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Quantitative Research Article

The Development and Effectiveness of Digital Well-being Intervention on Enhancing Digital Literacy and Psychological Well-Being of Thai Adolescents

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Abstract

Background/problem: Adolescents face offensive content, contact threats, and violations of privacy associated with digital technology, which can have effects on their psychological well-being. Supporting adolescents in developing digital literacy is crucial for helping them maintain their well-being.

Objective: This research aimed to study the effectiveness of a digital well-being intervention on the development of digital literacy and psychological well-being, while also examining the relationship between digital literacy and psychological well-being in early adolescents.

Design and Methodology: This research used a quasi-experimental design. A digital well-being intervention program was developed based on the self-determination theory, activity-based learning, concepts of self-esteem, and positive reinforcement. The participants were 70 school students from Chachoengsao province in Thailand. The experimental group received 10 sessions of training from the digital well-being intervention programs. Data analysis utilized MANOVA with repeated measures and Pearson's correlation.

Results: Main results showed that digital literacy and psychological well-being differed, over time (Wilk's $\Lambda = .78$, $F = 4.48$, $p < .01$). After the training and during the follow-up period, statistically significant differences were observed in the average scores of digital literacy and psychological well-being between the experimental and control groups at a significance level of .01. The relationship between digital literacy and psychological well-being in the experiment group showed a moderate correlation ($r = .64$, $p = .00$).

Conclusion and Implications: The findings of this study could be useful for practitioners working with adolescents for promoting appropriate digital technology use and enhancing psychological well-being in early adolescents.

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Digital technology plays a crucial role in daily activities, encompassing tasks such as receiving information, communication, entertainment, financial transactions, purchasing goods and services, education, and work (Tulinayo et al., 2018). Early adolescence marks a significant stage in individuals' lives, typically occurring between the ages of 10 and 14 years, as they transition from childhood to adolescence (Feldman & Elliott, 1990). During this period, children undergo educational changes from primary to early secondary education levels and experience shifts in various aspects, including physical, psychological, and lifestyle patterns. Therefore, they should be encouraged to adapt to these changes and lead creative lives. Studies on the usage behavior of digital technology among children and adolescents have found that smartphones are the most used devices, with usage starting immediately upon waking up and continuing throughout the day during leisure time after studies until bedtime (Kleechaya, 2016).

Additionally, other digital devices are used for communication, entertainment, as well as searching for information on topics of interest and for educational purposes (Holly et al., 2023; Kleechaya, 2016).

Psychological well-being is a component of positive psychology. Having psychological well-being enables adolescents to adapt and accept themselves, maintain independent thinking while still being open to others' perspectives, continuously learn new things for self-development, set goals in life, effectively manage life's challenges, and grow into quality adults (Jirathikrengkrai et al., 2021). Previous studies have found that prolonged use of technology throughout the day results in lower psychological well-being, compared to individuals who use it for less than an hour per day (Twenge & Campbell, 2019). Extended usage typically results in decreased engagement in physical activities, including social interaction, household responsibilities, and religious practices, thereby reducing psychological well-being (Twenge & Campbell, 2018). The use of digital technology poses various risks to adolescents, including content risks, contact risks, conduct risks, contract risks, privacy violations, and negative impacts on physical and mental health (Holly et al., 2023), cyberbullying and cybervictimization are also prevalent risks (Audrin & Blaya, 2020), which have adverse effects on adolescents' psychological well-being (Twenge & Campbell, 2019), resulting in negative emotional outcomes, feelings of anxiety and loneliness (Limone & Toto, 2022), depression symptoms (Coyne et al., 2019).

Supporting adolescents to develop digital literacy is, therefore, crucial as it empowers them to navigate digital technology within social and digital environments accurately, creatively, and safely. Digital literacy serves as a preventative and promotive factor for adolescents to maintain well-being when facing negative experiences online (Kumpfer, 2002). Individuals with digital literacy tend to report higher levels of psychological welfare. This is due to their ability to manage online risk experiences, navigate and cope with feelings of being bullied or harassed better than those with low digital literacy (Vandoninck et al., 2010; 2013). Therefore, developing digital literacy in adolescents helps protect them from the risks associated with digital technologies (Rodríguez-de-Dios et al., 2016). The previous research focused on the adopting model of digital literacy and psychological well-being of adolescents (Siriwattanarat et al., 2018; Yurayat et al., 2022). There is lack of studies related to intervention programs aimed at enhancing digital literacy and psychological well-being of adolescents in the context of Thailand.

