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RESEARCH ARTICLE

Profiling Adolescent Literacy Practices: The Impact of Reading Habits and Digital Device Use on Student Achievement

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ABSTRACT

This study explored the impact of digital media and reading habits on student achievement. The analysis of data from the 2013 Korean Education Longitudinal Study, involving 6,525 eighth graders, employed latent profile analysis to categorize students' engagement with digital devices and books. The research aimed to understand the impact of varied literacy practices, encompassing both digital device usage and reading habits, on academic performance. Findings indicate that extensive book reading, as part of a balanced approach to literacy engagement, tends to be associated with higher academic performance when compared to relying solely or primarily on digital devices for accessing information. Furthermore, the findings suggested that utilizing digital devices was significantly linked to lower academic achievement even when utilized for educational and academic purposes. The intricate relationship between digital media use, reading activity, and academic achievement underscores the need for guidance for a balanced literacy engagement that incorporates both traditional book reading and digital modalities for a technologically advanced world.

Key words: Literacy practices, reading habits, digital device use, latent profile analysis, academic achievement.

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Introduction

In the information era, the notion of literacy has transcended its traditional confines, which predominantly emphasized reading and writing abilities. Contemporary literacy encompasses a broader spectrum of proficiencies, extending beyond conventional literacies to encompass digital literacy. Depending on the specific context and purpose, various literacy concepts have emerged, including information literacy, media literacy, and ICT (Information and Communication Technology) literacy. These expanded definitions acknowledge the multifaceted skills needed in today's digital and information-driven landscape. In light of this, this necessity is pronounced for younger generations, who are destined to navigate an increasingly technologically advanced

society.

Considering the expanded definition of literacy, young individuals cultivate their literacy through diverse experiences, including reading books in both traditional paper and digital formats, as well as utilizing digital devices for various purposes. All of these experiences, involving the use and enhancement of literacy, collectively form their literacy practices. Literacy is conceived as an interpretive, experiential, and developmental processes where learners use language for learning (Baquedano-Lopez, 2004; Moje, 2000). Accordingly, literacy practice encompasses a wide range of actions related to reading, writing, and communicating in both print and digital contexts (Greenhow & Gleason, 2012). These practices can be formal or informal, occurring in educational settings, workplaces, communities, and everyday life. Students' experiences rooted in the use of literacy serve as the bedrock for further developing their proficiencies as they engage with a diverse range of information formats, encompassing both traditional books and multimodal media content (Kress, 2003). Hence, understanding how young individuals interact with various media in their daily lives is equally significant as assessing their current literacy levels. From an educational standpoint, comprehending how students engage with both books and digital media serves as a foundation for guiding them towards productive utilization of these resources. This guidance based on evidence aids in the development of the essential literacy skills required for their future roles in society.

This study aims to understand the relationship between digital media use, reading activity, and achievement. Firstly, it aims to delve into the various ways in which students engage with informational resources through latent profile analysis. These information resources encompass both traditional books and contemporary digital devices. Secondly, the study sets out to examine the intricate relationship between the use of digital devices and students' reading activities. In an era characterized by the proliferation of technology, it is imperative to comprehend how these devices may influence or intersect with conventional reading practices. Lastly, the research endeavors to investigate the relationships between students' profiles of engagement with diverse informational sources and their academic achievement. By discerning how students interact with information and its impact on their educational outcomes, this study aspires to contribute valuable insights to the realm of educational research and practice.

Background

Literacy Practices of Adolescents

In the past, the concept of literacy primarily revolved around competencies related to reading and writing, with a particular emphasis on comprehending and producing print-based texts (Baquedano-Lopez, 2004). However, in the current and forthcoming era, characterized by technological advancements, societies demand a broader spectrum of literacy skills. These encompass adeptly navigating technology, critically evaluating information, and proficiently engaging in diverse forms of communication, including multimodal formats (Kress, 2003). The term literacy practice now encompasses a wide array of actions and behaviors in which individuals actively engage to cultivate and apply their literacy skills. With the expanded definition of literacy, the domain of literacy practice has naturally expanded in scope. In addition to the transitions that adolescents experience during this phase, such as puberty, cognitive development, and

educational transitions, young individuals are also confronted with the ever-evolving digital landscape, demanding a range of new and diverse literacies.

Literacy practices, which encompass the diverse ways young individuals employ literacy for various purposes in different contexts, play a pivotal role in the construction of their knowledge and identities, as well as in the representation of those identities (Gee, 1999; Moje, 2000). These literacy practices have evolved into multimodal experiences, encompassing traditional paper books as well as multimedia content, and they occur within both formal and informal contexts. This study examines students' literacy practices by analyzing their reading habits, measured by the number of books read per month, and their use of digital devices for various purposes, gauged by usage time.

