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ORIGINAL ARTICLE

Exploring student and teacher perspectives on education with technological advancement in Indonesia through Design Thinking in response to COVID-19

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ABSTRACT

This research investigates the impact of coronavirus disease 2019 (COVID-19) on education in Indonesia, particularly focusing on the evolving role of technology in the learning process. Standing at the crossroads of pandemic-induced disruption and Indonesia's increasing reliance on technology, this study examines how teaching and learning paradigms have shifted in response. We explore the perspectives of students and teachers, delving into their adaptations to educational challenges and the influence of technology on learning environments. Employing Design Thinking principles, the research utilizes a combination of surveys and workshops to gain a deeper understanding of these challenges and co-create solutions. This approach involves the exploration of novel solutions like AI-generated DALL-E artwork, creative TikTok lessons, and collaborative VR demonstrations. These "culturally relevant and readily accessible technologies" proved instrumental in fostering student empathy, engagement, and concentration, highlighting their critical role in the post-pandemic era. Key findings reveal changes in learning habits, an increased reliance on technology, and the importance of empathy in understanding both student and teacher experiences. Furthermore, the study demonstrates the effectiveness of Design Thinking in generating practical solutions for online learning challenges. These solutions emphasize the importance of inclusive, collaborative, and interactive approaches for enhancing educational practices, particularly during crisis situations. This research contributes valuable insights to ongoing discussions about technology integration in education, while simultaneously underscoring the potential of Design Thinking in formulating effective educational solutions for the post-pandemic landscape.

Keywords: Education; Design Thinking; technology; empathy; inclusive; collaboration; COVID-19.

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic significantly shifted the educational landscape globally. Indonesia experienced a major change to online learning, offering particular challenges to its education system. This research aims to investigate the continued challenges faced by the Indonesian education system during and after this sudden change. It particularly focuses on how teachers and students adapted to the new reality of technology-driven education (Rahayu & Wirza, 2020; Tauhidah et al., 2021).

While existing literature has provided valuable insights into the challenges faced by teachers and students in Indonesia during the COVID-19 pandemic, including past research by Permatasari et al. (2021) and Eva et al. (2021), there are two research gaps that our study aims to address:

1. Challenges and adaptations in Indonesian education during the pandemic: past studies showed the initial challenges encountered during the pandemic (Noviyanti, Magfiroh, Wahyudi, & Puji, 2020). Still, the ongoing effects and adaptations in the Indonesian education system, especially in the context of prolonged disruption caused by the pandemic, remain to be comprehensively explored.
2. The potential of Design Thinking in addressing online learning challenges: another gap in the study pertains to how Design Thinking principles can be effectively applied to ideate and implement innovative solutions for the multifaceted challenges of online learning (Kumalasari & Akmal, 2021). While our research delves into this aspect, it remains relatively unexplored in the existing body of knowledge.

The research question of this study is: "How can design thinking contribute to the exploration and solution of challenges in technology-driven learning during the COVID-19 pandemic in Indonesia, and how might this influence future educational practices?" This research leverages Design Thinking (Brown & Katz, 2011), surveys, and workshops with artificial intelligence (AI) integration to bolster educational resilience in Indonesia during COVID-19.

This study provides innovative empathic design solutions such as AI-generated images utilizing DALL-E, creative TikTok videos, and collaborative VR

examples to greatly boost student engagement, involvement, and attentiveness. The use of such engaging tools is critical in the post-COVID era, where grabbing students' attention has become important. It explores the interplay of technology, pandemic impacts, and student-teacher dynamics (Henriksen et al., 2017), delivering insights and fostering future Design Thinking applications in education (Calavia et al., 2023).

This approach emphasizes both practical application and experimental innovation (von Thienen et al., 2023), contributing significantly to the field while also fitting with the CERN IdeaSquare innovative ethos.

THEORETICAL BACKGROUND

The COVID-19 pandemic had a profound impact on global education, particularly in Indonesia. Challenges unique to Indonesia, stemming from cultural and infrastructural diversity, necessitated a deep understanding of these contexts (Putra et al., 2020). Changes in instructional strategies and collaborative efforts are needed to prevent learning gaps (Rasmitadila et al., 2020).