This study aimed to develop an intervention to support early adolescents in the acquisition and retention of digital literacy and to enhance their psychological well-being. It investigates the effectiveness of a digital well-being intervention derived from behavioral science, psychological, educational, and technological concepts. By conducting a pilot study in Chachoengsao province, situated in the eastern region of Thailand, which is an area of implementation for the Eastern Economic Corridor project and digital infrastructure development initiatives. These initiatives include the installation of Wi-Fi and 5G networks, establishment of the smart environment innovation center, and development of the city data platform. As a result, digital technology plays an increasingly vital role in the lives of individuals in the area, particularly among adolescents who are in the stage requiring adaptation to cope with change, in order to align with societal or environmental conditions. The result of the study will produce tools directly beneficial to early adolescents, providing them with essential skill. Additionally, this further encourages appropriate usage behavior and ensures safety, thereby influencing and promoting psychological resilience and healthy development during adolescence.

Literature Review

This section provides an overview of the literature, relevant theories, and previous studies related to the current study. The topics include social cognitive theory, digital literacy, psychological well-being and digital well-being.

Social Cognitive Theory

Social cognitive theory, developed by Bandura (1986), emphasizes the triadic reciprocal determinism between personal factors (such as cognitions, beliefs, perceptions, and emotions), behavior, and environmental factors in shaping behavior. Based on the triadic reciprocal determinism framework, this research develops an intervention to provide a conducive environment through social interaction via group activities, including expressions of opinion, exchange of ideas, and group discussions, as well as practical exercises and presenting behavioral modeling, encompassing both individuals and media. This approach thereby facilitates the development of personal factors such as digital literacy and psychological well-being, consequently promoting the acquisition of appropriate digital technology behavior among early adolescents.

Digital Literacy

Digital literacy first emerged from the work of Gilster (1997), who defined digital literacy as the ability to understand and use information presented through computers, which is collected in various formats and from multiple sources. Building on Gilster's concept, studies have further explored and developed definitions and components of digital literacy. For instance, the DigEuLit project defines digital literacy as the awareness, attitudes, and personal capabilities to use digital devices appropriately, enabling the ability to identify, access, manage, integrate, evaluate, analyze, and synthesize digital content (Martin & Grudziecki, 2006). Digital literacy comprises essential skills such as digital skills and critical thinking skills, facilitating the appropriate usage behavior of digital devices and the ability to analyze digital media content, as well as possessing knowledge and proficiency in creating and communicating through digital technology (DeWaard & Hoechsmann, 2020). Nowadays, digital skills are imperative for adolescents to navigate life, as even though they may grow up familiar with digital technology, they still experience the impacts of its use (Holly et al., 2023). This study aimed to investigate digital literacy according to the components outlined by Rodríguez-de-Dios et al. (2016), who developed a framework and tools for studying digital literacy in adolescents. These components include: 1) technological skill: proficiency in utilizing digital technologies efficiently; 2) communication skill: competence in communicating via digital platforms; 3) information skill: capability to locate, acquire, and assess digitally based information; 4) critical skill: Ability to critically analyze obtained information; and 5) security skill: proficiency in engaging in interactive communication safely, mitigating risks and hazards. This study utilizes these components to define the content of the intervention and to develop a measurement tool for assessing digital literacy, which will be the outcome of the subsequent intervention.

