Salud, Ciencia y Tecnología. 2025; 5:1309
doi: 10.56294/saludcyt20251309

ORIGINAL

Online Learning Technology: Implications on Mental Health and Learning Outcomes of Students

Tecnología de Aprendizaje en Línea: Implicaciones en la Salud Mental y los Resultados de Aprendizaje de los Estudiantes

Abdul Malik Made[1], Syahril[2], Waskito[2], Fadhli Ranuharja[3] ✉, Afif Rahman Riyanda[4], Margaretha Karolina Sagala[4], Daniel Rinaldi[4], Uswatul Hakim[5], Joseph Oluwaseyi[6], Angel Torres-Toukoumidis[7]

[1]Vocational Technology Education, Universitas Negeri Padang. Indonesia.
[2]Universitas Negeri Padang, Department of Mechanical Engineering, Padang, Indonesia.
[3]Universitas Negeri Padang, Department of Electronic, Padang, Indonesia.
[4]Universitas Lampung, Faculty of Teacher Training and Education, Lampung, Indonesia.
[5]Universitas Negeri Padang, Department of Art, Drama, Dance and Music, Padang, Indonesia.
[6]Ladoke Akintola University of Technology, Technology Department, Ogbomoso, Nigeria.
[7]Universidad Politécnica Salesiana, Media Studies and Education Department. Cuenca, Ecuador.

Cite as: Made AM, Syahril S, Waskito W, Ranuharja F, Riyanda AR, Sagala MK, et al. Online Learning Technology: Implications on Mental Health and Learning Outcomes of Students. Salud, Ciencia y Tecnología. 2025; 5:.1309. https://doi.org/10.56294/saludcyt20251309

Submitted: 09-02-2024 **Revised:** 16-05-2024 **Accepted:** 19-12-2024 **Published:** 01-01-2025

Editor: Prof. Dr. William Castillo-González

Corresponding author: Fadhli Ranuharja ✉

ABSTRACT

This study examines the impact of online learning on students' mental health and learning outcomes at Batam University, focusing on digital literacy, socio-emotional engagement, digital skills, and the home learning environment. The transition to online learning, driven by the COVID-19 pandemic, has reshaped educational practices, introducing both opportunities and challenges for students. A quantitative approach with an explanatory survey method was adopted to analyze the direct and indirect effects of online learning on mental health and learning outcomes. The study involved 110 Mechanical Engineering students from the 2021, 2022, and 2023 cohorts. Data were collected using a questionnaire with 20 items for each variable, assessed on a Likert scale. Data validity and reliability were tested using SPSS, while path analysis with AMOS was employed to evaluate relationships between variables. The results indicate that online learning significantly affects students' mental health, particularly increasing academic anxiety and stress levels. However, it positively influences learning outcomes, especially in metacognitive skills, though challenges persist in collaborative skills and creativity. Digital skills and the home learning environment are critical factors in achieving successful learning outcomes. This study concludes that while online learning provides flexibility and innovation, it also presents psychological and social challenges. Increasing socio-emotional engagement and adopting a more holistic approach are necessary to mitigate mental health issues and enhance learning outcomes, ensuring that online education supports both the well-being and academic success of students.

Keywords: Online Learning; Mental Health; Learning Outcomes; Path Analysis.

RESUMEN

Este estudio examina el impacto del aprendizaje en línea en la salud mental y los resultados de aprendizaje de los estudiantes de la Universidad de Batam, centrándose en la alfabetización digital, el compromiso socioemocional, las habilidades digitales y el entorno de aprendizaje en el hogar. La transición al aprendizaje en línea, impulsada por la pandemia de COVID-19, ha transformado las prácticas educativas, introduciendo

tanto oportunidades como desafíos para los estudiantes. Se adoptó un enfoque cuantitativo con un método de encuesta explicativa para analizar los efectos directos e indirectos del aprendizaje en línea en la salud mental y los resultados de aprendizaje. El estudio involucró a 110 estudiantes de Ingeniería Mecánica de las cohortes de 2021, 2022 y 2023. Los datos se recopilaron mediante un cuestionario con 20 ítems por variable, evaluados en una escala de Likert. La validez y la confiabilidad de los datos se probaron utilizando SPSS, mientras que el análisis de rutas con AMOS se empleó para evaluar las relaciones entre las variables. Los resultados indican que el aprendizaje en línea afecta significativamente la salud mental de los estudiantes, aumentando particularmente la ansiedad académica y los niveles de estrés. Sin embargo, influye positivamente en los resultados de aprendizaje, especialmente en las habilidades metacognitivas, aunque persisten desafíos en las habilidades colaborativas y la creatividad. Las habilidades digitales y el entorno de aprendizaje en el hogar son factores críticos para lograr resultados de aprendizaje exitosos. Este estudio concluye que, si bien el aprendizaje en línea proporciona flexibilidad e innovación, también presenta desafíos psicológicos y sociales. Aumentar el compromiso socioemocional y adoptar un enfoque más holístico son necesarios para mitigar los problemas de salud mental y mejorar los resultados de aprendizaje, asegurando que la educación en línea respalde tanto el bienestar como el éxito académico de los estudiantes.

Palabras clave: Aprendizaje en Línea; Salud Mental; Resultados de Aprendizaje; Análisis de Trayectorias.

INTRODUCTION

The COVID-19 pandemic, as a contagious disease, has significantly impacted various aspects of life, including the education sector.[1,2] Efforts to mitigate the spread of the virus necessitated that individuals undergo self-quarantine at home, which led many countries to close schools, colleges, and universities.[3] According to UNESCO, more than 1,5 billion students across approximately 188 countries were affected by these closures.[4] This transition was largely driven by the need for social distancing to curb the virus transmission, rendering traditional face-to-face learning impractical.[5,6]

While online learning has been acknowledged as a viable alternative, it does not fully replicate the holistic benefits of in-person education, thus highlighting the need for continuous improvements in digital pedagogy to enhance learning outcomes.[7,8] Many educational institutions have started adopting online learning, although the quality of instruction remains influenced by factors such as teacher performance and student skills. Riyanda et al.[9] argue that online learning is regarded as an effective alternative, in line with Cook's[10] findings, which suggest that online education is superior to having no education at all and shares similarities with face-to-face learning.