Reading and Academic Achievement

Reading practices are vital for students' intellectual growth and learning. Not only do they bolster knowledge acquisition, but they also aid in expanding vocabulary, honing language and writing skills, as well as fostering critical thinking and comprehension (Ardhian et al., 2020; Cain & Oakhill, 2011; Duke & Pearson, 2009; Kaba & Ramaiah, 2020). However, there has been a noted decline in the volume of reading that students undertake, including both recreational and academic reading (Tegmark et al., 2022). Research aimed at evaluating and encouraging reading among adolescents covers a broad spectrum of studies, exploring various aspects such as out-of-school reading, reading habits, recreational reading, and the selection of reading materials by students (Balan et al., 2019; McKool, 2007; Smith, 2009). These studies shed light on the factors that influence students' positive reading habits. For example, Smith (2009) noted that reading behavior among adolescent students is more prevalent among female students and those from student groups with higher levels of parental education.

In the realm of students' reading practices, two significant constructs come into play: motivation for reading and the development of an identity as readers. Motivation for reading is a crucial driver of reading activities (Baker & Wigfield, 1999; Hall, 2012). Baker and Wigfield (1999) identified key dimensions of reading motivation, including recreational reading attitude, attitude toward books, and general reading attitude. Recognizing the importance of these aspects of reading practices is vital for understanding and supporting students' engagement with reading. One significant aspect that student reading influences is academic achievement in school (Bastug, 2014; McKool, 2007; Torppa et al., 2018).

Reading activities and habits wield significant influence over students' academic success and achievements. They enhance various intellectual abilities, including critical thinking, fluency, and comprehension (McKool, 2007). Furthermore, reading practices are closely linked to concept comprehension, critical thinking, and verbal fluency (Balan et al., 2019). Notably, Bastug (2014) reported that students' reading attitude and reading comprehension jointly predict their academic achievement, with reading attitude being a particularly strong predictor. This finding is corroborated by Torppa et al. (2019), who discovered that frequent leisure book reading positively correlates with improved reading comprehension in students from grades 4 to 9. Interestingly, students who progressively increased their reading habits over time demonstrated notable enhancements in their reading skills (Torppa et al., 2019). Cain and Oakhill (2011) highlight the noteworthy presence of the Matthew Effect in the reading practices and comprehension of young readers. This phenomenon suggests that those who engage in reading regularly tend to excel in reading comprehension, which, in

turn, motivates them to read even more. Conversely, young individuals who do not engage in reading as frequently find themselves in a cycle of reduced reading, diminished reading comprehension, and even lower engagement in reading.

Digital Device Usage and Academic Achievement

Young individuals from contemporary and forthcoming generations integrate computer and smart media devices into nearly every facet of their daily lives (OECD, 2021). They connect with peers using digital tools, participate in school learning activities via these devices, manage daily tasks through the internet, and access information through the vast digital landscape. This seamless incorporation of technology is reshaping how they interact, learn, and navigate the world around them, highlighting the pervasive role of digital devices in their personal and educational spheres. Consequently, the use of digital devices has become a crucial aspect of literacy practices, where individuals both utilize and enhance their reading and writing skills. Moreover, digital literacy is now recognized as an essential skill for participation in modern society.

Digital literacy equips students with the skills to effectively navigate, understand, and utilize the wealth of information available online. This proficiency empowers students to critically evaluate and discern reliable sources from misinformation, fostering informed decision-making and creative problem-solving skills. Digital literacy also enhances their ability to communicate and collaborate in a globally connected world, preparing them for a future workforce that increasingly relies on digital technologies. This skillset potentially enhances academic performance both directly and indirectly, but also lays the foundation for lifelong learning and active participation in a digitally driven society. However, this occurs when individuals utilize computers and smart media devices in beneficial ways and possess the abilities to do so effectively. This study investigates the present landscape of young individuals' use of computers and smart media devices and examines the correlation between utilization of computers and smart media devices and academic achievement, laying the groundwork for understanding its impact on education.

Investigations into computer and smart media device use and educational results indicate that the digital divide is no longer just about access to technology; rather, it arises from the manner in which students integrate their computers and smart media devices into daily activities. For instance, studies such as Vigdor et al. (2014) have shown that although U.S. students have access to computers and high-speed internet, this has coincided with declines in reading and mathematics outcomes. Similarly, the availability and usage of digital devices were not associated with improvements in reading achievement (Xiao et al., 2019). This lack of a positive correlation is echoed in the context of smartphone usage-often the most commonly owned digital device among students-where excessive use has been tied to diminished academic performance (Samaha & Hawi, 2016).