Psychological Well-Being

Well-being originates from two distinct approaches: the hedonic approach and the eudemonic approach. The hedonic approach focuses on happiness, defining well-being as the achievement of pleasure and the avoidance of pain. It evaluates happiness based on positive affect, negative affect, and life satisfaction, also known as subjective well-being (Kahneman et al., 1999). Eudemonic well-being focuses on living well, realizing one's human potential, fulfilling virtuous potentials, and living in alignment with one's inherent intentions (Deci & Ryan, 2008). In this regard, Ryff developed the concept of psychological well-being within the eudemonic framework, outlining its structure into six components (Ryff & Keyes, 1995): 1) self-acceptance: involves maintaining a positive self-perception and feeling satisfied with one's past experiences; 2) positive relations with others: involve fostering warm, rewarding, and trustworthy connections with individuals, demonstrating care for their welfare, and understanding the dynamics of interpersonal relationships; 3) personal growth: involves a continuous journey of self-development, embracing new opportunities for growth, consistently self-assessing, and evolving. 4) purpose in life: involves setting meaningful goals, experiencing a sense of direction, aligning beliefs with life's purpose, and having clear objectives for living; 5) environmental mastery: entails feeling competent and in control of managing one's surroundings, being capable of creating or selecting environments that resonate with personal needs and values; and 6) autonomy involves being self-directed and independent, capable of resisting social pressures to conform, and making decisions and taking actions aligned with personal values. This study utilizes the components of psychological well-being based on Ryff and Keyes's (1995) framework to define content in interventions and to develop measures for assessing psychological well-being.

Digital Well-Being

In contemporary society, technology and digital media have both positive and negative effects on individuals' health and lifestyles, leading to an increasing focus on well-being in a digital context (Thianthai & Tamdee, 2024). Digital well-being refers to individuals' subjective happiness within a social environment saturated with digital media (Büchi, 2021). Scholars emphasize the importance of achieving a "balanced" and "safe" interaction with technology, which involves maintaining equilibrium between its benefits and drawbacks (Büchi, 2021; Vanden Abeele, 2021). Additionally, experts underscore personal skills and values as crucial factors influencing the relationship between humans and technology, advocating for the integration of adaptive personal technology habits to meet essential goals (Al-Mansoori et al., 2023). Some studies aim to develop measures of digital well-being in adolescents, identifying three components: social, cognitive, and emotional domains (Rosič et al., 2024). Other scholars analyze digital well-being through psychological theories such as self-determination theory (Al-Mansoori et al., 2023; Passey, 2021), suggesting its potential as a central focus in research on digital media use and well-being (Vanden Abeele, 2021). The concept of digital well-being is applied by service providers and software developers aiming to create technology tools to help individuals foster healthier mobile media habits (Al-Mansoori et al., 2023). Despite the increasing interest in enhancing people's interaction with technology, existing literature often focuses on individual technological sources like smartphones (Rosič et al., 2024; Vanden Abeele, 2021). Therefore, there is a need for studies aimed at promoting digital well-being across a wider range of devices. Motivation drives individuals' behavior, propelling them into action, and also governs the regulation of their behavior across different domains of their lives. Hence, this research develops a comprehensive digital well-being intervention based on findings from focus groups comprising experts, along with a review of literature on self-determination theory (SDT). The SDT is a motivational theory that posits individuals have three basic psychological needs essential for psychological well-being: autonomy, relatedness, and competence (Deci & Ryan, 2015). This approach, combined with activity-based learning, self-esteem, and reinforcement concepts, aims to create activities that support participants' basic needs, leading to increased motivation to learn. This process is expected to be effective in developing digital literacy and psychological well-being in early adolescents. The developed digital well-being intervention was evaluated for quality by experts and initially tested on a group similar to the sample group to assess the appropriateness of the language and procedures. It was then revised accordingly to ensure suitability.

Therefore, the objectives of the research were, 1) to investigate its effectiveness in the development of digital literacy and psychological well-being of early adolescents; and 2) to examine the relationship between digital literacy and psychological well-being of early adolescents

Method

Research Design

This research is a study on the effectiveness of digital well-being intervention for adolescents using quasi-experimental designs. It involved a treatment-control pre-post-follow-up design (Sharpe & Cribbie, 2023)

Participants

A sample group was selected from a large school in Chachoengsao province, Thailand. This school accommodates students from various districts of the province, serving as a central hub for education and community involvement in the region. A total of 70 secondary school students aged 10-14 years were chosen based on their lowest scores in overall psychological well-being.

Sampling and Sample Procedures

The researchers determined the sample size using the G*Power program, setting an effect size of .25, α of .05, and power of .80 (Van Doorn et al., 2021), resulting in a sample size of 66 individuals. To mitigate potential sample loss during the research process, the researchers increased the sample size to a total of 70 individuals. Criteria for selecting participants included willingness to participate in the research and no

prior intervention related to improving digital literacy and psychological well-being. The researchers employed a purposive sampling method to assign participants to either the experimental or control groups, ensuring an equal number of participants in each group. Consequently, the groups comprised 35 individuals each.