Indonesian teachers faced significant challenges in adapting to online education, including technical and pedagogical shifts (Maddukelleng et al., 2023). Additionally, students' limited e-learning skills and access to technology presented further difficulties (Mailizar, Almanthari, Maulina, & Bruce, 2020). Despite the potential of digital media to enhance instructional quality (Rusydiyah et al., 2020), there was a need for a new approach to integrating these technologies effectively (Rahayu & Wirza, 2020; Tauhidah et al., 2021).

Government policies were instrumental in directing educators toward e-learning and social media use (Salehudin et al. 2020; Khan et al. 2021), but the pandemic laid bare several shortcomings, particularly in the realm of supporting educator's pedagogic skills and technology proficiency, along with students' readiness for online learning (Rifa'i, 2023). These challenges were compounded by infrastructural and socioeconomic disparities that the policies failed to mitigate (Sada, 2022). Wajdi et al. (2020) recognized some effective measures, but as Pratiwi & Ayu (2020) argue, there is a clear imperative for educational policies to be more dynamic and flexible, capable of sustaining education through crises and ensuring equitable access to resources. Hence, this research delves into ongoing challenges and necessary adaptations in the Indonesian education system.

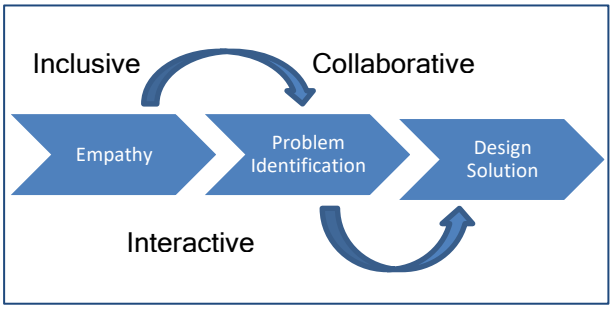

Fig. 1. Design Thinking approach

Design Thinking, known for its problem-solving abilities (Brown & Katz, 2011; Stackowiak & Kelly, 2020), was instrumental in addressing the challenges of online education in Indonesia. This research adopts a theoretical framework informed by three Design Thinking principles, outlined in Figure 1, emphasizing empathy, problem identification, and design solutions.

1. **Empathy**: empathy plays a pivotal role in comprehending the challenges faced by teachers and students in adapting to technology-driven education during the pandemic. By empathizing with their experiences and concerns, the research aims to uncover understandings (Pusca & Northwood, 2018; Henriksen, Richardson, & Mehta, 2017).
2. **Problem identification**: this research focuses on identifying and delineating the multifaceted challenges in the Indonesian educational landscape, shedding light on their evolution in the post-pandemic era (Rumahlatu et al., 2021).
3. **Design solutions**: the aim is not only to identify challenges but also to propose innovative and practical solutions, driven by design thinking principles (Pratomo et al., 2021).

To achieve these objectives, the research employs a Design Thinking approach with surveys and workshops (McCoy et al., 2016; Thornberg, Forsberg, Hammar Chiriac, & Bjereld, 2022).

METHODS AND DATA

This study used Design Thinking to explore challenges and opportunities in Indonesian tech-driven learning during COVID-19. Combining qualitative and quantitative data (triangulation) ensured a comprehensive understanding of complex issues.

Participant demographics

For this study, participants were recruited using a convenience sampling method. A total of 19 middle high school students and four high school teachers from the same school in Indonesia volunteered in response to an invitation via a school group chat, which aligned with the sampling techniques discussed by Isaac (2023). This demographic choice aligns with the need to understand tech-driven learning challenges and opportunities in Indonesia, as highlighted by Thornberg et al. (2022) in their exploration of teacher-student relationships and student engagement.

Design methodology

The study applied a Design Thinking approach to both student and teacher groups in Indonesian which then translated into English, albeit through different methods, resonating with the ideas of Gasparini (2015) on the use of Design Thinking in educational research.

