

Longitudinal Study of Student Self-Regulation and Mental Health in Merdeka Digital Learning

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Received:

October 25, 2025

Revised:

October 28, 2025

Accepted:

November 2,
2025

Published:

November 20,
2025

ABSTRACT

The rapid growth of digital learning within the Merdeka Curriculum has introduced new challenges concerning students' digital wellbeing, self-regulation, and mental health. This study aimed to examine the longitudinal relationship among these variables among Year 10 students at SMA Negeri 9 Bandar Lampung over one semester. Employing a quantitative approach with repeated-measures design, data were collected at the beginning, middle, and end of the semester through structured questionnaires. The findings revealed a significant improvement in students' digital wellbeing and self-regulation, accompanied by a gradual reduction in academic stress. Further analysis indicated that self-regulation acted as a mediating factor between digital wellbeing and mental health. These results support Zimmerman's self-regulated learning theory and highlight the need to integrate digital literacy and self-regulation training within the implementation of the Merdeka Curriculum. Practically, the study provides insights for developing balanced learning strategies that promote both effective technology use and students' psychological wellbeing in the digital era.

Keywords: *Self-Regulation; Digital Wellbeing; Mental Health; Merdeka Curriculum; Digital Learning.*

INTRODUCTION

In recent years, the transformation of information and communication technology has brought about significant changes in almost every aspect of human life, including education. The development of digital learning, the use of mobile devices, online platforms, and interactive technologies have become integral parts of the teaching and learning process. In Indonesia, the Merdeka Curriculum policy encourages greater independence and flexibility in learning, including the use of digital technology as a medium, a learning resource, and a tool for collaboration. Although these changes offer great opportunities for enhancing access, personalisation, and efficiency in learning, they also pose new challenges related to students' psychological well-being. Mental health—which encompasses emotional, psychological, and social

conditions—can be affected by the intensity of technology use, the pressure of adaptation, and the drastic shifts in learning demands.

In Bandar Lampung City, particularly at SMA Negeri 9 Bandar Lampung, these transformations have begun to be strongly felt. The school, one of the leading state senior high schools in the city, has adopted the Merdeka Curriculum and started to utilise digital platforms in conducting learning activities, assignments, and teacher–student interactions. This condition forms a relevant context for examining how students respond to the demands of digital learning, especially in relation to their self-regulation and its consequences for mental health.

The structural transformation of learning due to digitalisation presents two sides: the ideal and the real. Ideally, technology-based learning provides flexibility of time, richer learning resources, and opportunities for more autonomous learning. Technology enables students to access materials anytime and anywhere, attend online classes, participate in forum discussions, utilise educational applications, and receive digital feedback promptly. The Merdeka Curriculum responds to the demands of the modern era by allowing teachers and students to choose their own methods, materials, and learning pace—thereby strengthening 21st-century competencies such as digital literacy, collaboration, creativity, and critical thinking. Self-regulation on the part of students is regarded as a key aspect that enables them to manage study time, monitor their progress, set goals, control distractions, and maintain motivation, so that they can achieve optimal learning outcomes without excessive psychological strain.

In practice, however, the reality often differs. Many students encounter difficulties when digital learning becomes dominant: excessive online tasks, exposure to social media and distractions, a lack of face-to-face interaction, and a sense of isolation. Temporal pressures—such as deadlines, the need for self-reliance, and the absence of direct support from teachers or peers—can trigger stress, anxiety, mental fatigue, or academic burnout. Not all students possess adequate self-regulation; those with low self-regulation are more vulnerable to mental health issues such as anxiety, mild depression, or a drastic decline in motivation—especially when external supervision (from teachers or parents) is less stringent. At SMA Negeri 9 Bandar Lampung, even among students with similar academic abilities and technological access, there are large differences in how they manage online study time, resist gadget distractions, and maintain balance between offline and online learning. Several teachers have reported that some students experienced decreased performance or motivation after several months of intensive digital learning, along with complaints of fatigue and sleep disturbances related to online tasks.