Instruments

The English versions of the instruments were translated to Thai and utilized in this study. Considering the specific cultural context, experts proficient in both Thai and English were initially engaged to translate the research instruments from English to Thai. Subsequently, the Thai version was compared with the original text. All measurement instruments were evaluated using a Likert 5-point scale. The two research variables were measured as described.

Digital literacy instrument was based on the digital literacy concept of Rodríguez-de-Dios et al. (2016), and it contained 26 items. The IOC ranged from 0.57 to 0.83, with a reliability of $\alpha = .95$. The example question is “I always consider the credibility of the information received online”.

Psychological well-being instrument was based on the psychological well-being concepts of Ryff and Keyes (1995), which have been widely used in the study of psychological well-being in children and adolescents, and it contained 22 items. The index item-objective congruence (IOC) ranged from .67 to 1.00 with a reliability of $\alpha = .95$. The example question is “I feel good about who I am”.

Intervention

A digital well-being intervention was developed based on the self-determination theory (Deci & Ryan, 2015), along with principles of activity-based learning, and concepts of self-esteem and positive reinforcement. It comprised of group activities aimed at facilitating participant discussions, presentations, and expression of opinions. A total of 10 sessions were designed, with each session lasting for 50 to 100 minutes, with a total duration of approximately 9 hours and 20 minutes. The 10 sessions of the intervention are explained further.

Session 1: orientation session to introduce participants to each other, familiarize them with the training activities.

Session 2: self-exploration activity encourages participants to explore themselves, understand their strengths, and fosters an understanding that everyone has both strengths and weaknesses, which they must recognize and accept in themselves. It also supports fostering a sense of self-worth by sharing positive feelings towards group peers to build positive relationships.

Session 3: acceptance of change activity promotes acceptance of adolescent developmental changes and analyzes negative online situations that may affect self-confidence. Participants are presented with online scenarios that impact autonomy, such as body image criticism. They then discuss emotional management strategies and ways to maintain autonomy.

Session 4: communication skills activity supports appropriate communication with others, both online and offline, and trains participants in positive digital communication methods in various situations. It also involves collaborative discussions.

Session 5: goal-setting activity entails participants exploring and setting goals in their lives, emphasizing the importance of personal development to achieve their goals. It also provides guidance on leveraging digital technology for self-development.

Session 6: critical thinking development activity engages participants in critical thinking exercises related to digital media scenarios, prompting discussions on credibility assessment and information verification, and presents guidelines for critical thinking when receiving online information.

Session 7: digital device safety training provides participants with techniques for safe digital device usage and time management strategies for screen time through video clips. Participants then collaborate to discuss strategies for managing devices safely in various situations.

Session 8: online threat awareness activity raises awareness about online threats and risks, stimulating brainstorming for maintaining privacy and security, such as managing digital footprints. Each group presents their findings.

Session 9: game board activity to utilizes a boardgame to simulate digital risks and negative aspects of the online world, encouraging critical thinking and appropriate digital communication.

Session 10: the final session to summarize the learning outcomes from the training sessions. with a total duration of approximately 9 hours and 20 minutes.

Procedure

The researchers publicized the research project proposal, then sought permission and consent from parents and students who volunteered to participate in the research project and had them sign the informed consent. Subsequently, the participants were randomly assigned to experimental and control groups in equal numbers. In this study, both sample groups were assessed for digital literacy and psychological well-being in three phases: pre-intervention, post-intervention, and the follow-up period. Following the assessment of digital literacy and psychological well-being before the training, the experimental group received digital well-being intervention training for 10 sessions. Meanwhile, the control group did not receive any intervention. Upon completion of the training process, both the experimental and control groups were required to complete assessments of digital literacy and psychological well-being to measure the outcomes immediately after the training and again four weeks later. The researchers then conducted statistical analysis on the collected data. After the conclusion of this research, the researchers provided digital well-being intervention training to the control group.