Conversely, the use of computers and smart media devices for educational purposes, like online homework systems, has been associated with improved academic results (Fratto et al., 2016). Vigdor et al. (2014) cautioned that widespread access to computers and smart media devices could potentially widen, rather than close, achievement gaps among young students. Furthermore, the link between digital device usage and academic achievement appears to differ across various national contexts (Youssef et al., 2022). Considering that academic success is a pivotal determinant of students' life satisfaction (Samaha & Hawi, 2016), the significance of exploring the relationship between digital device use and achievement extends well beyond the academic sphere. Thus, students' usage of computers and smart media is not a

straightforward matter. It should not be framed merely as a question of access versus non-access, nor solely in terms of time spent using computers and smart media devices, particularly in relation to their academic achievement. To address the issue of digital device usage and reading activities as part of current students' literacy practices, we conducted a latent profile analysis. This analysis helped identify unobserved subgroups based on students' literacy practices and to comprehend the intricate relationship between these literacy practices and academic achievement.

Research questions of this study are as follows:

1) What are the distinct profiles of students' literacy practices, and what characteristics define these profiles?

2) Does students' academic achievement in mathematics, Korean, and English differ by their literacy practice profiles?

Methods

Participants

For this study, we analyzed the data from the 2013 Korean Education Longitudinal Study (KELS 2013), a large research project conducted by the Korean Educational Development Institute (KEDI). A total of 7,324 fifth graders in 2013 initially agreed to participate (see fig. 1) when KELS began in 2013. The original data collection employed a stratified cluster random sampling method to ensure a representative sample. As the study progressed to its fourth year, 6,677 of the original participants, eighth graders in 2016, continued their participation. It should be noted that some students' records in the dataset contained invalid or missing values in one of the scales under investigation. To maintain the integrity of the study's analyses, these records were omitted, resulting in a final analytical sample of 6,525 students.

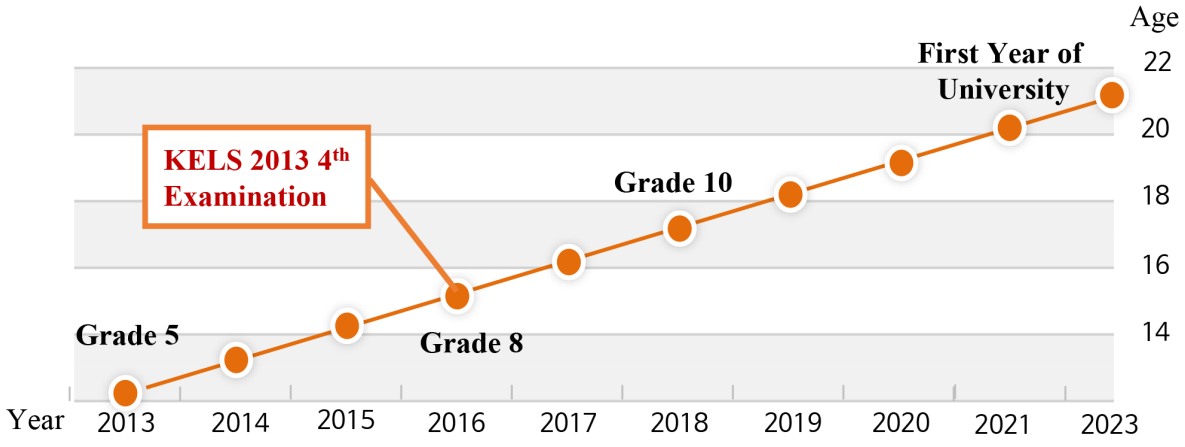


Fig. 1. Research design of KELS 2013

Selected Variables

To examine students' profiles for literacy practices - computer and smart media usage alongside reading amount - we collected the variables described in Table 1. The unique characteristic of this study's variables, especially those related to computer and smart media usage, is their irregular intervals. Rather than utilizing uniformly spaced categories, the intervals are varied, as evident from options such as "30 minutes to less than 1 hour" and "1 hour to less than 2 hours." Notably, the reasoning behind this particular design isn't elucidated in KELS 2013. Despite of the irregular nature of these intervals, there is a compelling argument to treat these variables as continuous. We acknowledge that this approach might muddle the interpretation, potentially masking key insights. However, by classifying all variables as continuous, we accommodate a broader spectrum of analytical techniques. Specifically, we employ latent profile analysis in this study, which adeptly captures trends, subtleties, and overarching patterns, ensuring findings are both exhaustive and readily comprehensible.