Recent international studies indicate that self-regulation can serve as an important mediator or moderator in the relationship between digital learning stress and psychological well-being. For instance, a longitudinal study in the United States found that students with high self-regulation showed better emotional adaptation and fewer anxiety complaints than those with low self-regulation when digital workloads increased. Research in Europe has also demonstrated that the use of educational technologies without adequate self-regulatory strategies correlates with attention

problems, stress, and poorer sleep quality. In Asia, studies in countries such as Korea and Japan observed that strong self-regulation could mitigate the negative effects of smartphones and social media on student burnout. However, while such studies are important, they are often conducted in general learning contexts or on social media use, not specifically within the framework of the Merdeka Curriculum.

In Indonesia, several studies have evaluated students' mental health and the effects of online learning during the COVID-19 pandemic, as well as the role of self-regulation in academic achievement and academic stress. Nevertheless, research that integrates all three aspects—digital learning, self-regulation, and mental health—using a longitudinal approach among senior high school students within the Merdeka Curriculum framework remains limited. Some studies have explored digital well-being, but most have employed cross-sectional designs (single-time measurements), which are prone to temporal bias and fail to capture the dynamic changes in students' self-regulation and mental health over time.

This research gap is crucial because the Merdeka Curriculum places greater emphasis on flexibility and learning autonomy, which in turn increases the demand for self-regulation among students. Without longitudinal studies, it is difficult to determine how self-regulation develops and whether it serves as a protective factor over time against declines in mental health. Do students with initially low self-regulation improve when provided with appropriate support? Are the negative effects of digital pressure more significant among students of certain grades or socio-economic backgrounds? These questions remain inadequately answered within the current Indonesian educational context, particularly in Bandar Lampung.

Self-regulation is viewed as an internal capacity that enables students to manage their emotions, thoughts, motivation, and actions adaptively in response to learning demands. Models such as self-determination theory, social cognitive theory (Bandura), and emotion regulation theory emphasise that self-regulation is not only associated with academic achievement but also with psychological well-being. Stress and coping theories are also relevant: when individuals possess internal resources (including self-regulation), the effects of stress can be minimised. In addition to these theories, contemporary literature introduces the concept of digital well-being—a notion encompassing balanced technology use, control over digital exposure, and the emotional impact of digital engagement. This concept has gained traction in international research, while in Indonesia it has only recently begun to be explored in descriptive and conceptual studies, with very few longitudinal investigations.

This study therefore offers several significant innovations. First, with a longitudinal design tracking changes in students' self-regulation and mental health across multiple time points over one semester at SMA Negeri 9 Bandar Lampung, it provides dynamic data and stronger temporal evidence than cross-sectional research. Second, the study investigates self-regulation not only as a predictor variable but also as a buffering variable that may mitigate the negative effects of digital learning on students' mental health. Third, conducting the study in a single school implementing the Merdeka Curriculum allows control over contextual variables such as school

culture, leadership, and teaching practices, ensuring that external factors are more manageable. Fourth, the research enriches Indonesian educational literature on digital well-being within the context of the latest education policy—the Merdeka Curriculum—where empirical longitudinal studies at the senior high school level are still scarce.

The objectives of this study are to examine how the self-regulation and mental health of senior high school students at SMA Negeri 9 Bandar Lampung change over time during one semester of digital learning under the Merdeka Curriculum, and to analyse whether self-regulation acts as a buffer moderating the negative relationship between the intensity of digital learning and students' mental health. Specifically, this study aims to: (1) measure the levels of students' self-regulation and mental health across three measurement waves within one semester; (2) test cross-lagged relationships between self-regulation and mental health over time; (3) determine whether self-regulation moderates the negative impact of digital learning intensity on students' mental health; and (4) provide practical recommendations for schools and education policymakers to strengthen students' self-regulation in order to safeguard their mental health in the digital era of the Merdeka Curriculum.

Theoretical Review

The development of modern education in the digital era has had profound consequences on the way students learn, interact, and manage their psychological well-being. This transformation highlights the importance of exploring key concepts such as self-regulation, mental health, and digital well-being, as well as understanding how these elements interact within the implementation of the Merdeka Curriculum. This theoretical review aims to provide relevant conceptual and empirical foundations to ensure that the present study stands on a robust academic basis while emphasising the novelty of its longitudinal design.

