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Understanding students' digital literacies profiles across gender, socio-economic status, and education level

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Abstract

As technology becomes an integral part of students' lives in today's digital age, it has become increasingly important to develop an understanding of their digital literacies, encompassing not only their competencies but also beliefs and preferences towards the use of technology. In this paper, we report the findings from a research project that investigate the digital literacies of Primary 5 and Secondary 3 students in Singapore using the Student Digital Literacies Profiling (SDLP) Tool, which we developed. Informed by the Common Framework of Reference for Intercultural Digital Literacies (CFRIDiL). The SDLP Tool offers a novel approach by assessing four dimensions of digital literacies: multimodal orchestration, digital technologies, intercultural communication, and transversal skills, while also integrating students' beliefs and preferences to provide a more holistic understanding. The study explores potential differences in digital literacies based on gender and socio-economic status (SES) in Singapore. Findings from 513 students indicate that students had most positive ratings in multimodal orchestration, with girls indicating more positive ratings than boys, while intercultural communication received the lowest ratings. Socio-economic status impacted girls more negatively than boys in multimodal orchestration and digital technologies, and Primary 5 students rated themselves higher in both multimodal orchestration and digital technologies than Secondary 3 students. We conclude with recommendations to address gaps in intercultural communication, support digital learning, and provide equitable digital access for lower-SES students.

Keywords: digital literacy, technology, socio-economic status, multimodality, intercultural communication

Introduction

Just as students today are engaged in digital communication outside of school, teachers are also increasingly using an array of digital technologies in their design of students' learning



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experiences. The need for students to develop digital literacies is becoming ever more critical in today's digital age where technology is an integral part of our lives. Digital literacies include having competencies that encompass both specific knowledge and skills, as well as the beliefs and preferences that shape how individuals engage with digital environments. These competencies involve meaning making with digital tools and in digital texts in contextually appropriate ways that reflect their ideas, experiences, and identities (Lim & Yee, in press). We adopt the plural form "literacies," acknowledging the diverse and multifaceted nature of multiliteracies (New London Group, 1996). Digital literacies, therefore, involve the ability to view and represent meaning across different semiotic modes, while also fostering a critical awareness of multimodal communication across varied contexts in consideration of specific conventions, values, and norms. The semiotic choices made by students in their multimodal communication reflect not only their ideas and experiences but also their identities. Thus, digital literacies encompass the expression and construction of individual identities as part of the meaning-making process, aligning with Martin's (2008) concept of using literacy to "secure and support one's own identity."

While the term "digital literacies" has tended to centre on technical competencies related to retrieving information from the internet and using digital tools (e.g., Gilster, 1997), broadened definition of digital literacies goes beyond the use of digital technologies to also include digital multimodal communication – that is, how we make and negotiate meanings in socially appropriate ways by combining various semiotic modes (Knobel & Lankshear, 2008). As technology evolves, so too does our usage, influencing "who we can be and the kinds of relationships we can have with others" (Jones & Hafner, 2021). Beyond technical competencies, digital literacies are expressions of our online identities, influencing how we behave, interact, and express our beliefs and preferences. As such, being digitally literate now involves not just the ability to use digital technologies, but also an understanding of how to orchestrate across different semiotic modes afforded by the digital medium to achieve specific communication goals (Lim & Toh, 2021; Sindoni et al., 2019).

Given that technology also facilitates connections across geographical and cultural boundaries, digital literacies also demands the recognition of socio-cultural diversity and possessing social competencies such as emotional regulation, teamwork, respect for differences, and adaptability to unforeseen circumstances. Research has underscored the importance of interpersonal and relational skills in fostering digital collaborations, maintaining digital well-being, and resolving conflicts that may arise in online environments (Fortes et al., 2021; Priyadarshini, 2022; Winardi et al., 2022). Effective online communication and the capacity to engage with diverse cultures, demonstrating intercultural sensitivity are also dimensions of digital literacies.

In addition, to communicate effectively in our digitally interconnected world—where interpersonal connections are both inevitable and essential—personal and relational skills are critical (Blakemore & Agllias, 2020). These so-called “soft” skills, including empathy, adaptability, resilience, decision-making, emotional intelligence, time management, stress management, and teamwork, are increasingly important for navigating interactions in online spaces. As such, these transversal skills should also be considered as a dimension of digital literacies.