Table 1. Selected variables from the KELS 2013 study

Variable Name	Descriptions	Values
L2Y4S3601	Question 36. Computer/Smart Media Usage-1) Study and Homework	(Per day) 0. Not at all 1. Less than 30 minutes 2. 30 minutes to less than 1 hour 3. 1 hour to less than 2 hours 4. 2 hours to less than 3 hours 5. 3 hours to less than 5 hours 6. 5 hours to less than 8 hours 7. 8 hours or more
L2Y4S3602	Question 36. Computer/Smart Media Usage-2) Information search and resource use other than learning	
L2Y4S3603	Question 36. Computer/Smart Media Usage-3) Texting, Chatting, Messenger, Email, Calls	
L2Y4S3604	Question 36. Computer/Smart Media Usage-4) Games and Entertainment	
L2Y4S3605	Question 36. Computer/Smart Media Usage-5) Clubs, Community Activities	
L2Y4S29	Question 29. Reading Activities-Reading Amount	(Per month) 0. Did not read; 1. 1 Book; 2. 2 Books; 3. 3 Books; 4. 4 Books; 5. 5 Books; 6. 6 Books; 7. 7 Books; 8. 8 Books; 9. 9 Books; 10. 10 Books or more

To determine whether academic achievement varies based on students' patterns of computer and smart media usage, as well as reading quantity, we also gathered variables that represent the vertical-scale achievement across three subjects: mathematics (L2Y4_M_THETA), Korean (L2Y4_K_THETA), and English (L2Y4_E_THETA).

Data Analysis

We applied latent profile analysis (LPA) to the data described above. LPA stands as one of the latent variable models for means, which includes observed continuous variables and discrete latent variables, often referred to as profile membership. LPA investigates qualitatively different groups of students, i.e., latent groups, based on the means of observed continuous variables. By making assumptions about what the hidden groups might look like, we can delve into distributions within these groups, thus obtaining the probability that each individual belongs to a specific group. This is particularly beneficial when faced with numerous variables that are challenging to handle and interpret, as it allows for a reduction into a few easily interpretable groups (Oberski, 2016).

LPA, called a person-centered approach, inherently carry an exploratory nature. Thus, the number of profiles were not predetermined; instead, we should determine the number of profile groups based on empirical evidence derived from model comparisons. In model comparison, we comprehensively evaluated various model fit indices, including

the Akaike Information Criterion (AIC; Akaike, 1987), the Bayesian Information Criterion (BIC; Schwarz, 1978), the sample-size adjusted BIC (SSBIC; Sclove, 1987), and entropy (Celeux & Soromenho, 1996). In terms of AIC, BIC, and SSBIC, a smaller value indicates superior model fit. As for entropy, values closer to 1 signify high certainty, whereas those near 0 indicate lower certainty.

In addition, we sought to compare models estimated to have 'k' profiles with those having 'k-1' profiles. To do this, we employed several hypothesis tests including the Vuong-Lo-Mendell-Rubin likelihood ratio tests (VLMR), the Lo-Mendell-Rubin likelihood ratio test (LMR; Lo et al., 2001), and the parametric bootstrapped likelihood ratio test (PBLR; McLachlan, 1987). Based on the test results, if the probability of significance was less than the alpha level of 0.05, we concluded that the estimated model with 'k' profiles was the more fitting one.

We also verified the number of profile groups constituted by fewer than 5% of the research participants, referencing the study by Marsh et al. (2009). The consideration of the group sizes is pivotal because groups constituted by less than 5% of the participants might be considered practically negligible, particularly with a large sample size. We ensured that models including profile groups with less than 5% (which translates to 326 individuals) were incorporated only when other indicators, such as LMR and PBLR, simultaneously seemed to fit the model.

After determining the optimal model, we visually represented the profiles using a line graph and provided detailed information for each profile. To scrutinize the impact of computer and smart media usage in conjunction with reading amount on academic achievement, we employed ANOVA and Tukey's HSD (honestly significant difference) test as post hoc with the computer program R version 4.1.3. This was performed to determine whether there are notable achievement differences in subjects such as mathematics, English, and Korean based on different profile groups. We employed what is known as the 1-step method. This method has recognized limitations, such as the potential for the secondary model to influence the formation of latent classes, as noted by Vermunt (2010).

To counter these issues, alternative methods, including the 3-step approaches suggested by Bakk et al. (2013) and Lanza's (2013) method employing Bayes theorem, have been developed. These methods can independently evaluate the relationship between the latent class variable and the predictors or distal auxiliary variables. While the 3-step approaches are advised when the inclusion of auxiliary variables significantly changes the latent classification, this was not applicable to our study. Asparouhov and Muthén (2014) also demonstrated that when auxiliary variables function as dependent variables, as with distal outcomes, both the 1-step and 3-step methods can fail due to changes in the formation of latent classes. In our study, where academic achievement serves as dependent variables, the 3-step would not be a viable alternative if the 1-step method proved problematic. Consequently, despite these risks, we opted not to use the less efficient 3-step approach, following Asparouhov and Muthén's (2014) guidance that "in principle, the 1-step approach can be used in practical applications." Consequently, we proceeded with the 1-step method.