Results

Sample Characteristics

The participants in the research consisted of 70 students, comprising 55.71% females and 44.29% males, with ages ranging from 13 to 14 years old (74.29% were 14 years old and 25.71% were 13 years old).

Descriptive Results

The researchers measured digital literacy and psychological well-being at three time points, including before the training (pre-test), immediately after completing the intervention (post-test), and follow-up period (follow-up test). The average scores obtained are detailed in Table 1.

Table 1

Mean Scores and Standard Deviations of Digital Literacy and Psychological Well-Being.

Variable	Group	Pre-test <i>M (SD)</i>	Post-test <i>M (SD)</i>	Follow-up <i>M (SD)</i>
Digital literacy	Experimental (<i>n</i> = 35)	3.52 (0.71)	4.21 (0.59)	4.35 (0.51)
	Control (<i>n</i> = 35)	3.54 (0.98)	3.56 (0.70)	3.60 (0.79)
Psychological well-being	Experimental (<i>n</i> = 35)	3.34 (0.57)	3.96 (0.57)	4.09 (0.63)
	Control (<i>n</i> = 35)	3.41 (0.59)	3.40 (0.62)	3.56 (0.61)

From Table 1, it was found that the experimental group's mean scores for digital literacy and psychological well-being increased compared to the pre-test scores and were higher than those of the control group. Nevertheless, based on the mean scores obtained from all three phases, it cannot be conclusively

inferred that the increase in mean scores of digital literacy and psychological well-being in the experimental group represents a statistically significant improvement.

Therefore, the researchers analyzed the data to test the effectiveness of the intervention using MANOVA with repeated measures. The results obtained from the experiment and control groups, over time, revealed statistically significant differences (see Table 1). These differences were highlighted in the multivariate analysis of variance of the average scores of digital literacies and psychological well-being and have been disaggregated by group and time periods. It was found that there was an interaction between the groups over time in the training sessions (Wilks' $\Lambda = .78$, $F = 4.48$, $p < .01$) as presented in Table 2. It can be concluded that digital literacy and psychological well-being differed over time in both the experimental and control groups.

Table 2

Multivariate Analysis of Variance of Average Scores of Digital Literacies and Psychological Well-Being, Disaggregated by Group and Time Periods

Variance	Wilks' Lambda(Λ)	Multivariate F -test	Hypothesis df	Error df	p	Partial Eta Squared
Group	.71	13.45	2	67	<.01	.29
Time	.71	6.50	4	65	<.01	.29
Group * Time	.78	4.48	4	65	<.01	.22

The analysis of variance of each variable separately to test the differences in mean scores of each variable in order, as shown in Table 3.

Table 3

Analysis of Variance of Digital Literacy and Psychological Well-Being Mean Scores between the Experimental and Control Groups

Variable	Sources of variation	SS	df	MS	F	p	η^2
Digital literacy	Within group						
	Time	7.90	2	3.95	7.00	<.01	.09
	Time * Group	6.22	2	3.11	5.51	<.01	.08
	Error	76.68	136	0.56			
	Between group						
	Group	11.10	1	11.10	23.73	<.01	.26
Psychological well-being	Error	31.78	68	0.47			
	Within group						
	Time	7.25	2	3.63	10.43	<.01	.13
	Time * Group	4.40	2	2.20	6.33	<.01	.09
	Error	47.28	136	0.35			
	Between group						
	Group	6.03	1	6.03	16.09	<.01	.19
	Error	25.50	68	0.38			

Table 3, shows that the mean scores of digital literacy and psychological well-being between the experimental and control groups differed at a statistically significant level at .01. Upon finding statistically significant differences between the experimental and control groups, pairwise comparisons of the mean scores of the digital literacy and psychological well-being variables between the experimental and control groups were conducted using the Bonferroni method with 95% confidence, as shown in Table 4.

From Table 4, when comparing the mean scores of digital literacy and psychological well-being at different time periods, the mean scores did not significantly differ between the experimental and control groups at the pre-test stage ($p = .91$ and $.61$, respectively). This indicates that students in both the experimental and control groups had similar baseline levels of digital literacy and psychological well-being before training. Furthermore, when considering the immediate post-test and follow-up test, it was found that the mean scores in the experimental group differed from those in the control group at a statistically significant level of $.01$. In summary, students in the experimental group who received training in the digital well-being intervention significantly higher levels of digital literacy and psychological well-being compared to students in the control group, at a statistically significant level. Additionally, when conducting pairwise comparisons of the mean scores of digital literacy and psychological well-being variables between the experimental and control groups, disaggregated by training period using the Bonferroni method with 95% confidence, to test the differences in mean scores of each variable, as shown in Table 5.