In reality, the implementation of quarantine policies during the COVID-19 pandemic had a significant impact on mental health, leading to increased levels of stress, frustration, and depression among both students and teachers.[11] The closure of educational institutions disrupted the learning process, resulting in interruptions in assessments and the cancellation of public exams, which exacerbated students' anxiety and complicated the educational landscape.[12]

Furthermore, the transition to online learning heightened stress and anxiety levels among teachers, affecting their ability to provide quality education.[13] The limited classroom interaction and inefficient schedules have diminished student satisfaction, which is crucial for engagement and performance.[14] Mental health disturbances have been shown to reduce focus, engagement, and performance in online settings, as difficulties in maintaining attention and navigating technical challenges further increased psychological burdens.[15]

Mozid[16] states that learning during the pandemic can change individual behavior, as the education sector was forced to shift to virtual learning, which is more effective through online systems.[17] Although online learning became a practical primary alternative,[18] its implementation without adequate infrastructure can hinder the essence of conventional pedagogy, such as learner interaction, access to materials, attention, consistency, time management, and evaluation.[19] This transition became inevitable due to the social distancing protocols imposed during the COVID-19 pandemic. However, many students have shown negative perceptions toward online learning, which can potentially trigger significant psychological stress.[20,21] One of the factors leading to this is the lack of enjoyable elements in online learning, which typically serve as sources of intrinsic motivation for students.

In addition, various technical issues, such as inadequate content quality, difficulties in using technology, and a lack of technical support, further exacerbate the learning experience for students. The shortage of hardware and software has also been identified as a major factor contributing to the psychological stress they experience. The transition to fully online learning has had a significant impact on students' mental health,[22] with research indicating that students enrolled in fully online courses report higher levels of psychological stress compared to those participating in hybrid or face-to-face formats.[23,24] Difficulty in understanding clear

instructional goals in online learning also worsens students' perceptions of the quality of education received,[25] making online learning not only a practical solution but also a mental burden.

The improper implementation of online learning during the pandemic has increased academic pressure among students, which has negatively impacted their mental health and satisfaction with the learning process.[26] This increase in stress not only reduces students' motivation and interest in learning but also hinders the achievement of optimal learning outcomes. Research indicates that learning outcomes are closely related to academic performance, making the negative implications of online learning on academic pressure a significant concern in the effort to achieve educational success.[27] A study found that 65 % of students reported a decrease in motivation as a result of the challenges faced in online learning,[28] while another study showed a significant relationship between stress levels and learning motivation, with 30 % of students experiencing severe stress.[29] The lack of student engagement in the learning process can lead to higher dropout rates, which in turn may threaten the overall quality of education.

The challenges in online learning significantly affect students' mental health, which in turn increases anxiety and decreases their motivation, ultimately undermining their academic success. Dewaele et al.[21] highlight that the absence of enjoyable elements in online education exacerbates students' anxiety, while technical issues such as poor quality of materials and inadequate support further intensify this mental burden.[30,31] Students often face obstacles such as inadequate devices, which not only increase psychological pressure but also hinder their ability to achieve instructional goals.[32] This decline in mental health directly impacts their perception of the quality of education received, as well as reduces their motivation to participate in learning activities.[33] As a result, the mental strain associated with online learning transforms it from an alternative that should be beneficial into a significant source of stress, ultimately jeopardizing the achievement of optimal learning outcomes and academic performance. Therefore, the negative impact of online learning on students' mental health becomes a critical issue that can affect their learning outcomes and academic achievements.

Based on the discussion on the impact of the COVID-19 pandemic on education, particularly through the transition to online learning, it is clear that this change has not only affected the learning process but also had a significant impact on students' mental health. Various challenges that have emerged, such as increased stress, anxiety, and depression, as well as technical barriers affecting the quality of learning, have contributed to a decline in students' motivation and academic performance. Therefore, it is important to explore more deeply how online learning technology affects students' mental health and their learning outcomes. This study aims to examine the implications of the use of online learning technology on students' psychological well-being, as well as how this contributes to their academic achievements. Thus, this research is expected to provide deeper insights into the challenges and opportunities in online learning, as well as offer recommendations to improve the quality of education in the context of online learning.

METHOD

This study employs a quantitative approach with an explanatory survey method to analyze both the direct and indirect effects of online learning on mental health and learning outcomes. The respondents consisted of 110 students from the Mechanical Engineering program at Universitas Batam, spanning the 2021, 2022, and 2023 cohorts. Data collection was conducted through random distribution of questionnaires. The questionnaire comprised 20 statements for each variable, designed to measure respondents' perspectives. All statements used a Likert scale to assess the level of agreement with each item.

The inclusion criteria for this study included students who had actively participated in online learning during the COVID-19 pandemic and were willing to complete the questionnaire. Exclusion criteria included students who did not provide complete responses or had limited experience with online learning during the specified period.

Table 1. Scale Measurement Level for Respondent's Agreement

Scale Category	Score
Always	4
Sometimes	3
Rarely	2
Never	1

Quantitative data analysis was conducted using SPSS software to categorize the variables and test the validity and reliability of the data. To examine the direct and indirect effects of online learning on mental health and learning outcomes, path analysis was used with the help of AMOS software.