Results

Descriptive Statistics

Table 2 presents the descriptive statistics of the observed variables. The data shows that, in academic performance, Mathematics records an average score of 231.97, accompanied by a standard deviation of 50.92. Korean's average score

is slightly lower at 230.48, with a standard deviation of 46.23. English, however, has the highest mean score at 250.50, with a standard deviation of 51.42. Furthermore, it's evident that most students typically use computers and smart media for clubs or community activities (L2Y4S3605) for less than 1 hour. The majority of students also engage with computers and smart media for activities like texting, chatting, messenger services, emails, and calls (L2Y4S3603) for about 1 to 2 hours. Moreover, it is interesting that the average number of books students read a month (L2Y4S3605) is 3.10.

Table 2. Descriptive statistics

Variable		Mean	SD
Academic Achievement	Mathematics	231.97	50.92
	English	230.48	46.23
	Korean	250.5	51.42
L2Y4S3601	Computer/Smart Media Usage-1) Study and Homework	1.75	1.26
L2Y4S3602	Computer/Smart Media Usage-2) Information search and resource use other than learning	2.1	1.4
L2Y4S3603	Computer/Smart Media Usage-3) Texting, Chatting, Messenger, Email, Calls	2.82	1.65
L2Y4S3604	Computer/Smart Media Usage-4) Games and Entertainment	2.23	1.73
L2Y4S3605	Computer/Smart Media Usage-5) Clubs, Cafes, Community Activities	0.84	1.36
L2Y4S29	Reading Activities-Reading Amount	3.1	2.88

Table 3. Model fit indices and hypothesis test results

Number of Profiles	Number of Parameters	AIC	BIC	SSBIC	Entropy	pVLMR	pLMR	pPBLR	<5%
2	19	145681.3	145810.2	145749.8	0.94	<0.01	<0.01	<0.01	0
3	26	143713.4	143889.8	143807.2	0.97	<0.01	<0.01	<0.01	0
4	33	142517.5	142741.3	142636.5	0.93	0.01	0.01	<0.01	0
5	40	141514.6	141785.9	141658.8	0.96	<0.01	<0.01	<0.01	2
6	47	140707.9	141026.8	140877.4	0.96	0.51	0.51	<0.01	3
7	54	140141.6	140507.9	140336.3	0.86	<0.01	<0.01	<0.01	3

Note. SSBIC= sample-Size adjusted BIC; pVLMR = p-values of Vuong-Lo-Mendell-Rubin likelihood ratio tests; pLMR = p-values of Lo-Mendell-Rubin adjusted LRT tests; pPBLR = parametric bootstrapped likelihood ratio test; < 5% = the number of profile groups including less than 5% of the sample.

Number of Profiles

Table 3 presents a detailed overview of the model fit indices and the hypothesis tests employed to ascertain the optimal number of profiles. It is evident from the table that as the number of profiles increased, the values of AIC, BIC, and SSBIC showed a decreasing trend. This pattern suggests that the model's fit improves as the model has a larger number of profiles, which is somewhat expected with a large sample (Marsh et al., 2009). However, it's important to delve deeper into the hypothesis tests. Notably, the results from both the VLMR and the LMR reveal that the distinction between the models with 6-profiles and 5-profiles is not statistically significant, with a p-value of 0.51. Additionally, it's worth highlighting that models encompassing more than 4 profiles include profile groups comprising less than 5% of the total participants. Despite their smaller size, these profile groups can be practically meaningful to distinguish the

groups when considering the usage of computers and smart media for club and community-related activities. When we comprehensively assess all these metrics and critically interpret the hypothesis test outcomes, it is evident that the model with five profiles emerges as the most suitable choice.

Descriptions of Profiles

Figure 2 describes each profile group with the number of students and their averages of the variables for computers and smart media use. It was assumed that the variance for each variable was consistent across the groups, with specific estimated values given as follows: L2Y4S3601 = 1.52, L2Y4S3602 = 1.83, L2Y4S3603 = 2.51, L2Y4S3604 = 2.91, L2Y4S3605 = 0.19, and L2Y4S29 = 4.36. The figure 1 underscores the diverse usage patterns among the student groups: Profile 1 and 5 students are more engaged in community-related activities, Profile 2 leans towards minimal usage, Profile 3 shows balanced engagement, and Profile 4 students are enthusiastic readers. This diversity reflects the multifaceted ways in which students engage in literacy practices, including use of digital devices and reading. As Henson and Roberts (2006) recommended, we do not label each profile respecting the fact that the profiles are latent.

