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Implementing Online Learning Models to Strengthen Student Characteristics in Physics Education during the Covid-19 Pandemic

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Abstract
The Covid-19 pandemic has significantly transformed higher education, shifting conventional face-to-face instruction to online learning and creating both challenges and opportunities for student development. This study aimed to analyze the implementation of online learning models and their influence on student characteristics in the Physics Education Study Program at Universitas Indraprasta PGRI. A descriptive qualitative approach was employed with purposive sampling of undergraduate students who had experienced online learning for at least two semesters, and data were collected through questionnaires, semi-structured interviews, and documentation. Thematic analysis was applied to identify patterns related to student learning strategies, the use of digital platforms, and character formation during online learning. The results revealed that students employed varied strategies such as mind mapping, blended learning, and group discussions via applications like WhatsApp, Zoom, and Google Classroom to sustain learning, while challenges included unequal internet access, limited technological facilities, and varying levels of readiness. Despite these obstacles, online learning contributed to the development of key character values, including independence, responsibility, discipline, and adaptability, which are essential in preparing students for the demands of the 21st century. The novelty of this study lies in its focus on the affective dimension of online learning, emphasizing character formation alongside cognitive achievement. The findings imply that universities and policymakers should design online learning systems that not only address technological barriers but also intentionally integrate character education to ensure holistic student development in future digital learning environments.

Keywords: Character Education; Covid-19; Higher Education; Learning Models; Online Learning.

INTRODUCTION

The global spread of the Covid-19 pandemic has transformed education systems across the world, forcing institutions to shift abruptly from traditional face-to-face instruction to online learning modalities. This transition has challenged both educators and learners, particularly in higher education, where independent learning, technological adaptation, and self-regulation are essential for academic success. Online learning is widely regarded as a flexible approach that promotes autonomous learning while accommodating health protocols during emergencies such as pandemics (AlQashouti et al., 2024; L.-H. Chen, 2023; Dhawan, 2020). However, its effectiveness depends on multiple factors, including students' digital readiness, the suitability of learning platforms, and the pedagogical strategies employed by instructors (Barikzai et al., 2024; Marzuki et al., 2024; Weerarathna et al., 2023).

In the Indonesian context, the sudden implementation of online learning posed significant challenges for universities, as many students lacked adequate technological infrastructure, internet access, and prior experience with digital platforms. Research has shown that students' engagement and achievement in online learning are highly influenced by the design of instructional models and the extent to which these models foster interaction, collaboration, and learner autonomy (Bergdahl, 2022; De Bruijn-Smolders & Prinsen, 2024; Pan, 2023).Physics education students, in particular, face unique challenges because their field requires not only

conceptual understanding but also the development of scientific attitudes, experimental skills, and problem-solving abilities, which are often difficult to achieve through online learning alone (Abdulrahaman et al., 2020; Bhaw et al., 2023; Zamiri & Esmaeili, 2024).

The role of character formation in higher education has also gained increasing attention, as the purpose of education is not solely to transmit cognitive knowledge but also to nurture affective and ethical competencies. Character education, understood as the cultivation of values such as responsibility, independence, honesty, and cooperation, is considered essential for preparing students as future citizens in a knowledge-based society (Chan, 2020; Sakti et al., 2024; Valladares, 2021). In online learning environments, character education can be embedded through pedagogical strategies that balance cognitive and affective domains, thereby shaping students into individuals who possess both intellectual intelligence (hard skills) and social-emotional competencies (soft skills) (Brundin et al., 2022; Gamage et al., 2021; Radianti et al., 2020). Prior studies have demonstrated that online learning can support character development when carefully designed to include collaborative learning, reflective activities, and value-based content (Alsayer, 2023; Perez-Aranda et al., 2024; van der Stap et al., 2024).

Nevertheless, research has also identified substantial obstacles in online learning implementation. Limited internet access, inadequate technological facilities, and a lack of digital literacy among both students and instructors have often reduced its effectiveness, particularly in developing countries (Mustafa et al., 2024; Rasimin et al., 2024; Sing Yun, 2023). Students have reported difficulties in adapting to new modes of learning, which negatively affect their motivation and learning outcomes (C. Chen et al., 2023; Feng & Xiao, 2024; Koskinen et al., 2023). Moreover, the extent to which online learning fosters student character development remains underexplored, as most studies have concentrated primarily on cognitive outcomes such as achievement and knowledge retention (Gao et al., 2024; Monib et al., 2025; Wijnia et al., 2024).This gap raises important questions about how online learning can be strategically implemented to support not only academic performance but also the holistic formation of student character in higher education.

In particular, research on physics education students during the Covid-19 pandemic in Indonesia remains limited. While previous studies have described the technical and pedagogical challenges of online learning in general, few have investigated how different learning models were adopted by students themselves and how these models contributed to shaping their independence, responsibility, and adaptability. Furthermore, the balance between cognitive and affective outcomes in online learning environments for physics education students has not been adequately examined, despite the critical role of character development in forming future teachers and professionals.

Therefore, the present study aims to analyze the implementation of online learning models among physics education students during the Covid-19 pandemic and to evaluate their impact on student characteristics, including independence, responsibility, and adaptability. By focusing on both cognitive and affective domains, this study seeks to provide a more comprehensive understanding of the opportunities and challenges of online learning in shaping the character of future physics educators. The findings are expected to contribute not only to the discourse on online learning effectiveness but also to the broader goal of integrating character education into higher education practices in Indonesia and beyond.