Self-regulation is a key concept for understanding how individuals control their behaviour, emotions, and cognition to achieve learning goals. Zimmerman (2015) defines self-regulation as a proactive process of planning, monitoring, and evaluating learning activities. This process is not merely a technical ability to manage time and learning strategies but also includes motivational and affective dimensions. In technology-based learning contexts, self-regulation becomes increasingly vital because students must take charge of their learning without constant teacher supervision. Recent studies have shown that strong self-regulatory skills are positively associated with academic achievement, digital literacy, and psychological well-being (Panadero, 2017; Dignath & Büttner, 2018).

Within the framework of 21st-century education, self-regulation is regarded as a fundamental soft skill. The positive effects of self-regulation on mental health are evidenced by Wolters and Brady (2020), who found that students with high self-regulation were better able to manage academic stress and sustain learning motivation amid digital distractions. Similarly, Sun and Rueda (2021) emphasised that self-regulated learning mediates the relationship between digital literacy and learning

outcomes, helping students navigate psychosocial challenges caused by technology-based academic pressures.

Students' mental health is another highly relevant issue in digital education. The World Health Organization (WHO, 2022) defines mental health not merely as the absence of psychological disorders but as a state of well-being in which individuals realise their potential, cope with normal life stresses, work productively, and contribute to their communities. In education, mental health is closely related to how students cope with learning demands, build social relationships, and maintain emotional well-being. Recent studies have reported rising cases of stress, anxiety, and even depression among adolescents due to the intensive use of digital devices for both learning and socialising (Twenge et al., 2018; Viner et al., 2019). These findings raise concerns that the integration of technology into education, if not supported by appropriate mechanisms, may harm students' mental health.

The concept of digital well-being has emerged in response to these challenges. Digital well-being refers to a state of balance between the use of digital technologies and the maintenance of physical and mental health (OECD, 2021). This concept stresses that technology use should enhance, not diminish, human well-being. In educational contexts, digital well-being concerns how students use digital devices healthily, manage distractions, and minimise negative impacts such as social media addiction or fatigue from excessive screen time (Pangrazio & Selwyn, 2020). Recent research shows that educational programmes that teach both digital literacy and self-regulation skills positively influence students' digital well-being (Livingstone et al., 2021; Hamilton et al., 2022).

The integration of self-regulation, mental health, and digital well-being reveals a complex reciprocal relationship. Students with high self-regulation are better able to maintain digital well-being because they can control their device use, set priorities, and manage emotions when faced with digital distractions. Conversely, students with low self-regulation are more prone to mental health issues as they struggle to manage study and rest effectively. A longitudinal study by Li et al. (2020) in China found that strong self-regulation at the beginning of the academic year was associated with lower academic stress at the end of the year and higher life satisfaction, highlighting the importance of longitudinal designs for comprehensively understanding these dynamics. The Merdeka Curriculum, as Indonesia's national education policy, emphasises flexibility, differentiation, and learning autonomy. Its implementation encourages students to be more active and independent in managing their learning processes, including the responsible use of digital technologies.

According to the Ministry of Education, Culture, Research, and Technology (2022), one of the goals of the Merdeka Curriculum is to equip students with 21st-century competencies—critical thinking, collaboration, communication, creativity, and digital literacy. However, several studies have found gaps between these ideal objectives and classroom realities. For example, Rachmawati and Yulianti (2022) reported that Indonesian secondary school students faced significant difficulties in managing time and motivation when engaging in platform-based learning. This

underscores the importance of connecting the implementation of the Merdeka Curriculum with issues of self-regulation and mental health.

Both international and national studies increasingly highlight that students' mental health cannot be separated from self-regulation skills and the quality of the digital learning environment. For instance, Baran et al. (2021) found that students with low self-regulation experienced higher levels of "Zoom fatigue" than those with strong self-regulation, particularly in online learning contexts. Similarly, Nugraha et al. (2023) in Indonesia demonstrated that digital well-being significantly contributes to maintaining student motivation in the Merdeka Curriculum, but its impact is stronger among students with good self-regulation. These findings reinforce that self-regulation influences not only learning outcomes but also students' psychological well-being in the digital era.

Recent studies have also shown that self-regulation-based interventions can improve students' mental health and digital well-being. For instance, learning programmes integrating self-regulated learning strategies have been proven to reduce academic stress and enhance learning satisfaction (Cho & Heron, 2019). Likewise, Bond (2020) reported that digital learning strategies supporting self-regulation help students maintain a balance between academic and personal activities. Hence, self-regulation can be regarded as a key mediating factor linking technological demands in the Merdeka Curriculum to students' mental health.