Profile 1 (325 students, 5.0% of total)

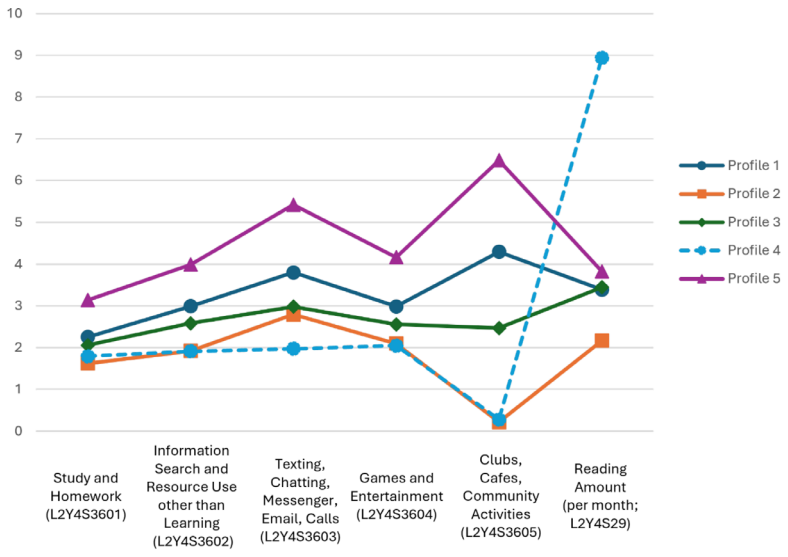
Students in this profile exhibit moderate engagement across most computer and smart media usage categories. Their values remain around the middle range for activities like studying and doing homework, information search, texting and chatting, and games and entertainment. Interestingly, they have a higher inclination towards using computer/smart media for clubs, cafes, and community activities. In terms of reading activities, their score is average. Students of this profile read 3.39 books per month on average.

Profile 2 (4,532 students, 68.6% of total)

Representing the majority of the students, this profile demonstrates lower engagement across nearly all categories of literacy practice. The most noticeable low engagement is in the use of computers and smart media for clubs, cafes, and community activities. Their reading activity amount is also relatively low, which aligns with their general trend of limited interaction with the mentioned tools and platforms. On average, students with this profile engage with 2.16 books each month, representing the least amount of reading across the five profiles.

Profile 3 (1,017 students, 15.5% of total)

These students maintain a balanced interaction across all the categories. They show uniform engagement without any extreme highs or lows. This suggests a consistent and regular pattern of using computer and smart media for a variety of purposes, from studying to entertainment. Students within this profile have an average monthly reading of 3.44 books.



	L2Y4S3601	L2Y4S3602	L2Y4S3603	L2Y4S3604	L2Y4S3605	L2Y4S29	Number of Students
	Study and Homework	Information search and resource use other than learning	Texting, Chatting, Messenger, Email, Calls	Games and Entertainment	Clubs, Cafes, Community Activities	Reading Amount (per month)	
Profile 1	2.25	2.99	3.80	2.99	4.29	3.39	325 (5.0%)
Profile 2	1.62	1.92	2.79	2.10	0.22	2.16	4532 (68.6%)
Profile 3	2.06	2.58	2.98	2.55	2.47	3.44	1017 (15.5%)
Profile 4	1.79	1.91	1.97	2.05	0.28	8.93	581 (9.7%)
Profile 5	3.14	3.99	5.42	4.16	6.49	3.82	70 (1.1%)

Fig. 2. Five profiles on computer, smart media usage and reading amount

Profile 4 (581 students, 9.7% of total)

Students in this profile are notable for their significant participation in reading activities. Remarkably, these students read an average of 8.93 books per month, especially when considering that students from all other profiles reported reading fewer than 4 books per month. In contrast to their reading amount, their engagement in other categories, especially clubs, cafes, and community activities, is quite low. This might indicate the group characteristic that prioritizes reading over other forms of digital interaction.

Profile 5 (70 students, 1.1% of total)

Although the smallest group, students in Profile 5 show the highest engagement across most categories of digital device use, especially in studying and homework, texting and chatting, and using computer/smart media for clubs, cafes, and community activities. Their active use of computers and digital devices suggests a heavy reliance or keen interest in using digital platforms for both academic and leisure activities. Students in this group reported an average monthly reading of approximately 3.82 books.

Academic Achievement of Each Profile

Tables 3, 4, 5, and Figure 3 show the academic achievement scores across the five distinct profile groups in three subjects: Mathematics, Korean, and English. There are evident variations in average scores between the profile groups for each subject. Across all three subjects, Profile 4 students showed the highest average score, while Profile 5 students had the lowest. The average gap between Profile 4 and 5 groups were widest in English. Despite these observed disparities, the provided ANOVA results (F-statistic and corresponding p-values) indicate that the differences in scores among the profile groups are statistically significant for any of the three subjects at the alpha level of 0.05. This suggests that academic achievement in mathematics, Korean, and English are different among the profile groups.