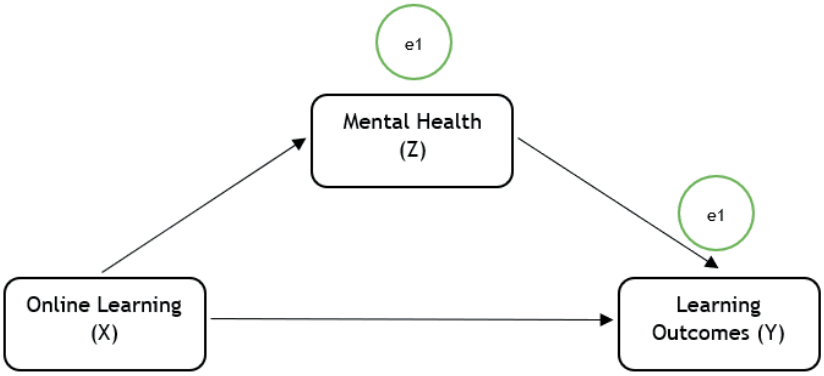

Figure 1. Path Analysis Research Design

Online Learning Variables

To understand the factors that influence the success of online learning, this study identified four main variables that play a significant role in shaping the effectiveness of online learning, namely Digital Literacy, Social and Emotional Engagement, Student Digital Skills, and Home Learning Environment.

Table 2. Online Learning Variables and Indicators

No	Indicator	Question
1	Digital Literacy	I am able to effectively use various online learning platforms.
		I feel confident in addressing technical issues during online learning.
		I frequently use technology to search for additional information related to the learning material.
		I can effectively use online collaboration tools (e.g., Google Docs or Zoom) to work with classmates.
		I can manage my time well during online learning, such as using reminder apps or calendars.
2	Social and Emotional Engagement	I actively participate in online discussions and interact with classmates.
		I feel connected to the instructor, even though the learning is conducted online.
		I can manage stress or anxiety arising from online learning.
		I feel more motivated to study when there is support from my classmates.
		I feel more responsible for my learning progress when I can collaborate with classmates online.
3	Students' Digital Skills	I possess the skills to operate online learning platforms with ease.
		I am capable of searching for and evaluating relevant information from online sources to support my learning.
		I can quickly learn how to use new tools or technologies introduced in online learning.
		I can effectively communicate with classmates or instructors through online platforms.
		I understand the importance of privacy and security when using technology for online learning.
4	Home Learning Environment	I have adequate technological devices (computer, tablet, internet) at home to support online learning.
		I study in a comfortable and distraction-free home environment, such as having good lighting and ergonomic seating.
		My family provides emotional and practical support in participating in online learning.
		I feel distracted while studying due to home conditions, such as noise or lack of a quiet study space.
		I am highly motivated and disciplined to engage in online learning even without direct supervision from the instructor.

Mental Health Variables

The rapid expansion of online learning has had a significant impact on students' mental health, which is a critical factor in their academic success. The study measured a range of mental health indicators to assess students' experiences, including academic anxiety, perceived academic workload, social isolation, psychological

well-being, and stress and resilience. The indicators measured were:

Table 3. Mental Health Variable Indicators

No.	Indicator	Question
1	Academic Anxiety	I feel confident in facing exams or assignments in online learning.
		I feel unprepared for exams or assignments in online learning.
		I am confident in my technological skills to support online learning.
		I feel able to manage academic pressure well during online learning.
2	Perception of Academic Workload	I feel that the academic workload in online learning is manageable.
		I feel overwhelmed by the number of tasks assigned in online learning.
		The online learning material requires more time than face-to-face learning.
		I struggle to manage my time to complete material or assignments in online learning.
3	Social Isolation	I feel isolated or disconnected from classmates or instructors in online learning.
		I find it difficult to interact or communicate with classmates on online platforms.
		I feel there is social support from classmates or instructors in online learning.
		Social interaction in online learning is sufficient to support my mental well-being.
4	Psychological Well-being	I feel happy and motivated in online learning.
		I feel more depressed or lose interest in online learning compared to face-to-face learning.
		I experience mental or emotional exhaustion after online learning sessions.
		I feel that online learning gives me the freedom to learn in my own way.
5	Stress and Mental Resilience	I feel able to cope with stress arising during online learning.
		I feel unable to handle the challenges that arise during online learning.
		I feel calm when faced with technical issues (e.g., internet disruptions, device malfunctions) in online learning.
		I feel overwhelmed or unable to cope with the stress I experience during online learning.

Learning Outcome Variables

In the context of education, learning outcomes are the main indicator for assessing the effectiveness of a teaching method. Learning outcomes reflect changes in knowledge, skills, and attitudes acquired by students after participating in the learning process. The learning outcome variables in this study were built based on five main indicators, namely: analytical and problem-solving skills, collaborative and teamwork skills, creativity and innovation, and metacognitive skills.

Table 4. Indicators of the Learning Outcomes Variable

Indicator	Question
Analytical and Problem-Solving Skills	I can easily analyze the information provided in the learning material.
	I can solve problems given in assignments or exams in a systematic and logical manner.
	I find it difficult to find solutions when facing complex problems.
	I feel confident in making decisions based on the analysis of data or information I have learned.
	I am able to connect concepts learned to find solutions to complex problems.
Collaborative Skills and Teamwork	I often find it difficult to work with team members who have differing opinions.
	I collaborate well with other team members to achieve common goals.
	I am able to resolve conflicts or differences of opinion constructively within the group.
	I rarely contribute in group work because I feel I cannot offer much input.
	I actively listen to and value the opinions of other team members to reach a consensus.
Creativity and Innovation	I frequently propose new ideas during class discussions or group projects.
	I am able to develop innovative solutions to challenges or problems presented in the learning process.
	I find it difficult to generate new, creative ideas in assignments or projects.
	I frequently try new approaches when completing assignments or projects.
	I believe that my creative ideas can help improve the quality of learning outcomes.

Metacognitive Skills	I rarely reflect on how I learn or identify my strengths and weaknesses.
	I adjust my learning strategies if I feel I do not understand certain material well.
	I feel capable of managing my study time to maximize learning outcomes.
	I often feel confused about the best way to learn certain material.
	I am able to recognize my strengths and weaknesses in learning and adapt my strategies as needed.