In summary, research on self-regulation, mental health, and digital well-being within the Merdeka Curriculum context still leaves ample room for exploration, particularly through longitudinal approaches. Most studies in Indonesia remain cross-sectional and do not examine the long-term dynamics among these variables. Therefore, the present study is expected to contribute new insights to Indonesian educational literature by offering a longitudinal perspective that explains the changes and consistency in the role of self-regulation on students' mental health over time in the context of digital learning..

METHOD

This study employed a quantitative approach with a longitudinal design aimed at examining the development of digital wellbeing, self-regulation skills, and students' mental health over a certain period during the implementation of the Merdeka Curriculum. The longitudinal design was chosen because it enables the observation of changes and the dynamics of students' conditions continuously over time. Through repeated observations, this study sought to trace the extent to which exposure to technology-based learning in schools influences students' digital wellbeing and self-management skills.

The research was conducted at SMA Negeri 9 Bandar Lampung, one of the public senior high schools in Bandar Lampung City that has implemented the Merdeka Curriculum and actively integrates digital technology into the learning process. This school was chosen due to the high intensity of digital device usage among students in both academic and non-academic activities. The research subjects were Year 10

students, as this group had just transitioned into upper secondary education and were adapting to a new learning system, making it more likely to identify changes in digital wellbeing, self-regulation, and mental health. The population of this study consisted of all Year 10 students at SMA Negeri 9 Bandar Lampung in the 2025/2026 academic year. The sampling technique used was purposive sampling, to obtain respondents who met specific criteria, namely students who routinely participated in digital-based learning activities. The sample size was determined based on adequate representativeness of the population and time constraints in collecting longitudinal data, with a minimum target of 100 respondents to ensure strong statistical validity.

The main research instrument was a Likert-scale questionnaire developed to measure the three main research variables. The digital wellbeing instrument was adapted from theoretical frameworks of digital literacy and psychological wellbeing, covering aspects such as time management in device use, emotional experiences while using technology, and the ability to maintain balance between digital and real-world activities. The self-regulation instrument was developed based on social-cognitive learning theory, assessing planning, monitoring, and self-evaluation dimensions in students' digital activities. Meanwhile, mental health was measured through indicators of emotional wellbeing, academic stress levels, and life satisfaction in the context of technology use. To ensure reliability and validity, the questionnaire was pilot-tested prior to the main data collection.

The collected data were analysed using descriptive and inferential statistical techniques. Descriptive analysis was used to describe the distribution of the research variables, while inferential analysis, particularly repeated measures ANOVA, was applied to examine significant differences across measurement periods. All analyses were conducted using statistical software to ensure accuracy and objectivity. This study also adhered to ethical standards, including obtaining consent from the school and informed consent from students, while maintaining the confidentiality of participants' personal data.

FINDINGS AND DISCUSSION

Findings

This section presents the empirical findings concerning the condition of Year 10 students at SMA Negeri 9 Bandar Lampung as research subjects, particularly regarding digital wellbeing, self-regulation, and mental health in the context of the Merdeka Curriculum implementation. The research was conducted longitudinally over one semester, with three measurement points—at the beginning, middle, and end of the semester. Through this design, the study sought to capture the dynamics of changes experienced by students in line with their increasing engagement in technology-based learning.

Data were collected through a structured Likert-scale questionnaire designed to assess students' levels of digital wellbeing, self-regulation, and mental health. The collected data were then processed to generate descriptive statistics and analysed quantitatively to identify significant differences across measurement periods. This

approach enabled the study to present not only a static condition of students at one point in time but also to reveal developmental trends throughout the learning process.

The results are presented in four main subsections: (1) initial data description, including respondent profiles and general patterns of digital technology use; (2) results of each research variable across three data collection periods; (3) longitudinal analysis using repeated measures ANOVA to assess significant changes; and (4) main findings summarising key patterns and inter-variable relationships. This systematic presentation aims to provide a comprehensive understanding of the relationship between digital wellbeing, self-regulation, and mental health within the framework of the Merdeka Curriculum.

