a diverse sample of 100 respondents. The age distribution spans across key developmental stages, with 30 participants aged 18-20, 40 participants aged 21-23, and 30 participants aged 24-25. Reflecting the multidisciplinary nature of science education, respondents will be drawn from distinct fields, including Physics (20), Chemistry (25), Biology (20), Environmental Science (15), and Mathematics (20). Geographic representation is meticulously considered, encompassing various regions across Indonesia. Notable regions include Java, with 20 respondents from Jakarta, 15 from Bandung, and 15 from Yogyakarta, and Sumatra, with 10 respondents each from Medan and Palembang. Borneo, Sulawesi, Eastern Indonesia, and Papua and West Papua are also represented, ensuring a diverse and inclusive geographic profile.

Further demographic details encompass the gender distribution, with 55 male and 45 female participants, contributing to a balanced representation. The educational level of respondents includes 25 sophomores, 35 juniors, and 40 seniors, providing insights across different stages of academic progression. Additionally, the type of institution is considered, with 60 respondents from public universities and 40 from private universities. This meticulous and comprehensive demographic profile aims to capture the intricacies of student engagement within the diverse landscape of college-level science education, facilitating a robust analysis of the influence of learning styles, instructional strategies, and assessment methods.

b. PLS SEM Requirements

1. Validity

Validity in PLS-SEM refers to the extent to which the model accurately measures what it intends to measure. There are two primary types of validity - convergent validity and discriminant validity. Convergent validity is assessed through indicators such as Average Variance Extracted (AVE), which should be above 0.5. This indicates that more variance is captured by the latent variable than measurement error. Discriminant validity is evaluated by ensuring that the square root of the AVE for each construct is higher than its correlations with other constructs. The AVE values ranging from 0.621 to 0.747 suggest good convergent validity. These values exceed the common threshold of 0.5, indicating that a substantial proportion of the variance in the latent constructs is captured by the indicators, demonstrating convergent validity.

2. Reliability

Reliability in PLS-SEM assesses the consistency and stability of measurement. Key metrics include Cronbach's Alpha and Composite Reliability (CR). Cronbach's Alpha values above 0.7 and CR values above 0.7 indicate acceptable reliability. High reliability ensures that the indicators collectively and consistently measure the latent constructs. The Cronbach's Alpha values ranging from 0.701 to 0.899 indicate acceptable to good internal consistency reliability for the latent constructs in the model. These values suggest that the indicators within each latent variable are adequately correlated, reflecting reliability in measurement. Composite Reliability values ranging from 0.725 to 0.916 further support the reliability of the measurement model. These values surpass the recommended threshold of 0.7, indicating that the latent constructs are measured reliably by their respective indicators.

3. VIF Values

The VIF assesses the extent of multicollinearity among the independent variables in the model. In PLS-SEM, a common threshold is a VIF value below 5, indicating low multicollinearity. High VIF values suggest that certain independent variables are highly correlated, potentially impacting the stability and interpretability of the model. The VIF values ranging from 3.210 to 3.981 are below the common threshold of 5, indicating low levels of multicollinearity among the independent variables. This suggests that the stability and interpretability of the model are not unduly influenced by high correlations among predictors.

4. Model Fit Criteria

Model fit indices, such as the Standardized Root Mean Square Residual (SRMR) and rms theta, evaluate how well the model reproduces the observed data. A lower SRMR (threshold around 0.08) and rms theta indicate better model fit. These indices assess the discrepancy between the observed covariances and those implied by the model, providing insights into how well the specified structural relationships align with the actual data. The SRMR value of 0.079 falls below the commonly accepted threshold of 0.08, indicating a good fit between the model and the observed data. Additionally, the rms theta value of 0.085 is close to the threshold, suggesting reasonable model fit. These indices collectively suggest that the structural model adequately reproduces the observed covariances.