Ethical principles were strictly adhered to in this study. Prior to data collection, all participants provided informed consent after being informed about the study's objectives, the confidentiality of their responses, and their right to withdraw at any time without any consequences. The study protocol was reviewed and approved by the Ethics Committee of Universitas Batam.

RESULTS

Online Learning Variables

The results from the survey distributed to respondents provide important insights into the factors influencing their online learning experiences. Based on the analysis of four key variables—Digital Literacy Skills, Social and Emotional Engagement, Students' Digital Competencies, and Home Learning Environment—the following presents the average scores for each statement measured across these variables.

Table 5. Responses to Online Learning Variables

Indicator	Average Score
Digital Literacy Skills	3,78
Social and Emotional Engagement	2,08
Students' Digital Competencies	3,84
Home Learning Environment	3,72

As shown in table 3, the online learning outcomes of students exhibit variation across different indicators. Overall, students' digital literacy is relatively high, with an average score of 3,78, indicating that most students are capable of effectively accessing, understanding, and utilizing digital technology in the learning process. Similarly, students' digital competencies were recorded as high, with an average score of 3,84, demonstrating their ability to operate digital devices and applications proficiently. The home learning environment also showed adequate support, with an average score of 3,72, reflecting the availability of sufficient resources and family support for online learning. However, the social and emotional engagement indicator scored relatively low, with an average score of 2,08, indicating a lack of interaction in these areas during online learning. This highlights the need for greater focus on enhancing this aspect, given its critical role in supporting optimal learning outcomes.

Mental Health Variables

The rapid expansion of online learning has had a significant impact on students' mental health, a crucial factor in their academic success. This study measured a range of mental health indicators to assess students' experiences, including academic anxiety, perceptions of academic workload, social isolation, psychological well-being, as well as stress and mental resilience.

Based on the research findings, the indicators that reflect students' responses to mental health variables include academic anxiety, perceptions of academic workload, social isolation, psychological well-being, as well as stress and mental resilience. Each of these indicators provides insight into how students perceive and manage their emotional and psychological aspects while engaging in online learning. Below are the results of responses to the mental health variables:

Table 6. Responses to Mental Health Variables

Indicator	Average Score
Academic Anxiety	3,12
Perception of Academic Workload	2,85
Social Isolation	2,75
Psychological Well-being	2,85
Stress and Mental Resilience	2,90

The results of the study, conducted on 110 students participating in online learning, show significant impacts on their mental health, particularly in terms of academic anxiety, academic workload, and mental resilience. The average score for academic anxiety (3,12) indicates a relatively high level of anxiety, linked to academic demands such as assignments and exams. The perception of academic workload, with a score of 2,85, suggests that students feel considerable pressure in managing online studies, likely due to challenging workloads or limited direct interaction with instructors and peers. However, the social isolation indicator, with a score of 2,75, reveals that the social impact of online learning is not as severe, although some students may struggle to build supportive social connections. The score for psychological well-being (2,85) indicates that most students remain in a stable psychological state, though challenges still exist that could affect their overall well-being. Lastly, the stress and mental resilience score (2,90) reveals a relatively high level of stress, despite students being able to maintain mental resilience.

Overall, these results suggest that although students possess resilience against the pressures of online learning, the negative impacts on mental health remain significant, especially concerning academic anxiety and increasing academic workload. A more comprehensive approach to supporting student mental health, including enhancing social support and stress management, is urgently needed to mitigate the negative impacts of online learning.

Learning Outcomes Variable

Learning outcomes are critical indicators for assessing the effectiveness of teaching methods, representing changes in knowledge, skills, and attitudes that learners acquire through the learning process. This complex construct is influenced by various factors and, in this study, is built upon five main indicators: verbal information, intellectual skills, cognitive strategies, dexterity, and motor skills. Particularly in the context of online learning, which requires specific skills and competencies, learning outcomes play a vital role in evaluating educational success. This study examines these outcomes through key indicators that reflect students' abilities across cognitive, social, and creative domains, with the following section presenting students' responses based on the data collected.

Table 7. Response to Learning outcome variables

Indicator	Average Score
Analytical Ability and Problem Solving	2,82
Collaborative Skills and Teamwork	2,86
Creativity and Innovation	2,95
Metacognitive Skills	3,09
Overall Average	2,93

The results obtained from the learning outcome indicators show variations in achievement in each dimension. The metacognitive skills indicator recorded the highest score (3,09), reflecting students' ability to manage and monitor their learning process effectively. Meanwhile, the creativity and innovation indicator (score: 2,95) showed quite good performance, although limited face-to-face interaction can hinder the development of creativity to the fullest. The indicators of collaborative and teamwork skills (score: 2,86) and analytical and problem-solving skills (score: 2,82) had lower scores, which may be due to limited opportunities for direct interaction in online learning.

Hypothesis Testing

Path analysis, supported by the AMOS software application, was utilized to test the hypotheses proposed in this study. The primary objective of hypothesis testing was to analyze how online learning (X) affects mental health (Z) and to what extent this effect influences learning outcomes (Y).

Table 8. Results of Path Analysis of the Influence of Online Learning on Mental Health and Learning Outcomes

Structural Equations	Estimate			S.E.	C.R.	P
	RW	SRW	R^2			
Model 1			0,11			
Z1 <--- X	0,33	0,30		0,06	5,5	***
Model 2			0,47			
Y <--- Z1	0,45	0,42		0,08	5,63	***
Y <--- X	0,4	0,38		0,09	4,44	***