Initial Data Description

The study involved 112 Year 10 students at SMA Negeri 9 Bandar Lampung in the 2025/2026 academic year, consisting of 58 male students (51.8%) and 54 female students (48.2%), with an average age of 15.6 years. All respondents were in the early stage of adaptation to a new school environment, implying that their digital technology use, self-regulation, and mental health dynamics were likely to fluctuate during the one-semester research period.

Before measuring the main variables, the study first examined general patterns of digital technology usage among students. The preliminary survey revealed that most students owned a personal smartphone (97%), while the rest used shared family devices. The average daily device usage was 5.8 hours, covering academic, entertainment, communication, and social interaction purposes. Based on activity distribution, 41% of students primarily used digital devices for learning (accessing e-learning applications, digital materials, or video-based learning platforms), 37% mainly for entertainment such as games and social media, and 22% for both purposes in a balanced manner.

These variations indicate differing tendencies that may influence students' digital wellbeing, self-regulation, and mental health. For instance, students who primarily used devices for entertainment showed higher levels of stress at the beginning of the semester, whereas those who used them mainly for learning reported greater academic pressure. This descriptive insight serves as an important contextual foundation for interpreting longitudinal data comparisons.

Measurement Results of Research Variables

The three main variables—digital wellbeing, self-regulation, and mental health—were measured at three points: the beginning, middle, and end of the semester. The mean scores and standard deviations are presented in the following table.

Table 1. Mean Scores and Standard Deviations of Research Variables Across Three Measurement Periods

Variable	Beginning of Semester (M ± SD)	Mid-Semester (M ± SD)	End of Semester (M ± SD)
Digital Wellbeing	3.12 ± 0.64	3.45 ± 0.58	3.71 ± 0.55

Self-Regulation	3.05 ± 0.61	3.39 ± 0.57	3.66 ± 0.52
Mental Health	3.21 ± 0.59	3.28 ± 0.63	3.47 ± 0.60

Source: Primary longitudinal data, 2025

The table shows that all three variables exhibited an upward trend throughout the semester. Digital wellbeing increased from an average of 3.12 at the beginning to 3.71 at the end of the semester, with the sharpest rise occurring between the initial and mid-semester phases. Self-regulation displayed a similar pattern, rising from 3.05 to 3.66, suggesting an improvement in students' ability to manage both academic and non-academic digital activities. Meanwhile, mental health improved more moderately—from 3.21 to 3.47—indicating gradual progress, though less pronounced than in the other two variables. To enhance interpretation, the results were also presented based on gender.

Table 2. Research Variable Scores by Gender (M ± SD)

Variable	Male (n=58)	Female (n=54)
Digital Wellbeing	3.32 ± 0.60	3.48 ± 0.56
Self-Regulation	3.28 ± 0.59	3.42 ± 0.54
Mental Health	3.31 ± 0.57	3.40 ± 0.59

Source: Primary longitudinal data, 2025

Although the differences were not statistically significant, female students tended to have slightly higher scores in all variables, particularly in digital wellbeing. This may indicate differences in technological use styles and adaptation strategies between genders.

Longitudinal Change Analysis

To determine whether significant differences occurred across the three measurement periods, repeated measures ANOVA was conducted. The results indicated significant differences in both digital wellbeing and self-regulation ($F = 8.72$, $p < 0.01$ for digital wellbeing; $F = 9.15$, $p < 0.01$ for self-regulation). A significant, though weaker, difference was also observed in mental health ($F = 4.26$, $p < 0.05$).

These findings confirm that the implementation of the Merdeka Curriculum over one semester had a measurable impact on improving students' digital wellbeing and self-regulation skills, while the enhancement of mental health progressed more slowly and moderately.

Table 3. Trends in Variable Changes

Variable	Beginning of Semester	Mid-Semester	End of Semester	Change Pattern
Digital Wellbeing	3.12	3.45	3.71	Significant increase
Self-Regulation	3.05	3.39	3.66	Significant increase
Mental Health	3.21	3.28	3.47	Moderate increase

Source: Primary longitudinal data, 2025

The table illustrates that the most substantial improvements in digital wellbeing and self-regulation occurred between the early and mid-semester phases, after which the increase stabilised. This trend can be interpreted as an effect of students' adaptation to digital learning applications and the gradual establishment of effective self-management strategies by mid-semester.

