Int. j. adv. multidisc. res. stud. 2024; 4(6):139-142

Received: 19-09-2024
Accepted: 29-10-2024

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Perceptions of Science Trainee Teachers on the Impact of the Flipped Classroom Model toward Intrinsic Motivation in Science: A Conceptual Paper

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DOI: https://doi.org/10.62225/2583049X.2024.4.6.3407
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Abstract
The flipped classroom model has gained attention in modern education for its potential to foster intrinsic motivation, especially in science learning environments. Conventional teaching methods often fail to engage students deeply, leading to diminished intrinsic motivation. Science education, which requires active engagement, may not adequately fulfill students' psychological needs for autonomy, competence, and relatedness. Despite increased interest in innovative pedagogical approaches, there is limited understanding of how these models influence intrinsic motivation, particularly across gender groups. This study aims to explore science trainee teachers' perceptions of the flipped classroom's impact on intrinsic motivation, with a focus on gender differences. Grounded in Self-Determination Theory (SDT), which underscores the importance of meeting psychological needs to enhance intrinsic motivation, this research employs a quantitative survey design. Data were collected using the Intrinsic Motivation Inventory (IMI), evaluating aspects such as interest/enjoyment, perceived competence, effort/importance, value/usefulness, perceived choice, and relatedness. Descriptive statistics were conducted to assess intrinsic motivation levels, and independent samples t-tests examined gender differences related to the flipped classroom model among science trainee teachers at the Teacher Education Institute (IPG).The findings will be presented and discussed to provide insights into gender-specific motivational dynamics within flipped classroom environments.

Keywords: Flipped Classroom Model, Intrinsic Motivation, Science Education

Introduction

Education is a key factor in human development and national progress. In recent years, emerging technologies have driven significant innovations in education globally, promoting a shift from teacher-centered to student-centered learning to meet the demands of the 21st century (Unal & Unal, 2017) [23]. Malaysia, aligned with these global efforts, implemented the Malaysian Education Development Plan (PPPM) 2013-2025, emphasizing quality enhancement in its education system. This transformation positions teachers as crucial agents in fostering engaging, modern learning environments in Science, Technology, Engineering, and Mathematics (STEM) education to meet international standards (Malaysia Ministry of Education, 2013) [16]. Within STEM, science education stands out as essential for developing critical thinking, problem-solving, and a deeper understanding of the natural world.

A critical factor in engaging students in science subjects is motivation, particularly intrinsic motivation, which encourages curiosity, persistence, and a lasting connection with learning (Priniski, Hecht, & Harackiewicz, 2018) [19]. While extrinsic motivation can drive short-term gains, intrinsic motivation where students' internal drive to learn and understand concepts without external rewards is critical in science education, where students must often grapple with complex and abstract topics. In this case, traditional teacher-centered approaches have been increasingly scrutinized for their inability to sustain intrinsic motivation, interest, and effort to acquire new knowledge and competences especially in science education (Ferriz-Valero *et al*, 2022; Huang & Hew, 2017) [7, 12].

The flipped classroom model (FCM) has emerged as an effective instructional strategy in modern education, particularly in sciences. By having students engage with content outside the classroom and dedicating class time to interactive, problem-solving activities, FCM supports active learning and autonomy (Meor Ibrahim & Assaadah, 2011; Hsieh, Wu, & Marek, 2017)

[17, 11]. This model aligns with the integration of Information and Communication Technology (ICT) in education, fostering essential 21st-century skills like self-directed learning and problem-solving (Garba, Byabazaire, & Busthami, 2015) [8]. However, despite the global success of FCM widely adopted in various educational settings (Utami, Glufron & Setiawati. 2024) [24], many of the researchers have focused on examine flipped classroom model' s impact on student achievement and engagement, however, specific impact on intrinsic motivation among science trainee teachers in Malaysia is underexplored. Furthermore, the role of gender in shaping perceptions of FCM's impact on motivation remains insufficiently studied (Chiquito *et al*., 2020) [5]. This research aims to examine these perceptions, focusing on how FCM influences intrinsic motivation level specifically in science education among Malaysian Science trainee teachers, providing insights to shape future educational practices.

Research Objectives

1. To examine the level of perception science trainee teachers of flipped classroom's impact on intrinsic motivation in science.
2. To compare male and female science trainee teachers' level perceptions of intrinsic motivation in science flipped classroom.

Research Questions

1. What is the level of perception of science trainee teachers of flipped classroom's impact on intrinsic motivation in science?
2. Is there a difference between male and female trainee science trainee teachers' level perceptions of intrinsic motivation in science flipped classroom?

Research Hypotheses

H_{01}: There is no significant difference between male and female science trainee teachers' perception of the impact of flipped classroom toward intrinsic motivation level in science.

Literature Review

The Flipped Classroom Model in Science Education

The FCM shifts from traditional teacher-centered instruction to a student-centered model where students engage with learning materials before class, allowing in-class time for interactive, hands-on activities (Santos & Serpa, 2020) [21]. This paradigm shift aligns with constructivist learning theories, emphasizing the importance of active participation and deeper understanding, particularly in the realm of science education (Robertson, 2022) [20]. Research has consistently demonstrated that active learning strategies, such as those employed in flipped classrooms, enhance student motivation and achievement, fostering a more engaging and participatory learning environment (Abeysekera & Dawson, 2015; Jayapaul, 2024) [1, 14].