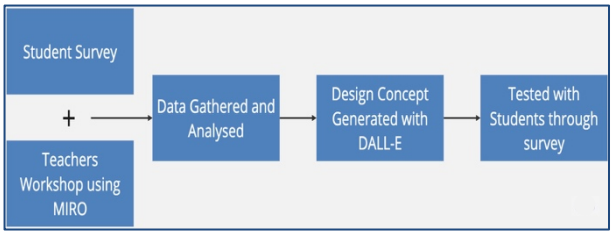

Fig. 2. Design research method

Empathy: problem identification, and design solution

- *Students:* the survey for students was designed to evoke empathetic responses, identify problems, and generate design solutions. Further, surveys were selected for students due to their capacity to articulate individual experiences and perceptions systematically across a larger population. This approach, suitable for gathering quantitative data and qualitative insights, allows for the efficient and anonymous expression of ideas and challenges faced by students. The survey design was open ended questions and was conducted online (Kypri, Gallagher, and Cashell-Smith 2004). The questions asked were:

    1. "How do you feel about the difference in learning before and after the pandemic?" (Empathy)
    2. "What do you think of the current learning process?" (Problem identification)
    3. "If you become an innovator of the future, what learning methods would you like to use with technology?" (Design solution)

Details	Students	Teachers
Number of participants	19	4
Age range	12-18	24-28
Gender distribution	Males and Females	Females
Years of study/teaching	Year 9 to year 12	2-3 years
Educational background	SMP and SMA (Middle School and High School)	University
Proficiency in technology	Zoom, Google Classroom	Zoom, Google Classroom

Table 1 Demographic of students and teachers.

- *Teachers:* in the Design Thinking workshop, teachers collaboratively discussed their experiences during the pandemic (Empathy), identifying challenges (Problem identification) and brainstorming potential solutions (Design solutions). Furthermore, workshops for teachers were chosen for their interactive nature and small participants: they foster in-depth discussion and collaborative problem-solving. This approach is necessary for educators implementing strategies and aligns with McCoy et al. (2016) emphasis on collaborative design thinking.

Data collection and analysis

The data from the student surveys and teacher workshops were collected and analyzed separately to identify key themes, challenges, and potential solutions. This analysis approach is supported by the mixed methods paradigm discussed by Stern et al. (2014) and Thornberg et al. (2022).

Design concept generation

Based on the analyzed data, three distinct design solutions were conceptualised. These concepts were visualized using DALL-E, a text-to-image AI model, facilitating rapid ideation and visualization of potential solutions. This innovative use of AI in the design process is informed by the work of Paananen, Oppenlaender, & Visuri (2023).

Testing

The resulting design concepts were then presented to students for feedback, ensuring that the solutions were aligned with their needs and preferences.

This methodology, illustrated in Figure 2, integrates the principles of design thinking with a mixed-methods research approach. By separately engaging students and teachers in the empathy, problem identification, and design solution stages, the study captures a holistic view of the educational challenges during the pandemic. The subsequent analysis and testing of DALL-E-generated concepts aim to provide innovative and practical solutions for technology-driven learning in Indonesia.

RESULTS

This research explored the difficulties faced by students and teachers in Indonesia when transitioning to technology driven learning during the COVID 19. It was based on the design thinking framework and a mixed method of research approach. The study focused on empathy, problem identification and design solutions. (Figure 1).

Table 2. Analysis of students and teachers

Category	Student perspective	Teacher perspective
Empathy	1. Shift in learning habits due to remote learning 2. Impact of technology on study routines and social interaction 3. Fluctuating motivation amid pandemic uncertainties	1. Struggles with student engagement in virtual settings 2. Technical challenges in online teaching 3. Reduced interactivity and personal connection with students
Problem identification	1. Challenges with fast-paced online teaching Increased reliance on technology for learning 2. Changes in teacher-student dynamics due to remote interactions	1. Distractions and lack of focus among students in online classes 2. Concerns over social media's influence on attention span 3. Challenges in maintaining student interest and avoiding burnout
Design solution	1. Preference for educational apps with interactive features 2. Interest in VR for immersive and practical learning 3. Desire for interactive teaching aids and Q&A sessions for active engagement	1. Utilizing social media for educational purposes 2. Emphasizing collaborative content creation for deeper learning 3. Integrating game-based learning to enhance student motivation and participation

Student perspectives

The survey conducted among students provided insights into their study habits, reliance on technology and fluctuating levels of motivation during the pandemic. It was observed that students faced difficulties in returning to their pandemic learning routines and demonstrated varying degrees of motivation (Table 2). They expressed a preference for teaching methods to foster collaboration and social interaction (Table 2). However, some students felt the need to supplement their learning by turning to platforms like YouTube or TikTok due to the pace at which certain teachers presented information (Table 2), which aligns with the findings of Pratiwi & Ayu (2020).