Note: RW (Regression Weight), SRW (Standardized Regression Weight); ***P<0,001

The results of the study can be explained as follows: In Model 1, the findings indicate that online learning (X) has a significant impact on mental health (Z1) with a regression coefficient (Estimate) of 0,33. This suggests that an increase of one standard deviation in online learning would lead to an improvement in mental health by 0,33 units. The Critical Ratio (C.R.) value of 5,50 and the highly significant P-value (P < 0,001) indicate that this effect is statistically strong. Additionally, the coefficient of determination (R^2) for Model 1 is 0,11, indicating that online learning contributes 11 % to the variation in mental health. Although this contribution is relatively small, it remains statistically significant. The standardized regression weight (SRW) between online learning and mental health is 0,30, which also reflects a positive relationship, though not very large. These findings align with the study by Copeland et al.[34], which highlighted that online learning can influence students' mental well-being, either positively or negatively, depending on factors such as social support and control over the learning environment. Furthermore, other research suggests that well-designed online learning can help reduce anxiety and depression, thanks to the flexibility it provides.[35]

In Model 2, online learning (X) has a direct significant effect on learning outcomes (Y) with a regression coefficient of 0,40, indicating that an increase of one standard deviation in online learning would result in a 0,40-unit improvement in learning outcomes. The C.R. value for this direct effect is 4,44, which is statistically significant with a P-value < 0,001. Moreover, mental health (Z1) also significantly influences learning outcomes (Y), with a coefficient of 0,45, meaning that an increase of one standard deviation in mental health can improve learning outcomes by 0,45 units. The standardized regression weight (SRW) of mental health on learning outcomes is 0,42, showing a substantial and significant contribution to the process. Allcoat et al.[36] state that online learning, particularly with the application of multimedia and interactive techniques, can enhance students' understanding and learning outcomes. This finding is consistent with Gopal et al.[37], who found that online learning can improve academic achievement, provided it is supported by adequate infrastructure and students' independent learning skills.

The coefficient of determination (R^2) in Model 2 indicates that online learning, both directly and indirectly through mental health, explains approximately 47 % of the variation in learning outcomes. This suggests that online learning makes a substantial contribution to learning outcomes, with a more dominant direct effect (0,40) compared to the indirect effect through mental health (0,33 x 0,45 = 0,15). Thus, while online learning has a significant impact on learning outcomes, the majority of this influence occurs through the direct pathway, with the contribution of mental health as a mediator being smaller but still statistically significant.

DISCUSSION

This study highlights the significant impact of online learning on students' mental health and academic outcomes. The findings suggest that online learning has a significant impact on academic anxiety and perceived academic workload among students. The mean score of academic anxiety recorded was quite high, at 3,12, reflecting the pressure felt by students due to academic demands. A similar study by Batool and Rashid[38] showed that students involved in online learning tend to experience higher levels of academic anxiety compared to those who study face-to-face. This anxiety is often related to uncertainty around exams, difficulty completing independent assignments, and limited access to technology that can hinder the learning process. In addition, Sharma et al.[39] found that online learning exacerbates pre-existing anxiety, especially related to ineffective time management and pressure to achieve high academic results without direct interaction with lecturers or peers.

Perception of high academic workload was also recorded in this study, with a score of 2,85, indicating that students find it difficult to manage increased academic demands, especially in the context of online learning. Research by Iturbe Zúñiga[40] revealed that students often feel overwhelmed by the demands of assignments and exams in online learning, which they perceive as more challenging than in face-to-face learning. The inability to receive direct support from face-to-face instruction, coupled with the reliance on technology, adds to the complexity of the academic workload that students face. Furthermore, other studies have highlighted that the transition to online learning often disrupts students' time management strategies, ultimately worsening their perception of academic workload.[41]

Despite these challenges, the social impact and isolation associated with online learning were relatively lower in this study (score of 2,75), indicating that although social interaction was limited, some students were still able to establish support networks outside of the online learning environment. However, several studies suggest that despite the potential for virtual social support, social isolation remains a significant challenge in online learning. Surya et al.[42] state that, although technology enables students to interact through online platforms, feelings of alienation and social isolation persist, especially for those who rely heavily on face-to-face interaction. Liu and Lin[43] also highlight that, while online interaction can be beneficial, the sense of isolation remains substantial, particularly for students under stress or experiencing emotional difficulties.

Overall, the results of this study align with recent findings that suggest online learning presents unique challenges in managing academic anxiety and workload. While efforts to mitigate these negative impacts

through social support and the use of technology have been made, the psychological effects stemming from increased academic demands remain a primary concern within the context of online learning.

The path analysis model in this study reveals that mental health plays a significant mediating role in the relationship between online learning and student academic outcomes. The hypothesis testing results indicate that online learning has a significant direct effect on students' mental health, with a regression coefficient of 0,33 ($p < 0,001$), suggesting that well-designed online learning can help reduce academic anxiety and enhance students' mental well-being. Wang[44] confirms that structured stress management in online learning is associated with improved mental health, which, in turn, positively influences academic achievement. Furthermore, other studies indicate that online learning that offers flexibility and emotional support contributes to reducing anxiety and improving students' mental health.[45]

Additionally, mental health has a positive effect on academic outcomes, with a coefficient of 0,45 ($p < 0,001$), indicating that students with better mental health are more likely to achieve optimal learning outcomes. This finding supports studies that suggest students with good psychological well-being are better able to focus and manage stress when facing academic tasks, resulting in improved performance.[46] Rafsanjani et al.[47] also found that lower levels of anxiety are associated with higher academic performance. Therefore, mental health should not only be considered as an isolated factor but also as a critical link in enhancing the relationship between online learning and student academic outcomes, underscoring the importance of psychological support in online learning environments to optimize academic achievement.

The learning outcomes of students in online learning show varied achievements depending on the indicators measured. Metacognitive skills, which include students' ability to plan, monitor, and evaluate their learning processes, were recorded with the highest score (3,09), indicating that students in online learning tend to better regulate their learning processes. This finding aligns with studies suggesting that online learning can foster the development of metacognitive skills.[48,49,50,51] However, analytical and problem-solving skills, as well as collaborative and teamwork skills, showed relatively lower achievement levels, which may be attributed to the limited direct interaction in online learning environments.[52] Creativity and innovation were also considered positive indicators in online learning, though not as optimal as in face-to-face settings. This result is consistent with findings that direct interaction is more effective in stimulating creativity.[53] Thus, while online learning has the potential to enhance certain aspects of student skills, limitations in collaboration and direct interaction may hinder the development of more complex social and cognitive skills.