Table 4

Pairwise Comparisons of the Mean Scores of Digital Literacy and Psychological Well-Being between the Experimental and Control groups during the Pre-test, Post-test, and Follow-up periods.

Variable	Group	Time	Mean Difference	p
Digital literacy	Experimental - Control	Pre-test	-0.02	.91
		Post-test	0.64**	< .01
		Follow up	0.75**	< .01
Psychological well-being	Experimental - Control	Pre-test	-0.07	.61
		Post-test	0.56**	< .01
		Follow up	0.53**	< .01

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5

Pairwise Comparisons of the Mean Scores of Digital Literacy and Psychological Well-Being Variables between the Experimental and Control Groups, Disaggregated by Intervention Period.

Variable	Group	Time	Mean Difference	p
Digital literacy	Experimental	Pre-test (1) – Post-test (2)	-0.70**	< .01
		Pre-test (1) – Follow up (3)	-0.84**	< .01
		Post-test (2) – Follow up (3)	-0.14	1.00
	Control	Pre-test (1) – Post-test (2)	-0.02	1.00
		Pre-test (1) – Follow up (3)	-0.06	1.00
		Post-test (2) – Follow up (3)	-0.04	1.00
Psychological well-being	Experimental	Pre-test (1) – Post-test (2)	-0.62**	< .01
		Pre-test (1) – Follow up (3)	-0.74**	< .01
		Post-test (2) – Follow up (3)	-0.13	1.00
	Control	Pre-test (1) – Post-test (2)	0.01	1.00
		Pre-test (1) – Follow up (3)	-0.15	.86
		Post-test (2) – Follow up (3)	-0.16	.08

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

From Table 5, it was found that the mean scores of digital literacy and psychological well-being of students in the experimental group compared between the post-intervention and pre-intervention periods differed at a statistically significant level of $.01$ for both variables. This indicates that after completing the intervention, students in the experimental group had significantly higher levels of digital literacy and psychological well-being than they did before training, at a statistically significant level. Meanwhile, the

mean scores of students in the control group did not differ at a statistically significantly level of .05 at any intervention period. Thus, the researchers found that the level of digital literacy and psychological well-being demonstrated a significant correlation. Furthermore, the researchers assessed the levels of digital literacy and psychological well-being, as shown in Figures 2 and 3.

The analysis of the Pearson's product moment correlation between digital literacy and psychological well-being variables aimed to provide evidence supporting the notion that an increase in digital literacy level influences psychological well-being. The findings revealed a moderate correlation between the two variables ($r = 0.64$, $p < .01$). Therefore, it can be concluded that digital literacy is correlated with the psychological well-being of adolescents.