The term “digital natives,” coined by Marc Prensky (2001), refers to millennial learners who have grown up surrounded by emerging technologies, such as computers, smartphones, and video games. These individuals connect with family and friends through social networking, text messaging, and other technology-mediated forms of communication (Prensky, 2001). However, despite their familiarity with digital tools, research shows that digital natives do not necessarily excel in all digital skills, such as producing and interpreting digital texts (Brumberger, 2011). Furthermore, digital natives do not share a uniform level of digital literacies; their experiences vary significantly due to differences in access and opportunities, influenced by factors like socioeconomic status (SES) and family background (Brown & Czerniewicz, 2010; Hatlevik & Christophersen, 2013; Selwyn, 2009). Therefore, developing a deeper understanding of their digital literacies, as well as contributing factors is crucial.

One key factor influencing students’ digital literacies profile is gender (Gui & Argentin, 2011; Nasah et al., 2010). Research has shown that gender was a significant factor in explaining differences in the theoretical knowledge dimension of digital literacy skills, but it was not relevant in differentiating digital literacy skill levels in the operational and evaluational dimensions. This meant that females were usually as skilled as males in routine activities online, but they might experience more problems when facing technical problems or unexpected outcomes. This finding suggested that the school curriculum should consider gendered differences in digital literacies training for students. In a multinational project on what youths are doing with media, Scolari (2018) found that digital literacies are gender biased in that girls use media that focus on relational aspects, while boys tend to focus on playful aspects. The possible influence of gender on the students’ digital literacies profile has motivated our research question to examine if this was indeed the case amongst Singapore students.

In addition to gender, socioeconomic status (SES) is another critical factor influencing students’ digital literacies. The pervasive use of digital technologies in all aspects of our lives has exacerbated the digital divide between the rich and the poor (Chew & Soon, 2021). Apart from issues with access to digital devices and software, the digital divide is also manifested in the differences in digital literacies amongst youths. Students from higher SES backgrounds tend to engage in online activities that are productive and involves

communication and creation of texts, while individuals from lower SES backgrounds often participate in more passive consumption activities, such as online shopping and entertainment (Robinson et al., 2020). The influence of SES on students' digital literacies profile had been reported in the last two decades (Gui & Argentin, 2011, Nasah et al., 2010; Scherer & Siddiq, 2019). International studies have concluded that the SES of students matter when it comes to their digital literacies (Gladkova, et al., 2020), thus also motivating our research question to examine if this was an issue amongst Singapore students. It is essential to understand the differences in students' digital literacies profile across SES to enable targeted interventions to meet the specific needs of diverse populations. This effort can help mitigate the risk of leaving certain communities behind, fostering equitable access to the opportunities in the digital age.

In this paper, we report on the Singapore Student Digital Literacies Profile project (OER11/22VLF), to uncover students' digital literacies profiles in terms of their competencies, beliefs, and preferences through our development of a questionnaire tool <https://digitalliteraciesprofile.com>. Our study also seeks to offer insights on the digital literacies profiles of Primary 5 and Secondary 3 students in Singapore in relation to the possible influence of gender and SES. The research questions are:

1. What are the digital literacies profiles of secondary 3 (15-year-old) students and primary 5 (11-year-old) students in Singapore?
 - a) How do students' ratings differ across the four dimensions of digital literacies (Multimodal Orchestration, Digital Technologies, Intercultural Communication, Transversal Skills)?
2. To what extent do gender, socioeconomic status (SES) and education level influence ratings on each digital literacy dimension?
 - a) How are digital literacies profiles different in terms of gender?
 - b) How are digital literacies profiles different in terms of student family's SES?
 - c) How are digital literacies profiles different in terms of education level?

Common framework of reference for intercultural digital literacies

There are several frameworks for the assessment of digital literacies around the world. Of note, is the European Commission's Digital Competence Framework 2.1 (DigComp 2.1) and UNESCO's Digital Literacy Global Framework. The DigComp 2.1 framework is primarily technical, emphasising skills in information and data literacy, communication, collaboration, digital content creation, safety, and problem-solving. The Digital Literacy Global Framework expands on this by including two additional areas: a) operations involving devices and software, and b) career-related competencies. This latter aspect

focuses on the abilities to identify and use hardware and software tools, as well as to possess the digital competencies required for specific occupations, enabling individuals to operate specialized technologies and analyse relevant data.