In this study, path analysis reveals that online learning has a significant impact on student learning outcomes. The direct effect of online learning on learning outcomes is recorded with a coefficient of 0,40, indicating that improvements in the quality of online learning directly enhance student performance.[54] Furthermore, the indirect effect through students' mental health also contributes significantly, with a coefficient of 0,15. This suggests that while online learning exerts a direct influence on learning outcomes, students' mental health serves as a supporting factor that enhances the effectiveness of online learning.[55] The coefficient of determination (R^2) of 0,47 in Model 2 indicates that online learning, both through direct and indirect pathways, accounts for nearly 50 % of the variation in student learning outcomes. Therefore, these findings strengthen the argument that effective online learning design should not only prioritize cognitive aspects but also consider students' mental well-being to achieve optimal learning outcomes.[56]

CONCLUSIONS

This study highlights the significant impact of online learning on students' mental health and learning outcomes. High levels of academic anxiety, perceptions of academic workload, and challenges such as social isolation and stress were identified as key issues. While students showed strong metacognitive skills, analytical abilities, collaboration, and creativity were less developed. The findings emphasize the dual impact of online learning on learning outcomes, both directly and indirectly, mediated by mental health.

Despite its insights, the study's limitations include its cross-sectional design, small sample size, and reliance on subjective perceptions. External factors like internet quality, social support, and environmental influences were not deeply explored, underscoring the need for future research to address these gaps and support healthier online learning environments and environmental factors, were not controlled for or explored in-depth in this study.

REFERENCES

1. Riyanda AR, Agnesa T, Wira A, Ambiyar A, Umar S, Hakim U. Hybrid Learning: Alternatif Model Pembelajaran di Masa Pandemi Covid-19. basicedu. 2022 Apr 18;6(3):4461–9.

2. Batubara HS, Riyanda AR, Rahmawati R, Ambiyar A, Samala AD. Implementasi Model Pembelajaran Blended Learning di Masa Pandemi Covid-19: Meta-Analisis. basicedu. 2022 Apr 23;6(3):4629–37.

3. Rahmawati R, Putri RD, Nurdin N, Triaristina A, Rachmedita V, Wira A. Efektifitas Implementasi Video Conference Sebagai Media Pembelajaran Dimasa Pandemi Covid-19. Voteteknika. 2022 Sep 28;10(3):33.

4. Ranjan P, S J. Impact of Covid-19 Pandemic on Indian Education System. Aksh. 2020 Dec 31;1(3):1–4.

5. Torre Rodríguez A, Hurtado Velasco I. Unexpected Gap in Education Due to COVID-19. PYM. 2024 Jun 7;(398):46–51.

6. Easterbrook MJ, Lester KJ, Lacey A, Doyle L, Grozev VH. Social and Educational Impacts of Epidemics and Pandemics. In: Williams R, Kemp V, Porter K, Healing T, Drury J, editors. Major Incidents, Pandemics and Mental Health [Internet]. 1st ed. Cambridge University Press; 2024 [cited 2024 Dec 1]. p. 231–40. Available from: https://www.cambridge.org/core/product/identifier/9781009019330%23CN-bp-31/type/book_part

7. Mulenga EM, Marbán JM. Is COVID-19 the Gateway for Digital Learning in Mathematics Education? CONTEMP EDUC TECHNOL. 2020 Apr 18;12(2):ep269.

8. Alwan M. The impact of covid-19 on the implementation of learning in the digital era 4.0. mt. 2021 Mar 6;7(01):1–18.

9. Riyanda AR, Ambiyar A, Syahril S, Fadhilah F, Samala AD, Adi NH, et al. Evaluation of Online Learning Processes in FKIP Universitas Lampung During Covid-19 Pandemic.

10. Cook DA. The failure of e-learning research to inform educational practice, and what we can do about it. Medical Teacher. 2009 Jan;31(2):158–62.

11. Dingle GA, Han R, Alhadad SS, Beckman E, Bentley SV, Gomersall SR, et al. Data from four consecutive cohorts of students in Australia (2019–2022) show the impact of the COVID-19 pandemic on domestic and international university students' mental health. Aust N Z J Psychiatry. 2024 Jun;58(6):528–36.

12. Colvin MK, Reesman J, Glen T. Altered Trajectories: Considering the Long-Term Impact of Educational Disruption during the COVID-19 Pandemic on Neurodevelopment and a Call to Action for Neuropsychology. Archives of Clinical Neuropsychology. 2024 Apr 24;39(3):305–12.

13. Reuter PR. The Impact of COVID-Related Restrictions on the Mental Health of Students. In: Rezaei N, editor. The COVID-19 Aftermath [Internet]. Cham: Springer Nature Switzerland; 2024 [cited 2024 Dec 1]. p. 35–50. (Advances in Experimental Medicine and Biology; vol. 1458). Available from: https://link.springer.com/10.1007/978-3-031-61943-4_3

14. Meo SA, Abukhalaf DAA, Alomar AA, Sattar K, Klonoff DC. COVID-19 Pandemic: Impact of Quarantine on Medical Students' Mental Wellbeing and Learning Behaviors: COVID 19 and Quarantine. Pak J Med Sci [Internet]. 2020 May 18 [cited 2024 Dec 1];36(COVID19-S4). Available from: https://www.pjms.org.pk/index.php/pjms/article/view/2809

15. Vaidya H, Agarwal N, Kotipalli S, Anand AA, S DrVL. A study on the impact of COVID-19 on the mental health of undergraduate students. Asian J Manage Commerce. 2024 Jan 1;5(1):256–62.

16. Mozid NE. Association between psychological distress and coping strategies among students engaged in online learning. PLoS ONE. 2022 Jul 1;17(7):e0270877.