METHODS

This study employed a descriptive qualitative design with a focus on analyzing the implementation of online learning models and their influence on the development of student characteristics in the Physics Education Study Program at Universitas Indraprasta PGRI during the Covid-19 pandemic. The research population consisted of undergraduate students enrolled in the Physics Education program, and a purposive sampling technique was used to select participants who had actively experienced online learning for at least two semesters. Data collection was carried out through online questionnaires and semi-structured interviews

designed to capture students' perceptions, learning experiences, and character development in terms of independence, responsibility, discipline, and collaboration. The research instruments were validated by education experts to ensure content validity and clarity, while a pilot test was conducted with a small group of students to refine the questionnaire items. Data analysis followed a thematic approach, beginning with data reduction, categorization, and coding of responses, which were then interpreted to identify recurring patterns and emerging themes. To enhance trustworthiness, triangulation was applied by comparing findings from questionnaires, interviews, and relevant documentation. Ethical considerations were strictly observed, with informed consent obtained from all participants, confidentiality of responses maintained, and voluntary participation ensured throughout the research process. This methodological approach was intended to provide a comprehensive understanding of how online learning models shaped both cognitive and affective dimensions of student development in the context of pandemic-induced educational transitions.

RESULTS AND DISCUSSION

Students' Experiences in Online Learning

The findings revealed that students in the Physics Education Study Program experienced both opportunities and challenges during online learning throughout the Covid-19 pandemic. The majority of students reported initial difficulties in adapting to the transition from face-to-face to online learning, particularly due to limited internet connectivity and lack of adequate technological devices. However, some students developed strategies such as mind mapping, note-taking, and online group discussions to support their learning independence. These findings indicate that while online learning created barriers, it also encouraged students to cultivate adaptive learning behaviors.

Online Learning Models Applied by Students and Lecturers

Several models of online learning were identified, including the use of WhatsApp groups for sharing materials and attendance, video conferencing platforms such as Zoom and Google Meet for synchronous discussions, and Google Classroom for assignment submissions. In some cases, lecturers relied solely on asynchronous methods, while others combined synchronous and asynchronous learning, resembling a blended learning approach. Students reported that blended approaches were more effective in maintaining interaction and reducing misunderstanding in group assignments.

Character Formation through Online Learning

The study also found that online learning contributed to the development of student character, particularly in terms of independence, responsibility, and discipline. Students noted that the absence of face-to-face supervision required them to manage their own study schedules and remain committed to completing assignments on time. Collaborative online discussions also enhanced students' communication and teamwork skills, although some participants highlighted difficulties in maintaining consistent engagement due to technological and motivational constraints.

Discussion

The results of this study confirm that online learning during the pandemic had a multifaceted impact on students' learning and character development. Consistent with the findings of Rahman (2020), students encountered significant technical and infrastructural challenges, yet the process also fostered independence and self-regulation. Similarly, Haleem (2022) emphasized that online learning environments, despite their limitations, provided opportunities for character education by promoting responsibility and resilience. The reported effectiveness of blended learning in this study aligns with international research by Mathew (2024), who argued that combining synchronous and asynchronous learning modes enhances interaction and supports diverse learning needs.

In addition, the identification of WhatsApp groups as a widely used medium supports the findings of Lai (2022), who demonstrated that mobile-based platforms facilitate continuity of learning

in contexts with limited technological resources. The importance of collaborative learning through video conferencing resonates with du Plooy (2024), who highlighted the role of digital tools in fostering student collaboration and active engagement in online settings. Furthermore, the contribution of online learning to students' independence and problem-solving ability echoes the work of Martin-Alguacil (2024) and Goodwin (2024), who emphasized that student-centered approaches enhance critical thinking and adaptability, even in non-traditional learning environments.

The novelty of this study lies in its contextual focus on Physics Education students in Indonesia, specifically examining how online learning not only supported cognitive aspects of learning but also influenced affective and character dimensions. While much of the existing literature has focused on the cognitive effectiveness of online platforms, this study highlights the balance between cognitive and affective domains, which is essential in developing well-rounded graduates in science education.

The implications of this research are significant for educators and policymakers. Lecturers should consider adopting blended learning models that combine synchronous discussions and asynchronous resources to optimize student engagement and understanding. Universities must also provide adequate technological infrastructure and training to support effective online learning. At a policy level, integrating character education into online curricula is crucial to ensure that students develop independence, responsibility, and collaboration skills alongside academic knowledge.

Nevertheless, this study has limitations. The sample was limited to a single study program at one university, restricting the generalizability of the findings. Data collection relied heavily on self-reported questionnaires and interviews, which may be subject to response bias. Furthermore, the study did not include longitudinal tracking of student development, leaving open questions about the long-term sustainability of character formation through online learning. Future research should expand to multiple institutions, incorporate mixed-methods approaches, and examine long-term outcomes to provide more comprehensive insights into the role of online learning in shaping both academic and character development.

CONCLUSION

This study concludes that the implementation of online learning models during the Covid-19 pandemic played a crucial role not only in maintaining the continuity of education for students in the Physics Education Study Program at Universitas Indraprasta PGRI but also in shaping important aspects of student character, including independence, responsibility, discipline, and adaptability. Although online learning was challenged by unequal internet access, limited technological infrastructure, and varying levels of student readiness, many students demonstrated resilience by adopting strategies such as mind mapping, blended learning approaches, and active use of digital platforms to sustain academic performance. The findings highlight that online learning, when supported by adequate facilities, clear instructional design, and effective collaboration between lecturers and students, can foster both cognitive and affective development. The novelty of this study lies in its focus on how online learning contributes to character formation in higher education, a dimension often overlooked in previous research that primarily emphasized cognitive achievement. The results imply that universities and policymakers should integrate character education into online learning frameworks to ensure holistic student development, while future research is encouraged to expand the scope by employing longitudinal designs and larger, more diverse populations to capture broader insights into the long-term impact of online learning on student character.

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