Intrinsic Motivation and Science Learning

Intrinsic motivation, defined as the internal drive to engage in activities that align with personal interests, plays a pivotal role in the context of science learning (Deci & Ryan, 2000) [6]. Numerous studies highlight the critical impact of learning environments on fostering intrinsic motivation, leading to positive outcomes such as improved mental health, enhanced creativity, and superior long-term academic performance (Tanti *et al*., 2020; Candel *et al*., 2024; Cerasoli *et al*., 2014) [22, 2, 3]. In particular, the FCM enhances intrinsic motivation by creating opportunities for autonomy, competence, and relatedness, which are essential components according to Self-Determination Theory (Ryan & Deci, 2000). When students perceive their learning as meaningful and enjoyable, they are more likely to engage deeply with the content, leading to higher levels of persistence and success (Cerasoli *et al*., 2014; Li, Hew & Du, 2024) [3, 15].

Moreover, the FCM supports collaborative activities and extends discussions, enriching the learning environment (Wei *et al*., 2014) [25]. Students who are intrinsically motivated tend to be self-directed, actively seeking solutions to learning challenges (Chen *et al*., 2018; Hastuti, 2020 [10]; Mursyidah *et al*., 2021 [18]). However, Zainuddin and Halili (2016) [9] caution that students may experience a lack of perceived effort or importance in the learning process. Therefore, self-paced pre-class materials are crucial for fostering intrinsic motivation, as they allow students to take ownership of their learning experiences.

Trainee Teachers and Pedagogical Shifts

Within this pedagogical framework, trainee teachers play a crucial role in adopting and implementing new pedagogical strategies. Their experiences during teacher training, characterized by practical exercises and exposure to innovative methods, shape their perception and acceptance of models such as the flipped classroom (Garba *et al*., 2015) [8]. Trainee teachers' perceptions of the effectiveness of these approaches are influenced by their self-efficacy and technological skills, which in turn affects their future teaching practice. By embracing active learning strategies, trainee teachers can create motivating learning environments that are responsive to the needs of 21st century learners.

Gender Inclusivity

The effectiveness of the flipped classroom model in science education extends beyond general student populations, demonstrating significant potential for promoting gender inclusivity. Recent studies indicate that female students may benefit more from the interactive and collaborative elements of the flipped classroom compared to their male counterparts (Chiquito *et al*., 2020) [5]. This observation suggests that the model can effectively enhance intrinsic motivation across diverse demographic groups, fostering a more equitable learning atmosphere for all students (Yan *et al*., 2024; Ikwuka & Okoye, 2021) [25, 13]. Collectively, these findings emphasize the relevance of the in fostering student motivation, particularly among science trainee teachers. They also highlight the importance of further exploring its implications for gender inclusivity in educational settings.

Methodology

Research design

This study employs a quantitative research design using a survey method to assess science trainee teachers' perceptions of the flipped classroom model's impact on intrinsic motivation. Also aims to compare perceptions between male and female teachers, identifying potential gender differences in motivation levels within science education.

Study sample

The study involves 100 science trainee teachers from the Bachelor of Education Program at the Teacher Education Institute (IPG). Purposive sampling was employed to ensure participants had specific experience with the flipped

classroom model, providing valuable insights into its impact on intrinsic motivation in science education.

Research procedure

Data were collected via a structured questionnaire distributed online using Google Forms. The questionnaire was disseminated through social media platforms and institutional channels to science trainee teachers from the Bachelor Degree Program in Teaching (PISMP). Respondents were first provided with an introduction to the flipped classroom model, highlighting its key components. They were then asked to reflect on their experiences with this pedagogical approach and how it influenced their intrinsic motivation. The Intrinsic Motivation Inventory (IMI) was used to measure motivation across various subscales such as interest/enjoyment, perceived competence, and effort. Descriptive statistics summarized demographic variables and intrinsic motivation levels, while inferential statistics assessed gender differences in perceptions.

Instrument

The primary instrument used for data collection was a modified version of the Intrinsic Motivation Inventory (IMI), originally developed by Deci & Ryan (2000) [6]. This version consists of 25 items across six subscales: interest/enjoyment, perceived competence, effort/importance, value/usefulness, perceived choice, and relatedness. The IMI has been widely used and validated in various educational contexts. Respondents rated their agreement with each item on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The IMI's reliability in this study was confirmed with a Cronbach's alpha value of 0.896, indicating high internal consistency.

Data analysis

The data analysis for this study employs a quantitative approach, guided by two research questions: (i) What is the perception level of science trainee teachers regarding the flipped classroom's impact on intrinsic motivation? and (ii) Is there a difference in perceptions between male and female trainee teachers?. Descriptive statistics were used to summarize demographic data by using frequency and percentage and intrinsic motivation levels, as measured by the Intrinsic Motivation Inventory (IMI). Responses were analyzed using a 5-point Likert scale, with means and standard deviations calculated for each subscale to categorize motivation levels. To measuring differences in intrinsic motivation between male and female teachers, an independent samples t-test was conducted. Before analysis, normality was verified, and Levene's test confirmed that the assumptions of the t-test were met. A p-value of less than 0.05 indicated statistical significance, providing insights into gender influences on perceptions of the flipped classroom model's effectiveness in enhancing intrinsic motivation in science education.

Conclusion

The study highlights that science trainee teachers generally perceive the flipped classroom model as a powerful tool for fostering intrinsic motivation among students in science. By promoting autonomy and active engagement, the flipped model creates a more student-centered learning environment. However, effective implementation requires adequate support and resources for teachers. Future research could explore long-term impacts of the flipped model on student motivation and learning outcomes across different contexts.

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