Building on DigComp 2.1 and the UNESCO Digital Literacy Global Framework to include multimodal communication and intercultural communication in digital spaces, Sindoni and colleagues (2019) developed the Common Framework of Reference for Intercultural Digital Literacies (CFRIDiL). The CFRIDiL encompasses four broad dimensions: Multimodal Orchestration, Digital Technologies, Intercultural Communication, and Transversal Skills. As part of the EU-MADE4LL project, data was gathered from 214 students through teaching and learning activities across five university classes, during which they produced digital artifacts and multimodal content such as blogs, websites, and fanvids. Through the analysis of this data and student observations, general descriptors for each of the four dimensions were formulated.

Multimodal Orchestration is the combination of resources for making meaning in digital texts and online interactions (such as speech, writing, still and moving images, music and sounds, layout etc.), which answers the question: “how do I make meanings in digital environments?”. Digital environments are inherently multimodal, where communication extends beyond language to incorporate a broad range of auditory and visual elements, such as text, sound clips, images, videos, typography, and colour. Effectively navigating this dynamic landscape and leveraging the potential of digital technologies requires multimodal orchestration – the ability to comprehend, interpret, and create content across diverse communication modes. Digital literacy goes beyond the mere use of tools, devices, and software; it involves understanding how different media interact and integrating them cohesively to achieve specific communication objectives (Lim & Tan-Chia, 2023; Lim & Toh, 2020; Sindoni et al., 2019).

Digital Technologies refer to the use of digital tools and understanding of their affordances, which answers the question: “how do I use the tools of digital environments?”. The dimension of Digital Technologies encompasses the traditional understanding of digital literacies, which includes the ability to use digital devices like smartphones and computers, navigate online platforms and applications, and access and evaluate information found on the internet.

Intercultural Communication is the awareness of socio-culturally diverse contexts and needs as well as community-specific practices which answers the question: “how do I make meanings with others in digital environments?”. Intercultural communication has become a crucial dimension of digital literacies in today’s transnational technological landscape, which fosters connectivity across geographical and cultural boundaries. Being digitally literate now extends beyond effective online communication; it also entails engaging with diverse cultures and countries while demonstrating intercultural sensitivity. This includes

recognizing the diversity of socio-cultural contexts and developing essential social competencies such as emotional regulation, teamwork, respect for differences, and adaptability to unforeseen circumstances. Research underscores the importance of interpersonal and relational skills in facilitating virtual collaboration, maintaining digital well-being, and resolving conflicts that may arise on online platforms (Fortes et al., 2021; Priyadarshini, 2022; Winardi et al., 2022). Given its significance, intercultural communication must be integrated into the framework of digital literacies in the 21st century.

Transversal Skills is the use, management and awareness of “soft” skills, including personal and relational skills such as emotional intelligence, stress management and team building, which respond to the question “which personal and relational skills can help me facilitate communication?”. Effective communication in our digitally connected world hinges on essential personal and relational skills, often referred to as “soft” skills or 21st Century Competencies. These skills include empathy, adaptability, resilience, decision-making, emotional intelligence, time management, stress management, and teamwork. As interactions in online spaces become more prevalent, transversal skills have gained increasing importance. Social interdependence theory suggests that these skills are crucial for accurate communication and constructive management of intragroup conflict, thereby fostering effective collaboration (Johnson & Johnson, 2009). Research indicates that individuals equipped with these competencies are better positioned to build meaningful relationships and navigate interpersonal dynamics within the complex landscape of online collaboration (Lindsey & Rice, 2015). Developing such skills not only benefits individuals but also contributes to creating positive and constructive online environments.

Methods

Survey instrument: Student digital literacies profiling tool

A survey instrument, the Student Digital Literacy Profiling (SDLP) tool (Yee et al., 2025), was administered to student participants in Singapore. The development of the tool was informed by the Common Framework of Reference for Intercultural Digital Literacies (CFRIDiL; Sindoni et al., 2019), which consists of macro-categories, general descriptors and scenario examples for the four dimensions described in the previous section. While the CFRIDiL provides a valuable conceptual and descriptive framework, it was not designed as a questionnaire and its descriptors – derived from university-level data, were abstract and less relatable to other platforms of learners. The SDLP tool was therefore developed to broadly translate the CFRIDiL’s conceptual framework into measurable survey items suitable for a younger audience. This process involved updating examples of digital genres to reflect those actually used by younger participants, simplifying language, and

contextualising descriptors to match the background knowledge and digital literacy levels of Singaporean students.