Table 4. Achievement scores in English by profile group with ANOVA and Tukey's HSD results

	Profile 5	Profile 1	Profile 3	Profile 2	Profile 4	F (df)
Mean	231.87	242.97	243.99	251.41	261.22	10.27***
(SD)	(52.50)	(51.85)	(52.16)	(50.97)	(50.64)	(4,6520)
Tukey's HSD Test Results (Column - Row)						
Profile 5		11.09	12.12	19.54**	29.35***	
Profile 1			1.02	8.44**	18.25***	
Profile 3				7.42***	17.23***	
Profile 2					9.81***	

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 5. Achievement scores in Korean by profile group with ANOVA and Tukey's HSD results

	Profile 5	Profile 1	Profile 3	Profile 2	Profile 4	F (df)
Mean	216.99	225.17	225.79	231.04	238.94	14.91***
(SD)	(45.77)	(50.09)	(46.19)	(45.51)	(48.02)	(4,6520)
Tukey's HSD Test Results (Column - Row)						
Profile 5		8.18	8.80	14.05*	21.96***	
Profile 1			0.62	5.57	13.78***	
Profile 3				5.25**	13.16***	
Profile 2					7.9***	

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 6. Achievement scores in mathematics by profile group with ANOVA and Tukey's HSD results

	Profile 5	Profile 1	Profile 3	Profile 2	Profile 4	F (df)
Mean	213.31	220.25	225.08	233.40	241.63	17.59***
(SD)	(36.52)	(49.76)	(50.54)	(50.79)	(50.77)	(4,6520)
Tukey's HSD Test Results (Column - Row)						
Profile 5		6.94	11.77	20.09***	28.31***	
Profile 1			4.83	13.15***	21.37***	
Profile 3				8.32***	16.54***	
Profile 2					8.22***	

* p < 0.1, ** p < 0.05, *** p < 0.01

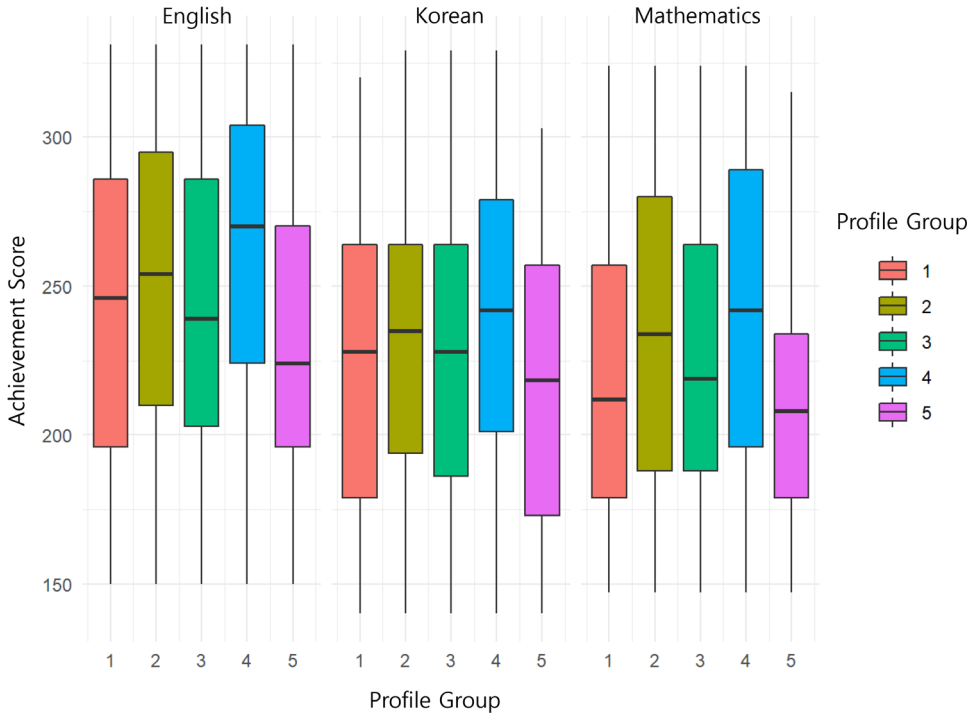


Fig. 3. Box plots of academic achievement by profile group

The findings from the Tukey's HSD post hoc tests are detailed in Tables 3, 4, and 5. Notably, the average achievement scores of students in Profile 4 - enthusiastic readers - are significantly higher than those in all other profile groups across mathematics, Korean, and English. Profile 2, characterized by lower engagement with digital devices, shows significantly higher achievement than Profiles 1, 3, and 5 in English and Mathematics. However, Table 4 indicates that the differences of scores in Korean between Profiles 2 and 1 are not significant, contrary to what was observed in mathematics and English. Additionally, the analysis provides no substantial evidence of differences in academic achievement between the groups in Profiles 1, 3, and 5.