17. Mandal T. Challenges in Online Education During the COVID-19 Pandemic: A Case Study in Higher Education Institutes of Rural Areas of Birbhum District of West Bengal, India. In: Purpuri L, Gray S, editors. Advances in Educational Marketing, Administration, and Leadership [Internet]. IGI Global; 2024 [cited 2024 Dec 1]. p. 156–84. Available from: https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/979-8-3693-1507-1.ch008

18. Subiyantoro S. Transformative online learning post-pandemic: challenges, opportunities, and future trends. Pekommas. 2024 Jun 20;9(1):29–39.

19. Adeniyi IS, Hamad NMA, Adewusi OE, Unachukwu CC, Osawaru B, Chilson OU, et al. Reviewing online

learning effectiveness during the COVID-19 pandemic: A global perspective. Int J Sci Res Arch. 2024 Feb 28;11(1):1676–85.

20. Sato SN, Condes Moreno E, Rubio-Zarapuz A, Dalamitros AA, Yañez-Sepulveda R, Tornero-Aguilera JF, et al. Navigating the New Normal: Adapting Online and Distance Learning in the Post-Pandemic Era. Education Sciences. 2023 Dec 24;14(1):19.

21. Dewaele J, Magdalena AF, Saito K. The Effect of Perception of Teacher Characteristics on Spanish EFL Learners' Anxiety and Enjoyment. The Modern Language Journal. 2019 Jun;103(2):412–27.

22. Kumar A, Sharma K, Sharma A. Empirical Analysis of Psychological Well-Being of Students During the Pandemic with Rebooted Remote Learning Mode. In: Castillo O, editor. Proceedings of Data Analytics and Management [Internet]. Singapore: Springer Nature Singapore; 2023. p. 13–29. Available from: https://link.springer.com/10.1007/978-981-19-7615-5_2

23. Sutton H. Fully online courses impacted student mental health. The Successful Registrar. 2023 May;23(3):8–8.

24. Sutton H. Research finds fully online courses impacted student mental health. Recru & Retain Adult Learner. 2023 Feb;25(5):9–9.

25. Gutiérrez-Aguilar O, Ticona-Apaza F, Ticona-Apaza V, Chicaña-Huanca S. Factors Influencing Psychological Distress Mediated by E-Learning Courses in Times of Covid-19. In: Communication and Applied Technologies [Internet]. Singapore: Springer Nature Singapore; 2023. p. 237–48. Available from: https://link.springer.com/10.1007/978-981-19-6347-6_21

26. Phiriepa A, Mapaling C, Matlakala FK, Tsabedze W. Covid-19 and Online Learning: A Scoping Review of The Challenges Faced By Students in Higher Institutions During Lockdown. e-Bangi [Internet]. 2023 Nov 3 [cited 2024 Dec 3];20(4). Available from: http://ejournal.ukm.my/ebangi/article/view/63721/14542

27. Masril M, Jalinus N, Ridwan, Ambiyar, Sukardi, Irfan D. A Flexible Practicum Model on Education: Hybrid Learning Integrated Remote Laboratory Activity Design. Int J Onl Eng. 2024 Jul 16;20(10):4–17.

28. Pratama NA, Sari AC, Batu Bara PKN. The Effect of Online Learning on Student Motivation and Achievement during the Pandemic. edumaniora. 2024 Aug 27;3(02):33–8.

29. Nisak C, Munir Z, Hafifah VN. Hubungan Tingkat Stress dengan Motivasi Belajar Mahasiswa Fakultas Kesehatan dalam Pembelajaran Online pada Masa Pandemi Covid-19 di Universitas Nurul Jadid Paiton Kabupaten Probolinggo. TRLG [Internet]. 2024 Sep 28 [cited 2024 Dec 3];5(3). Available from: https://ejournal.unuja.ac.id/index.php/trilogi/article/view/8975

30. Shams M, Khosha A. A Study on Foreign Language Learning Anxiety Among English Major Students in Online Environments. Spr J Arts Humanit Soc Sci. 2024 May 29;3(5):98–102.

31. Ifenthaler D, Cooper M, Daniela L, Sahin M. Social anxiety in digital learning environments: an international perspective and call to action. Int J Educ Technol High Educ. 2023 Aug 28;20(1):50.

32. Anggraini HW, Hayati R, Sari A. An Exploration of Students' Anxiety in Online Foreign Language Learning. IJE. 2022 Feb 28;15(1):20–7.

33. Oztosun L, Gonzo F, Nadda V. The Impact of Digital Learning Technology on Higher Education Students' Mental Health: In: Munna AS, Nadda V, Allahyari TA, Cantafio G, Bilan S, editors. Advances in Educational Technologies and Instructional Design [Internet]. IGI Global; 2023 [cited 2024 Dec 3]. p. 92–109. Available from: https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-6684-8282-7.ch005

34. Copeland WE, McGinnis E, Bai Y, Adams Z, Nardone H, Devadanam V, et al. Impact of COVID-19 Pandemic on College Student Mental Health and Wellness. Journal of the American Academy of Child & Adolescent Psychiatry. 2021 Jan;60(1):134-141.e2.

35. Nurunnabi M, Almusharraf N, Aldeghaither D. Mental Health and Well-Being during the Covid-19 Pandemic in Higher Education: Evidence from G20 Countries. Journal of Public Health Research. 2020 Nov;9(1_suppl):jphr.2020.2010.

36. Allcoat D, Hatchard T, Azmat F, Stansfield K, Watson D, Von Mühlenen A. Education in the Digital Age: Learning Experience in Virtual and Mixed Realities. Journal of Educational Computing Research. 2021 Sep;59(5):795–816.

37. Gopal R, Singh V, Aggarwal A. Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID 19. Educ Inf Technol. 2021 Nov;26(6):6923–47.

38. Batool H, Rashid A. Comparative analysis of psychological distress between online and on-Campus learning among university students. MHSI. 2024 Dec 3;28(6):1029–39.