Key Findings

Based on the overall analysis, several key findings emerged. First, students' digital wellbeing improved significantly throughout the semester, suggesting that they were able to adapt to healthier patterns of technology use over time. Second, self-regulation skills increased, indicating students' growing ability to set learning goals, monitor progress, and control their use of technology. Third, mental health showed slower but positive improvement, suggesting that non-academic factors such as social pressures and personal demands continued to play a role despite progress in digital wellbeing and self-regulation.

Correlation analysis revealed a strong positive relationship between digital wellbeing and self-regulation ($r = 0.68$), a moderate correlation between digital wellbeing and mental health ($r = 0.52$), and a positive correlation between self-regulation and mental health ($r = 0.57$). These results highlight that self-regulation skills play a pivotal role in maintaining digital balance while supporting students' mental health. In other words, the better the self-regulation ability, the greater the likelihood that students will exhibit both healthy digital wellbeing and good mental health.

This study provides evidence that the implementation of the Merdeka Curriculum, supported by digital technology, affects not only cognitive aspects but also has tangible impacts on students' digital wellbeing and self-regulation skills. Ultimately, these improvements contribute to better mental health, albeit with a slower rate of change.

Discussion

This discussion section aims to interpret the research findings by linking them to theoretical frameworks, previous studies, and the socio-educational context of SMA Negeri 9 Bandar Lampung as the research site. Based on the results presented earlier, the variables of digital wellbeing, self-regulation, and mental health demonstrated diverse dynamics throughout one semester of learning. The longitudinal results indicated significant changes—both increases and decreases—which reflect students' adaptation process to technology-based learning within the framework of the Merdeka Curriculum. The following discussion elaborates an in-depth interpretation of each major finding and its implications for theoretical development and educational practice.

Interpretation of Digital Wellbeing Findings

The results revealed a significant increase in digital wellbeing scores from the beginning to the end of the semester. This finding suggests that students became increasingly capable of balancing their digital activities between academic purposes and personal entertainment over time. At the start of the semester, most students struggled to manage their screen time due to the intensity of online assignments and a tendency for excessive multitasking. However, by mid-semester, students began to

demonstrate better adaptation to their digital learning routines and increased awareness of the importance of maintaining a healthy balance in technology use.

This phenomenon aligns with the findings of Przybylski and Weinstein (2019), who demonstrated that digital wellbeing improves when individuals can effectively control their screen time and distinguish productive activities from digital distractions. Within the context of SMA Negeri 9 Bandar Lampung, this adaptation can also be associated with the school's implementation of a digital literacy school policy, which emphasises responsible and healthy use of technology.

The improvement in digital wellbeing may also be linked to students' internalisation of technological use norms embedded in the Merdeka Curriculum, where reflective practices and project-based learning require students to regulate their own digital learning pace. This finding reinforces Beetham's (2022) view that digital wellbeing is not merely the result of limiting screen time, but also of metacognitive abilities to manage one's goals and digital behaviours.

Despite the overall increase, considerable individual variation remained. Some students continued to experience high stress levels due to technology-driven academic demands. This indicates that interventions to strengthen digital literacy must be adjusted to individual self-regulation capacities to ensure that digital wellbeing is achieved equitably among all students.

Interpretation of Self-Regulation Findings

Self-regulation exhibited a steady upward trend throughout the semester, indicating that students became increasingly capable of planning, monitoring, and evaluating their learning behaviour in digital environments. At the beginning of the semester, many students reported difficulties in maintaining self-directed learning consistency, primarily due to distractions from social media. However, as project-based learning methods within the Merdeka Curriculum were implemented, students began to engage more actively in managing their own learning goals.

This improvement in self-regulation aligns with Zimmerman's (2000) theory of self-regulated learning (SRL), which emphasises that the ability to control cognitive, motivational, and behavioural aspects is key to successful independent learning. In digital contexts, self-regulation becomes increasingly crucial as students must manage their time, concentration, and motivation without direct teacher supervision. This study supports Panadero's (2017) findings that students with high self-regulation tend to achieve better academic outcomes in online learning environments.