The proposed solutions put forth by students, such as problem solving and the use of virtual reality technology, for interactive learning reflect the principles by Pratomo et al., (2021) for engaging and practical education (Table 2).

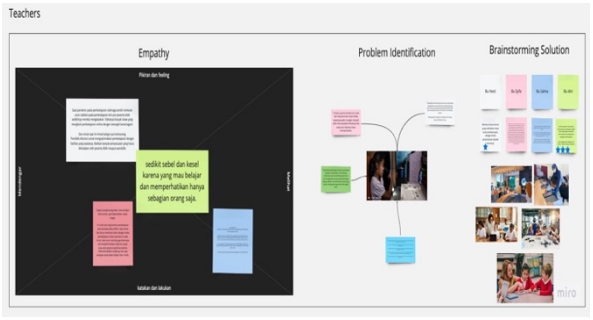

Fig. 3. Design Thinking workshop for teachers

Teacher perspectives

The teacher workshop, utilizing Miro and Microsoft Teams, facilitated active collaboration and idea generation (Figure 3). Teachers expressed concerns about student engagement, decreased learning interest, limited resources, and technical challenges, resonating with the difficulties faced in adapting to online education as discussed by Rahayu & Wirza, (2020). Their emotional responses of annoyance and frustration were reflective of the broader challenges faced in the educational sector during the pandemic (Table 2).

Teachers proposed solutions, including group demonstrations, social media's integration, and game-based learning with rewards, aiming to enhance student collaboration and motivation. These solutions align with the innovative approaches to education suggested by Tauhidah et al. (2021) and are aimed at addressing the unique challenges of the pandemic (Table 2).

Synthesis of findings and Design Thinking application

The research methodology, combining individual student surveys and collaborative teacher workshops, enabled a comprehensive exploration of challenges and effective solutions. While there was no direct interaction between students and teachers, the independently collected data provided valuable insights. These insights were visually represented using DALL-E, showcasing an

innovative approach to conceptualizing and testing potential solutions (Figure 4).

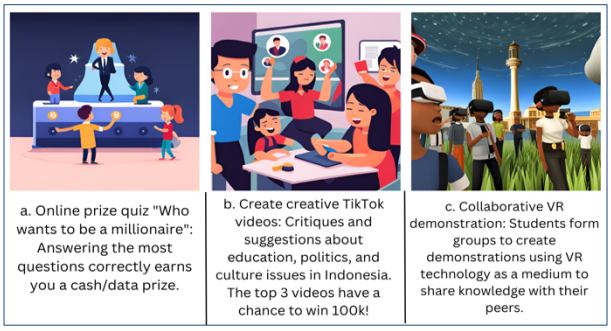

Fig. 4. Design Concept - Picture Generated by DALL-E

Through the design thinking process, three design concepts were generated using DALL-E and tested with students (Figure 4). The first concept, an online prize quiz, reflects a blend of competitive engagement and reward-based learning underscored by students. The second, creative TikTok video production, aligns with a contemporary pedagogical approach that values creativity and social media as tools for educational discourse. The third, a collaborative VR demonstration, encapsulates the collective call for immersive educational experiences (Table 2).

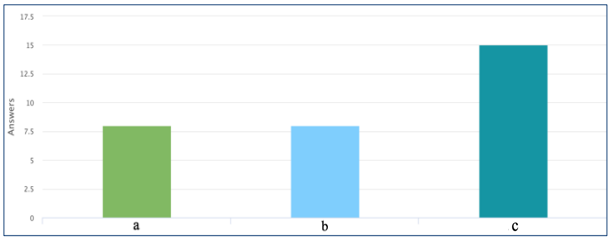

Fig. 5. Design concept result

The preferred concept, a Collaborative VR demonstration, was chosen by 79% of the students, indicating a strong preference for interactive and immersive learning experiences, supported by the work of Paananen, Oppenlaender, & Visuri (2023) (Figure 5). One of the students mentioned, *'I want to experience technology in every educational institution through 3D VR tools. I believe that 3D VR will make learning more exciting. I will also create debate and presentation sessions.*' This statement highlights the student eagerness for widespread adoption of 3D VR technology in education, emphasizing the potential for enhanced engagement and interactive learning experiences.