39. Sharma VK, Singh DrDR, Department of Computer Applications, Jagatpur P. G. College, Varanasi-221302 (Uttar Pradesh), India., Singh V, Department of Computer Applications, MGU Bhopal, (M.P), India., Singh DrR, et al. Studying the Influence and Analysis of Online Education on Students' Health and Education During the Pandemic. IJRTE. 2023 Nov 30;12(4):6–13.

40. Iturbe Zúñiga A. The Effects of Online Learning on Students' Anxiety and Motivation. [Internet] [MA]. Illinois State University; 2022 [cited 2024 Dec 8]. Available from: https://ir.library.illinoisstate.edu/etd/1636

41. Sudheer AK, Thoti KK, George A, Komagan L. The Effects of Online Education on the Emotional Well-Being of College Students during the Spread of the Covid-19 Pandemic. EEL. 2023 May 19;13(3):500–8.

42. Surya YWI, Mazahir I, Yaseen S, Wibowo NSW. Digital resilience: Understanding the influence of social media and support networks on university students' isolation during COVID-19. MKP. 2024 Jun 28;37(2):126–38.

43. Liu Q, Lin D. The impact of distance education on the socialization of college students in the Covid-19 era: problems in communication and impact on mental health. BMC Med Educ. 2024 May 24;24(1):575.

44. Wang S. Problems with Students' Mental Health in the Context of Online Learning. TSSEHR. 2024 Apr 1;5:44–8.

45. Nash C. Self-Directed Online Learning in Support of Mental Health to Promote Positive Psychosocial Outcomes in Public Schools [Internet]. 2023 [cited 2024 Dec 8]. Available from: https://www.preprints.org/manuscript/202306.1498/v1

46. Oztosun L, Gonzo F, Nadda V. The Impact of Digital Learning Technology on Higher Education Students' Mental Health: In: Munna AS, Nadda V, Allahyari TA, Cantafio G, Bilan S, editors. Advances in Educational Technologies and Instructional Design [Internet]. IGI Global; 2023 [cited 2024 Dec 8]. p. 92–109. Available from: https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-6684-8282-7.ch005

47. Rafsanjani MA, Wijaya PA, Baskara A, Wahyudi HD. Mental health and learning achievement during the COVID-19 outbreak: A lesson from online learning among Indonesian college students. Obraz nauka. 2023 Mar 18;25(3):155–73.

48. Solano Chuma JC, Montero Jácome CS. Difficulties during virtual education with students during the confinement by the Covid - 19 pandemic in Cañar, Ecuador. Salud, Ciencia y Tecnología. 2024;4:795.

49. Valdiviejas H, Ferreira Leitão Azevedo R, Bosch PN, Perry M. Automatic Detection of Metacognitive Language and Student Achievement in an Online STEM College Course. OLJ [Internet]. 2024 Sep 1 [cited 2024 Dec 8];28(3). Available from: https://olj.onlinelearningconsortium.org/index.php/olj/article/view/4127

50. Ruiz Muñoz GF, Yépez González DA, Romero Amores NV, Cali Proaño Ángela F. Augmented reality's impact on STEM learning. Salud, Ciencia y Tecnología. 2024;4:1202.

51. Yifei L, Mohd Radzi NB, Hoque KE. The Effect of Meta-Cognitive Skills Management And Skills Engagement On Cognitive Outcome Of Students During Online Learning In Selected Universities In Beijing, China. Kuey

[Internet]. 2024 [cited 2024 Dec 8]; Available from: https://kuey.net/index.php/kuey/article/view/6766

52. McMillan MA, Little PJ, Yoon S, Park M. Critical Thinking and Metacognition: Processes and Outcomes within the Learning Cycles. J Probl Based Learn. 2022 Oct 31;9(2):110–8.

53. Yamada M, Geng X, Goda Y, Teasley SD. Investigating Metacognitive Behaviors with Online Learning Support Tools. In: 2024 IEEE International Conference on Advanced Learning Technologies (ICALT) [Internet]. Nicosia, North Cyprus, Cyprus: IEEE; 2024 [cited 2024 Dec 8]. p. 280–4. Available from: https://ieeexplore.ieee.org/document/10645943/

54. Prasetyanto D, Rizki M, Sunitiyoso Y. Online Learning Participation Intention after COVID-19 Pandemic in Indonesia: Do Students Still Make Trips for Online Class? Sustainability. 2022 Feb 9;14(4):1982.

55. Hamdan AK. The reciprocal and correlative relationship between learning culture and online education: A case from Saudi Arabia. IRRODL [Internet]. 2014 Jan 27 [cited 2024 Dec 8];15(1). Available from: http://www.irrodl.org/index.php/irrodl/article/view/1408

56. Silva AMS, Ximenes VM. Discussões sobre saúde mental e suporte social entre estudantes universitários: Discussões sobre Saúde Mental e Suporte Social. Revista Ciências Humanas. 2022;15(1).

FINANCING

None.

CONFLICT OF INTEREST

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Abdul Malik Made, Syahril, Waskito, Fadhli Ranuharja.
Formal analysis: Afif Rahman Riyanda, Margaretha Karolina Sagala.
Research: Abdul Malik Made, Syahril, Waskito.
Methodology: Afif rahman Riyanda, Margaretha Karolina Sagala, Uswatul Hakim.
Project management: Abdul Malik Made, Fadhli Ranuharja.
Resources: Abdul Malik Made, Syahril, Waskito, Fadhli Ranuharja,Afif Rahman Riyanda.
Supervision: Afif Rahman Riyanda, Joseph Oluwaseyi, Angel Torres-Toukoumidis.
Validation: Syahril, Waskito, Daniel Rinaldi, Uswatul Hakim.
Templating: Margaretha Karolina Sagala, Daniel Rinaldi, Uswatul Hakim.
Drafting - original draft: Abdul Malik Made, Fadhli Ranuharja.
Writing - proofreading and editing: Abdul Malik Made, Fadhli Ranuharja, Joseph Oluwaseyi, Angel Torres-Toukoumidis.