Figure 2
Levels of Digital Literacy

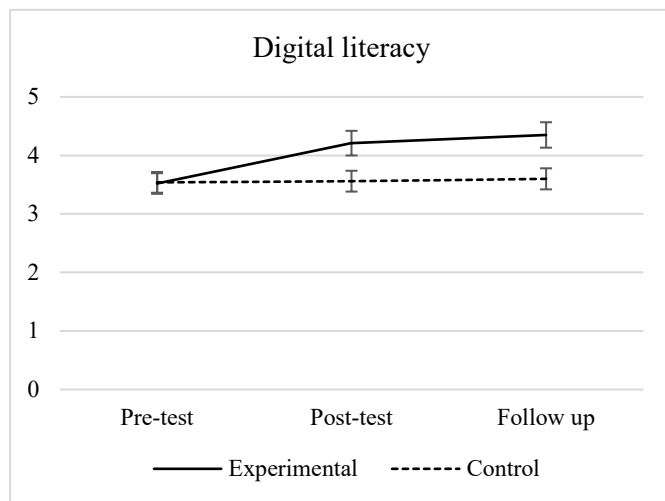
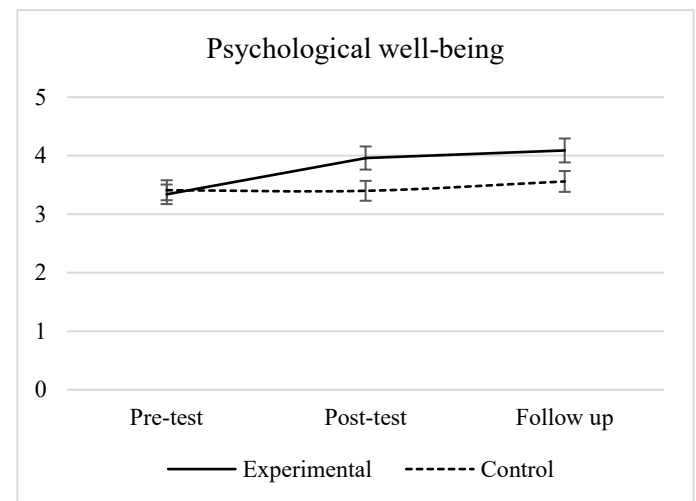


Figure 3
Levels of Psychological Well-being



Discussion and Conclusion

Discussion of Main Results

The study examined the effectiveness of the digital well-being intervention for early adolescents and found that students in the experimental group who participated in the intervention had higher average scores in digital literacy and psychological well-being compared to the control group. This outcome could be attributed to the development of the intervention, which is based on the social cognitive theory. Integrated social and personal factors by the application of the self-determination theory, activity based-learning, self-esteem and positive reinforcement framework in designing the content and activities of the digital well-being intervention. Self-determination theory framework aims to promote the fulfilment of basic psychological needs, including autonomy, relatedness, and competence, which in turn motivates participants to engage in learning activities. Motivation is the driving force behind an individual's desire to seek knowledge, engage in actions, comprehend, believe, or acquire specific knowledge, skills, attitudes, or values, it is inherently associated with the level of cognitive effort typically expended during learning endeavors (Filgona et al., 2020). Supporting participants to meet their basic psychological needs, in this study, involved the application of activity-based learning, self-esteem enhancement, and positive reinforcement within the intervention activities. These activities were structured according to the principles of activity-based learning, which is suitable for enhancing digital literacy skills and providing a framework for educational management in the digital era (Kinchang & Chatwattana, 2023). This program thus comprises a variety of activities customized to developmental stages and emphasizes hands-on practice both individually and in groups. These activities include scenario-based exercises, gaming, brainstorming, opinion sharing, and group discussions. Participants thereby become knowledge constructors through active engagement and successful experiential learning. Consequently, activities that support individuals in having

a choice and acknowledging their internal perspectives have been shown to enhance autonomy (Deci & Ryan, 2015). Consistent with previous research, activity-based learning has been found to effectively achieve the objectives for developing high school students (Sithsungnoen et al., 2022). Furthermore, this intervention applied positive reinforcement techniques, such as point accumulation with subsequent reward exchange, to stimulate participants to exhibit positive behaviors and cooperation during training. Examples include answering questions, creating creative works, presenting outputs, etc. Supported by prior research, it has been found that reinforcing positive behaviors is effective in motivating students to be interested in lessons, participate actively, make efforts, and achieve good learning outcomes (Boniecki & Moore, 2003).

From a past research, a correlation has been found between global self-esteem and psychological well-being (Rosenberg et al., 1995), as the use of digital technology can impact an individual's self-esteem (Jan & Ahmad, 2017). Therefore, it is conceivable that if participants receive development in digital literacy, they will possess adequate skills to cope with and manage the impact of digital technology on themselves and experience increased self-esteem. Therefore, this study applied the design of activity content that focuses on developing self-esteem and encouraged facilitators to use appropriate methods to promote self-esteem. This includes offering acceptance and attention, providing positive feedback or reflections, presenting role models, and supporting problem-solving skills (Mruk, 2006). Developing self-esteem, as mentioned, also aids in supporting responses to basic psychological needs, such as the provision of constructive and positive feedback, which facilitates the need for competence (Deci & Ryan, 2015). In organizing activities within the digital well-being intervention, support is provided to recognize the value and benefits of knowledge gained from training and to create a positive atmosphere, fostering good rapport among participants. Group activities are structured to promote intimacy, consultation, assistance, and collaboration in assigned tasks to ensure participants do not feel isolated and develop a sense of belonging that satisfies the need for relatedness. Therefore, the participation of individuals in the digital well-being intervention, and the subsequent enhancement of digital literacy and psychological well-being, can be attributed to the responsiveness of participants to psychological needs, supported by Deci and Ryan (2015), who assert that satisfying three basic psychological needs is crucial for psychological well-being and enhances motivation, ultimately leading to improved performance.