Discussion and Conclusion

The purpose of this study was to generate students' profiles on literacy practices, using computer and smart media usage and reading amount, and to examine the relationship between the profiles and their academic achievement. As technology increasingly integrates into our daily routines and educational systems, students' methods of learning are expanding to include not just reading books but also utilizing technological devices. Therefore, comprehending how these literacy practices-spanning from traditional reading to the utilization of technology-affect and contribute to academic success is essential for creating effective educational guidance to ensure digital device usage supports academic achievement. This study focused on the impact of students' daily literacy practices, including digital device utilization and reading habits, on their academic performance. To achieve this, we conducted latent profile analyses using a range of data capturing literacy practices, including computer and smart media use for various purposes and reading

amount, and linked these with academic results in key subjects, Korean, Mathematics, and English.

Initially, we analyzed each profile to gain insights into students' daily engagement with literacy activities. Within the five distinct profiles identified from the data, Profile 4, comprising 9.7% of the participants, stands out due to its students' significant inclination towards reading. Compared to their peers in other profile groups, students in Profile 4 spend a lot more time reading and significantly less time using digital devices, participating the least in various digital activities, such as searching for information, utilizing digital resources, communicating via text and chat, and entertaining themselves with games. Furthermore, through visual examination and ANOVA results, students within Profile 4 showed the highest academic achievement, and the differences in academic achievement were statistically significant. These findings may imply that extensive book reading tends to align with minimal use of digital devices for diverse technological activities, and this pattern of literacy engagement may be associated with higher academic achievement. These findings align with previous studies that have argued for the positive impact of reading activities on academic achievement (McKool, 2007; Torppa et al., 2019).

Another key finding from this study is that the student group that most frequently used digital devices for study and homework purposes exhibited the lowest achievement across all three subjects. Students classified within Profile 5 exhibited the most extensive use of digital devices across all categories, including academic and homework purposes, yet they demonstrated the lowest levels of achievement. In the same vein, students in Profiles 2 and 4 with minimal usage of digital devices showed the higher academic achievement in all three subjects, Korean, Mathematics, and English than the other profiles groups. While the average scores of the Profile 5 group showed statistical differences only from those of Profiles 2 and 4, the mathematics achievement scores for Profile 5 were noticeably lower than those of other groups, as visually depicted in Figure 3. The observed negative relationship between the use of digital devices and academic achievement is also consistent with previous research, including studies by Samaha and Hawi (2016) and Xiao et al. (2019). However, it is important to note that there are also studies suggesting a positive impact on achievement when technology is used for specific academic purposes, such as in the case of online homework systems (Fratto et al., 2016). To ensure that literacy practices involving digital devices effectively enhance student learning, simply having access to digital devices and the internet is not enough. A deeper investigation is needed to understand why frequent use of digital devices for academic purposes, as observed in profile 5, does not correlate with higher academic achievement.

In examining the use of digital devices, it was noted that students in Profile 5 primarily engaged in online community and club activities, despite representing a minor segment of the study at 1.1%. This use of computers and smart media for such virtual interactions in online communities was key in distinguishing these profiles. Unlike social interactions through texting, emails, and calls with people they know in real life, these students were often communicating within online spaces with anonymous users. Analysis revealed that students engaging heavily in online clubs and communities also showed the broadest use of digital devices for various purposes, coupled with the lowest academic performance compared to the other profile groups. Further research is required to determine if engaging in online communication with unknown individuals directly affects students' learning adversely, or if other factors, such as the amount of time dedicated to such online interactions, play a mediating role in the observed relationship between participation in online communities and clubs and educational outcomes.

When we examined the academic performance data across the profiles, we discovered a distinct pattern within the subject of mathematics. The differences in mathematics scores were visually more pronounced across the groups than in Korean and English. This suggests that the unique nature of mathematics, with its skill-based and conceptual challenges, might be more deeply affected by the varied ways in which students interact with technology and reading materials. This particular insight calls for further investigation, as it implies that mathematics learning could be more susceptible to the influences of the diverse behavioral profiles we've identified in our research.

This study sought to explore and understand students' literacy practices in the context of an increasingly digital world and how these practices relate to academic achievement. Profile analysis revealed distinct groups of students with Profile 4 standing out due to a marked preference for reading over digital device use, which correlated with higher academic performance. We discovered that students tend to use digital devices more for non-academic purposes than for studying. Further, traditional book reading is more closely associated with academic success than using digital devices for academic work. Overall, this study suggests a potential negative relationship between extensive digital device use and academic success, particularly highlighted by Profile 5 students who used technology heavily but had the lowest academic results.

The findings underscore the importance of not only providing access to digital tools but also equipping students with the skills to use them effectively for learning. Additionally, our data pointed to mathematics as a subject area where the interplay between digital device use and academic achievement might be particularly complex, inviting further investigation. This study contributes to a nuanced understanding of the relationship between students' daily literacy practices and academic outcomes, which is crucial for shaping future educational strategies.

Conflicts of Interest

The authors declared no conflicts of interest.

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