Further, another student mentioned, *'A teaching method in which there is a lot of practice for each topic/lesson, especially in subjects like mathematics and physics, where much time is spent only on learning theory, whereas there are many real-life examples that can apply mathematical concepts. To make practice more efficient, students could use VR technology*.' This perspective underscores the need for practical application in subjects like mathematics and physics and suggests that VR technology could offer an efficient solution to bridge the gap between theory and real-world application, aligning with the focus of this study on technology's role in education during the COVID-19 pandemic.

In conclusion, this study in post-pandemic Indonesia illuminates the complexities of technology-driven learning. Design Thinking, employing novel solutions like AI generated DALL-E artwork and collaborative VR, fostered student empathy and engagement. These culturally relevant technologies hold promise for enhancing education. By incorporating these interactive elements, educators can cultivate inclusive, collaborative environments that demonstrably improve learning outcomes. This aligns with Design Thinking's emphasis on practical application and experimental innovation (von Thienen et al., 2023), contributing significantly to the field and fitting the CERN IdeaSquare focus on innovative approaches.

DISCUSSIONS AND CONCLUSIONS

This research investigated the multifaceted challenges faced by Indonesia's education sector during the COVID-19 pandemic, including the abrupt shift to online learning, technological disparities, and the psychological impact on students and teachers. To address these challenges, the study employed Design Thinking, known for its problem-solving abilities (Brown & Katz, 2011), alongside surveys, workshops, and AI integration. This approach emphasized empathy in problem identification and solution design, ultimately generating innovative solutions.

The findings provide valuable insights and pave the way for future Design Thinking applications in education (Calavia et al., 2023). Significantly, the research yielded two key contributions:

1. **Practical application:** this research demonstrates Design Thinking's effectiveness in crafting adaptable and real-world solutions for educational challenges. Students' preferences for interactive learning technologies like educational apps and virtual reality serve as an example. Similarly, teachers' adaptations using social media and game-based learning showcase how Design Thinking can address practical needs in classrooms. These findings support the notion that Design Thinking fosters practical solutions that enhance educational experiences (Henriksen et al., 2017).
2. **Experimental innovation:** this project underscores the potential of Design Thinking for fostering empathetic and innovative educational solutions with integration of AI model for design solutions. The research aligns with the CERN IdeaSquare focus on experimental innovation, by demonstrating

Design Thinking's ability to generate creative approaches to educational challenges (von Thienen et al., 2023). By emphasizing empathy throughout the process, Design Thinking allows for solutions that not only address practical needs but also consider the human element in education.

Furthermore, this research underscores the critical role of technology in modern education, particularly its potential for creating more engaging and interactive learning experiences. This aligns with previous research highlighting the importance of technology in education (Rahayu & Wirza, 2020). The research also emphasizes the need for inclusive, collaborative, and interactive approaches during crises, a crucial point for future educational planning.

Focusing on the Indonesian context allowed the study to consider cultural influences on participants' perspectives. While the proposed solutions might need adjustments in different settings, the demonstrated resilience of Indonesia's education system offers valuable insights for tackling similar challenges globally. Future research can build upon these findings by involving a wider range of stakeholders in co-creating and validating technology-based learning solutions through a Design Thinking lens. This focus on practical applications can ensure adaptable and effective educational strategies across diverse educational landscape.

This research has limitations. The focus on Indonesia may limit the generalizability of the findings. Additionally, the use of surveys and workshops may not capture all perspectives within the education system. Future research can address these limitations by employing a wider range of methodologies and conducting studies in different cultural contexts.

Overall, this research demonstrates the value of Design Thinking as a tool for addressing educational challenges and fostering innovation in education. It highlights the importance of technology, empathy, and collaboration in creating effective learning experiences, especially during times of crisis. Future research can build upon these findings to develop even more robust and adaptable educational strategies for a diverse and ever-evolving learning landscape.

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