The SDLP tool is composed of the same four dimensions as the CFRIDiL, but it uniquely consists of 51 items rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Within each dimension, items are structured into three categories: competencies, (“I can...”), beliefs (“...should...”), and preferences (“I like...”). Each category contains only a small number of items per dimension (3–4), and all items, regardless of category, were rated on the same 5-point Likert scale. This integrated structure captures not only what students feel capable of doing, but also how they think about digital practices (beliefs) and how they feel about engaging in them (preferences).

Consistent with the tool’s validation, these categories were designed and statistically tested as components of a single construct within each dimension. Because each sub-aspect includes only a handful of items, analysing them separately would risk unstable estimates given the limited number of items per subcomponent and would not align with the validated structure of the tool. Additionally, analysing them collectively also reflects how digital literacy operates in real life: what students can do (competencies), is closely shaped by what they believe they should do (beliefs) and what they are inclined to do (preferences). Treating these aspects separately may overlook their theoretically integrated nature within the framework, whereas analysing them as a composite construct provides a more holistic and ecologically valid representation of students’ digital literacies. Table 1 provides examples of these items, along with their corresponding rationale as derived from the CFRIDiL framework.

The validation of the SDLP was conducted with around 800 students and demonstrated good reliability and validity. It involved expert review for content validity, pilot testing with a small group, and psychometric testing through exploratory and confirmatory factor analyses (Yee et al., 2025). Reliability testing showed high internal consistency for each dimension (composite reliability = 0.86–0.89, omega [ω] = 0.87–0.90). Strong correlations among the competencies, beliefs and preferences items within each dimension confirmed that they measure the same underlying construct, which is why these categories were validated and analysed collectively rather than separately. The full list of items can be found in Appendix A.

Recognising that digital literacies are inherently social practices, the tool incorporated scenarios of digital engagement specific to the educational landscape of Singapore. Upon completing the questionnaire, participants were provided with their digital literacies profile based on their responses. The profile was presented as an avatar accompanied by a brief description of the individual’s key digital literacy attributes. This feedback highlights participants’ strengths, encouraging greater self-awareness. The profiles are designed for

self-reflection, and are not used to compare participants with one another or against predefined standards, allowing students to focus on their unique strengths.

Table 1

Examples of items used and their rationale according to the CFRIDiL

Dimension	Item (developed in the SDLP tool)	Rationale (derived from CFRIDiL)
Multimodal Orchestration (MO)	<i>Competencies:</i> When I am making a slideshow about my favourite character, I can first organise all the pictures, facts and video clips that I want to use in my computer.	Can manage data, information and content to be used in the production of a digital text or participation in online communication (e.g., organize and retrieve data).
	<i>Beliefs:</i> When I am making a fun slideshow on my hobbies, it should have pictures to accompany words.	Can complement different resources, for example, writing and images, through adding, repeating and so on.
	<i>Preferences:</i> When I am making a fun slideshow (e.g., hobbies), I like mixing pictures, words and music.	Complement different resources, for example, writing and images, through adding, repeating and so on.
Digital Technologies (DT)	<i>Competencies:</i> When I am making a slideshow about my school, I can use apps and software (e.g., Paint, PowerPoint, Windows Movie Maker) to help me make the content.	Can use different devices to produce a digital text or engage in communication online.
	<i>Beliefs:</i> When I think about my use of technology, I should identify what I am good and not good in.	Understand where personal digital competence needs to be improved or updated.
	<i>Preferences:</i> When I am making a slideshow, I like to change the style settings (font, colours, music) to express my preferences.	Use digital technologies in a creative and innovative way to serve the purposes of the digital text or online communication.
Intercultural Communication (IC)	<i>Competencies:</i> When I am communicating online, I can respect everybody even though they are younger than me.	Respects otherness by being willing to suspend one's own belief about what is 'natural' and/or 'fair' on the basis of one's own cultural perspective and by being open to what others believe as 'natural' and/or 'fair' in tune with the context of the digital text or online communication and/or online affinity spaces.
	<i>Beliefs:</i> When I am playing an online game with my friend who needs more time to respond, I should slow down to match their pace.	Make use of the experience of others in a digital text or communication online to reflect on issues that are frequently taken for granted within one's own social environment
	<i>Preferences:</i> I like learning about people from different kinds of backgrounds through watching videos from other countries.	Show openness towards, interest in and curiosity for diversity through different resources (i.e., language, gaze, gestures, etc.) without applying prejudgments on the others' representations, expressions and behaviour while interacting with a