Empirically, the improvement in self-regulation at SMA Negeri 9 Bandar Lampung was also influenced by learning approaches that encouraged reflection and self-evaluation. Teachers integrated digital reflection journals and learning portfolios, prompting students to assess their own progress. Such practices have proven effective in strengthening the self-regulation cycle, as explained by Schunk and DiBenedetto (2020), in which reflection plays an integral role in maintaining long-term motivation. However, some students still struggled to maintain focus when exposed to multiple digital platforms simultaneously. This suggests that interventions based on digital self-

control and attention management training are still needed to foster more optimal self-regulation development.

Interpretation of Mental Health Findings

Students' mental health demonstrated relatively complex dynamics over the research period. At the beginning of the semester, stress and anxiety levels were high due to adaptation to the new learning system and technology-based academic demands. However, from mid- to end-semester, there was a significant decrease in stress scores and an increase in emotional wellbeing scores. This finding indicates that students gradually developed effective coping strategies and adapted to the digital learning rhythm.

This result aligns with Lazarus and Folkman's (1984) stress and coping theory, which posits that psychological wellbeing improves when individuals interpret challenges as opportunities for growth rather than threats. In this context, the Merdeka Curriculum appears to provide space for students to express themselves, collaborate, and adjust their learning styles according to their potential, thereby reducing academic stress.

This study also supports Keles et al.'s (2020) findings that moderate and purposeful use of digital technology can enhance adolescents' mental wellbeing, particularly when technology is used for positive social interaction. At SMA Negeri 9 Bandar Lampung, students utilised online study groups and digital discussion forums to exchange ideas and provide mutual support, functioning as social buffers against academic pressure.

However, the research also found that mental wellbeing remained influenced by the intensity of social media exposure outside academic contexts. Students with screen time exceeding six hours per day tended to have higher stress levels. This reinforces Twenge's (2023) assertion that balancing digital engagement with non-digital activities remains a major challenge for adolescents in the technological era.

Relationships Between Variables

Correlational and longitudinal analyses indicated that digital wellbeing was significantly and positively associated with both self-regulation and mental health. Students with higher levels of self-regulation tended to exhibit better digital and mental wellbeing. This finding suggests a mediating mechanism, wherein self-regulation acts as a bridge between digital balance and mental health.

This aligns with Anshari et al. (2021), who emphasised that digital self-regulation abilities can reduce the risk of mental health issues caused by excessive technology use. Self-regulation functions as an internal control system that enables students to navigate academic demands in digital environments without compromising emotional balance. In the context of SMA Negeri 9 Bandar Lampung, students who managed their screen time, limited social media distractions, and prioritised learning activities experienced increased life satisfaction and reduced academic anxiety.

The longitudinal findings revealed that changes in self-regulation significantly contributed to improvements in digital wellbeing. This suggests that strengthening self-regulation could serve as a preventive strategy to safeguard students' mental health amid educational digitalisation. Thus, the relationships among the variables in this study are not linear but mutually reinforcing within a continuous cycle of digital learning adaptation.

Comparison with Previous Research

This study enriches existing literature by presenting longitudinal evidence within the Indonesian secondary education context. Most previous studies, such as those by Putri and Santoso (2021) and Rahmawati et al. (2022), employed cross-sectional designs that could not capture the temporal dynamics of students' digital behaviour. By adopting a longitudinal approach, this research successfully illustrated clearer and deeper patterns of how digital wellbeing and self-regulation evolve over time.

The findings also confirm global studies such as those by Valkenburg et al. (2022) and Livingstone and Byrne (2018), which assert that digital wellbeing is not a static state but the outcome of ongoing social learning and technological adaptation. However, in the Indonesian context, school environment and teacher support appear to play a greater role than in more developed countries. This highlights the importance of school culture and contextual pedagogical approaches in shaping students' digital behaviour.

From a mental health perspective, this research aligns with Parker et al. (2021), who found that reflective learning strategies can reduce academic stress through improved self-regulation. Thus, this study not only reinforces but also extends prior findings within the framework of national education policy, particularly the implementation of the Merdeka Curriculum.

Theoretical and Practical Implications

Theoretically, this study contributes to a deeper understanding of the interrelationship among digital wellbeing, self-regulation, and students' mental health in digital learning contexts. The findings support an interdependent model positioning self-regulation as a mediating factor between digital and psychological wellbeing. This model can be used to expand Zimmerman's (2000) self-regulated learning theory within the context of modern educational digitalisation.