5. R Square

R Square values indicate the proportion of variance explained by endogenous variables in the model. Higher R Square values (closer to 1) suggest that the model effectively explains the variability in the dependent variables. However, PLS-SEM tends to provide more conservative R Square values compared to covariance-based SEM. The R Square value of 0.780 indicates that the model explains approximately

78% of the variance in the endogenous variables. This is a substantial proportion and suggests that the specified structural relationships effectively capture the variability in the dependent variables.

c. Hypothesis Test Result

Table 1. Hypothesis Test Result

	Original Sample	Sample Mean	Std Dev	T Stats	P Value
LS -> SE	0,635	0,617	0,021	11,825	0,000
IS -> SE	0,575	0,512	0,014	12,321	0,000
AM -> SE	0,525	0,502	0,023	11,428	0,000

Source: Data Analysis Result, 2024

Table 1 presents the results of hypothesis testing for the influence of learning styles (LS), instructional strategies (IS), and assessment methods (AM) on student engagement (SE) in college-level science courses. The original sample means for each relationship are reported alongside their standard deviations, t statistics, and p-values. The findings reveal significant effects, as evidenced by the remarkably high t statistics and p-values of 0.000 for all three hypotheses. Specifically, the hypothesis related to learning styles (LS -> SE) demonstrates a substantial mean difference of 0.635 with a small standard deviation of 0.617, supported by a robust t statistic of 11.825. Similarly, instructional strategies (IS -> SE) exhibit a mean difference of 0.575, a small standard deviation of 0.512, and a significant t statistic of 12.321. Lastly, the hypothesis concerning assessment methods (AM -> SE) shows a mean difference of 0.525, a small standard deviation of 0.502, and a significant t statistic of 11.428. These results collectively underscore the statistically significant impact of learning styles, instructional strategies, and assessment methods on student engagement in college-level science courses, emphasizing the importance of considering these factors in shaping effective pedagogical approaches.

Discussion

The findings of this research offer valuable insights into the intricate dynamics of student engagement in college-level science courses, shedding light on the roles played by learning styles, instructional strategies, and assessment methods. The significant mean differences observed in the hypothesis tests underscore the profound impact of these factors on student engagement, reinforcing the notion that tailoring pedagogical approaches to individual learning preferences is pivotal.

The robust t statistics and exceedingly low p-values across all hypotheses (LS -> SE, IS -> SE, AM -> SE) provide compelling evidence in support of the research objectives. The results indicate that students' preferred learning styles significantly influence their engagement in science courses, emphasizing the need for educators to adopt diverse instructional strategies and assessment methods to accommodate these preferences. The substantial mean differences, coupled with small standard deviations, suggest not only the statistical significance but also the consistency of these effects across the sample.

The observed effects hold implications for educators and curriculum designers, highlighting the necessity of adopting a holistic approach to enhance student engagement. Aligning instructional strategies with diverse learning styles and incorporating varied assessment methods can foster a more inclusive and dynamic learning environment. This, in turn, may contribute to improved comprehension, critical thinking skills, and overall academic performance in science education.

Furthermore, the results emphasize the interconnectedness of these factors, underscoring the need for an integrated and adaptable pedagogical framework. Educators should consider the interplay between learning styles, instructional strategies, and assessment methods, recognizing that a tailored and flexible approach can better address the diverse needs of students. The findings not only contribute to the academic discourse on science education but also provide practical implications for educators seeking to optimize their teaching practices.

CONCLUSION

In conclusion, the results of this research illuminate the crucial relationship between learning styles, instructional strategies, assessment methods, and student engagement in college-level science courses. The statistically significant mean differences and robust statistical indicators underscore the profound impact of these pedagogical elements on students' level of engagement. The findings advocate for a shift from one-size-fits-all teaching methodologies to a more tailored and adaptive approach that acknowledges and incorporates diverse learning styles. Educators and curriculum designers should consider the interconnection of these factors, recognizing that a holistic and student-centered approach enhances the overall learning experience. By aligning instructional strategies and assessment methods with students' preferences and needs, educators can create an inclusive and dynamic environment that fosters higher levels of engagement, critical thinking, and academic achievement in science education. These results not only contribute to the academic understanding of effective pedagogy in science courses but also provide actionable insights for educators aiming to optimize their teaching practices for the diverse and dynamic landscape of college-level science education.

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