Transversal Skills (TS)	<i>Competencies:</i> When I see a social media post about my friends that is negative, I can tell how it will make my friends feel. <i>Beliefs:</i> When I am doing a project with my classmates online, and a disagreement between group members occurs, I should try to resolve it. <i>Preferences:</i> When I have many things to do for an online project, I like to start early.	digital text or participating in online communication. Can understand and empathise with others. Cope with pressure and problems. Prioritise tasks effectively.
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Focus group discussions

With the assistance of teachers, four Focus Group Discussions (FGDs) were conducted for both Primary 5 and Secondary 3 students during curriculum hours to gather feedback from students who had completed the digital literacies questionnaire. The FGDs were intended to provide complementary, contextual insights that would enrich the interpretation of the quantitative survey findings. The discussions focused on students' thoughts about the survey, the importance of digital literacy, their use of digital devices, and how they interact digitally in different contexts, such as with friends, family, or teachers. Each 30-minute session was held in a private, distraction-free environment. The FGDs were structured to capture perspectives from different gender and SES groups. The students' SES was assessed based on their housing types, distinguishing between public and private housing in Singapore, as outlined by Ng and colleagues (2014). We conducted 8 FGDs, each FGD had about 3-5 students. The composition of each FGD was structured by gender, age, and housing type. For Primary 5, 17 students participated: 5 girls and 5 boys from low SES backgrounds, and 4 boys and 3 girls from higher SES backgrounds. For Secondary 3, 16 students took part: 3 boys and 3 girls from low SES backgrounds, and 5 girls and 5 boys from higher SES backgrounds. Students were selected with the assistance of their teachers, prioritising those who had recently completed the questionnaire so that their recollection of the experience was still fresh in their minds. Additionally, teachers helped to identify students who were more comfortable with speaking in a group setting. The FGD data was analysed thematically, with key insights identified and organised for discussion according to the research themes.

Participants

The choice to recruit Primary 5 and Secondary 3 students was guided by discussions with the Ministry of Education in Singapore. These two groups have experienced the most of

primary and secondary education respectively and are not in the final year of study where they are sitting for the national examinations.

We approached school principals across Singapore to invite their schools to participate. When principals consented, form teachers distributed information sheets and consent forms to all parents in the targeted cohort via the schools' online parent-teacher communication portal. Only students whose parents provided consent participated, and the survey was administered during curriculum hours. While we aimed to include entire cohorts within each participating school, the overall sample ultimately depended on which schools agreed to take part and which parents provided consent, meaning it was not a fully random or stratified sample. Although this recruitment process is technically a form of convenience sampling, it drew from a broad cross-section of public schools and included whole cohorts rather than selected individuals. We therefore believe the sample is reasonably representative of Singapore's public school population, though findings should still be interpreted with the usual caution regarding voluntary participation (Hiratsuka, 2025).

Table 2

Participant demographics

Group	Primary 5	Secondary 3
Sample Size	198	315
Number of schools involved	2	2
Age	11	15
SES (housing type)		
Public: HDB 1 or 2 room flat	16	6
Public: HDB 3 room flat	42	52
Public: HDB 4 room flat	56	148
Public: HDB 5 room flat or executive flat	25	74
Private: Condominium	45	31
Private: Landed Property	14	4
Gender		
Female	69	155
Male	129	160

Data analyses

Students' ratings across the four dimensions were compared using the non-parametric Kruskal-Wallis test, which does not assume normal distribution. This test was selected due to the ordinal nature of the data, collected using a 5-point Likert scale.

To assess the influence of SES, gender, and education level on students' ratings across each dimension, we conducted four separate structural equation modelling (SEM) analyses using R (version 2023.06.1). These variables were included as covariates in the analyses, with individual items regressed on them. As explained in Methods 2.1, the three categories (beliefs, competencies, and preferences) within each dimension were analysed collectively rather than separately, in line with the validated structure of the SDLP tool described there.

To account for potential interaction effects, we included the interaction terms *education level* $\times$ *SES* and *SES* $\times$ *gender*. These terms were considered important because we aimed to explore whether the effect of SES on students' ratings varied depending on education level (i.e., whether education level moderated the SES-rating relationship), as well as whether the effect of SES differed by gender (i.e., whether gender moderated the SES-rating relationship).