Practically, the findings provide several important implications for schools, teachers, and policymakers. First, schools need to design digital literacy programmes that go beyond technical skills by integrating psychological wellbeing and self-regulation dimensions. Second, teachers should be trained to identify signs of digital fatigue and support students in setting healthy technology-use boundaries. Third, policymakers may consider these results as a foundation for developing national digital wellbeing guidelines aligned with the Merdeka Curriculum's spirit of fostering character and 21st-century competencies.

This study opens opportunities for future research to explore more detailed psychological mechanisms linking digital and mental wellbeing, such as digital self-efficacy, online social support, and adaptive learning styles. The longitudinal approach has proven effective in capturing mid-term changes in digital behaviour and can be extended over a longer period to monitor the sustainable impact of educational digitalisation on students' wellbeing.

CONCLUSION

This longitudinal study revealed that digital wellbeing, self-regulation, and mental health are interrelated and dynamically evolving dimensions within technology-based learning under the Merdeka Curriculum. The findings carry substantial meaning, demonstrating that educational digitalisation is not merely about technology use as a learning tool but also reflects the formation of self-awareness and psychological balance among students in the digital era. Empirically, digital wellbeing improved alongside the strengthening of students' self-regulation abilities, which in turn positively influenced their mental health.

The study underscores that digital wellbeing does not emerge instantly but results from an ongoing adaptation process to digital learning environments. Students with higher self-regulation were found to be more capable of managing screen time, filtering relevant information, and limiting digital distractions, thereby experiencing reduced stress and enhanced emotional wellbeing throughout the semester. Consequently, digital wellbeing and self-regulation function as protective mechanisms against psychological pressures stemming from intensive technology exposure.

More broadly, the findings indicate that the goals of the Merdeka Curriculum—to cultivate students who are independent, reflective, and adaptive—cannot be separated from their ability to navigate the digital world with awareness and self-control. The curriculum's flexible and reflective learning model provides students with opportunities to build meaningful digital literacy—encompassing not only technical proficiency but also ethical and emotional awareness in technology use. In essence, healthy digital learning can only be achieved when supported by the cultivation of self-regulation and attention to mental wellbeing.

This study extends self-regulated learning theory into the digital realm by demonstrating that self-regulation serves as a bridge between digital and psychological wellbeing. The identified relational model illustrates an adaptive cycle, wherein enhanced self-regulation improves digital wellbeing, and sustained digital wellbeing supports students' mental stability. This offers a new theoretical foundation for developing a more comprehensive digital wellbeing education model within Indonesian secondary schools.

The research also presents opportunities for implementing school-based interventions focusing on digital self-regulation training. Teachers and counsellors can use these findings to design learning strategies that foster healthy technology use awareness through reflective practices, digital project-based learning, and balanced

screen-time management. Moreover, schools could develop a “healthy digital ecosystem” policy involving students, teachers, and parents to build a supportive and sustainable digital culture.

In the future, this study can be expanded through long-term longitudinal approaches covering broader populations across regions and educational levels. Further studies could incorporate additional variables such as digital self-efficacy, online social support, and digital emotional intelligence to provide a more comprehensive understanding of Indonesian students’ digital wellbeing. Experimental research could also be conducted to test the effectiveness of digital self-regulation training programmes in reducing academic stress and enhancing psychological wellbeing.

Ultimately, this research affirms that digital transformation in education must be accompanied by students’ self-awareness transformation regarding technology. The Merdeka Curriculum has opened significant opportunities to balance cognition, emotion, and digital ethics. Therefore, digital wellbeing should not be viewed merely as an individual responsibility, but as a shared responsibility within the educational system to cultivate a resilient, mentally healthy, and digitally wise generation in the modern era.

ACKNOWLEDGMENTS

The authors would like to express their deepest gratitude to Universitas Indonesia Mandiri, Lampung, for providing continuous support, research facilities, and an academically conducive environment that enabled the completion of this study. Special appreciation is also extended to Universitas Ahmad Dahlan, Yogyakarta, for its valuable academic collaboration and contributions throughout the research process.

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