In the analysis of correlations between digital literacy and psychological well-being variables, it was found that both variables were moderately correlated. This suggests that digital literacy is associated with the psychological well-being of early adolescents. This could be attributed to the beneficial aspects of digital technology in various aspects of life. However, if adolescents use digital technology without adequate knowledge, it can adversely affect their psychological well-being, leading to negative emotions such as sadness, anxiety, and depression. Consistent with previous studies, excessive use of digital technology has a positive correlation with negative psychological outcomes among adolescents aged 14-18 (Limone & Toto, 2022). The duration of adolescents' usage on social media platforms is positively correlated with feelings of anxiety and depression (Coyne et al., 2020). Online gaming contributes to social detachment and impacts well-being (Liu et al., 2021). Hence, adolescents with high levels of digital literacy are better equipped to manage online risk experiences, avoid, or cope with negative experiences more effectively than those with lower digital literacy levels (Vandoninck et al., 2010; 2013). Individuals with higher digital skills, report higher levels of well-being compared to those with lower digital skills (Vandoninck et al., 2010). Therefore, based on the findings of this study, it can be concluded that digital literacy and psychological well-being are significantly correlated.

Limitations

The limitation of this research study is that the effectiveness of the digital well-being intervention program was tested only among early adolescents in an extra-large secondary school in Chachoengsao province. There was no comparison with other schools, or contexts, such as medium-sized or small schools. Consequently, the results may not be applicable to other adolescent groups in sufficiently diverse contexts. Therefore, applying study findings must be adjusted to fit the specific context. Additionally, although this

study emphasizes the satisfaction of basic psychological needs, there was no post-intervention assessment of the level of satisfaction of basic psychological needs. This lack of data makes it unclear effect of autonomy, competence, and relatedness influence the increased levels of digital literacy and psychological well-being among the participants. Therefore, future studies should include an examination of this aspect to confirm the specific influence of key variables contributing to the achievement of the objectives of the digital well-being intervention.

Implications for Behavioral Science

The findings of this research suggest that the digital well-being intervention appears to be valuable in promoting appropriate and safe digital technology behavior among early adolescents while simultaneously fostering psychological well-being. This intervention can indeed serve as an effective tool for teachers, school psychologists, and other professionals working with adolescents. By integrating digital well-being practices into extracurricular activities and resources to guide adolescents in their digital interactions. However, due to the cross-sectional of this study and the brief follow-up assessed after training, future research should focus on developing interventions that are continuous and examining the long-term outcomes of the intervention, such as the durability of safety and responsibility behavior in digital technology usage and the promotion of mental health in early adolescence. Therefore, future studies should expand the scope by developing interventions suitable for other contexts, such as interventions involving families, and conducting them with parents/guardians. Family involvement in interventions has the potential to significantly enhance the mental health of adolescents (Berger et al., 2024).

Conclusion

This study has developed a digital well-being intervention program, derived from the application of self-determination theory, activity-based learning, self-esteem enhancement, and positive reinforcement. It was found that the digital well-being intervention program can foster literacy in using digital technology and improve the psychological well-being of early adolescents. Additionally, a correlation was found between digital literacy and psychological well-being. Adolescents who have close interactions with digital media during the critical period of physical, emotional, and social development may experience impacts on their mental well-being. Therefore, the development of mental well-being in adolescents should consider issues related to empowering them to use digital technology knowledgeably, which forms the basis for fostering their immediate and future mental health.

Declarations

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Ethical Approval Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board from the Human Research Ethics Committee at the Research and Development Institute Nakhon Ratchasima Rajabhat University (HE-159-2566 and July 17, 2023)

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