Within each dimension, bifactor structures and/or error covariances were added to account for the potential influence of shared scenarios across items. This step aimed to control for any systematic effects that could arise from shared scenarios or shared variance unrelated to the latent construct being measured. Specifically, error covariances were used instead of bifactor structures when only two items shared the same scenario, to maintain model parsimony. Full model specifications, including summaries are presented as supplementary materials.

To further complement the SEM results, we also conducted item-level analyses using the Mann-Whitney U test. This allowed us to explore the effects of gender, SES and education level on individual survey items.

Findings

Students digital literacies profiles

All participants were assigned a profile based on the dimension they rated the most positively in; Multimodal Orchestration – The Orchestrator, Digital Technologies – The Digitalist, Intercultural Communication – The Communicator, and Transversal Skills – The Connector. A fifth profile, The Designer, was assigned to students who rated an average of 4.25 (Agree to Strongly Agree) across all four dimensions. This profile represented the smallest proportion of students. In cases where participants had identical highest ratings across multiple dimensions, they were included in the count for each corresponding profile category. For example, a participant rating equally high in Multimodal Orchestration and Digital technologies was counted in both the Orchestrator and Communicator profiles. The total number of profiles counted would thus exceed the total number of participants because participants with multiple profiles are counted more than once. Tables 3 and 4 present profile distributions among Primary 5 and Secondary 3 students, comparing unique counts (no double-counting) and double-counted values. Across both groups, the Orchestrator profile was the most common, while the Communicator and Designer profiles represented the smallest proportions.

Table 3

Profile distribution among Primary 5 students. Note: 'Unique counts' represent participants assigned to a single dominant profile. 'Double counting' includes participants in all profiles where their ratings tied for the highest score.

Profile	Unique count	Double counted	Percentage (Unique)	Percentage (Double)
The Orchestrator	48	57	24%	27%
The Digitalist	42	45	21%	21%
The Communicator	21	27	11%	13%
The Connector	48	57	24%	27%
The Designer	26	26	13%	12%
Multiple profiles (overlap)	13	NA	7%	NA
Total Participants	198	212	100%	100%

Table 4

Profile distribution among Secondary 3 students.

Profile	Unique count	Double counted	Percentage (Unique)	Percentage (Double)
The Orchestrator	76	113	24%	29%
The Digitalist	53	74	17%	19%
The Communicator	47	73	15%	19%
The Connector	74	107	23%	28%
The Designer	18	18	6%	5%
Multiple profiles (overlap)	47	NA	15%	NA
Total Participants	315	385	100%	100%

Ratings between dimensions

Both Primary 5 and Secondary 3 students generally gave positive ratings across all four dimensions of digital literacies (Table 5), with significant differences between the dimensions in both groups: Primary 5 ($H = 33.38$, $df = 3$, $p < .001$, $\eta^2 = 0.003$) and Secondary 3 ($H = 9.57$, $df = 3$, $p = 0.02$, $\eta^2 = 0.0004$). As shown in Figure 1, Primary 5 students gave the highest ratings for Multimodal Orchestration (MO) and Digital Technologies (DT), while Intercultural Communication (IC) received the lowest ratings, which significantly differed from the other three dimensions. Similarly, as illustrated in Figure 2, Secondary 3 students also rated Multimodal Orchestration the highest and Intercultural Communication the lowest, with a significant difference between the two dimensions ($adj. p = 0.02$).

Table 5

Descriptive statistics for Primary 5 (P5) and Secondary 3 (S3) students' ratings across the four dimensions.

	Multimodal Orchestration			Digital Technologies			Intercultural Communication			Transversal Skills		
	P5	S3	Total	P5	S3	Total	P5	S3	Total	P5	S3	Total
Mean	3.96	3.80	3.86	3.98	3.78	3.86	3.83	3.75	3.78	3.92	3.79	3.84
Med- ian	4	4	4	4	4	4	4	4	4	4	4	4
Mode	5	4	4	5	4	4	4	4	4	5	4	4

Figure 1

Mean ranks across dimensions for Primary 5 students. Ranks were derived from responses on a 5-point Likert scale and calculated using the Kruskal-Wallis test. Note: Bars indicate significant group differences, with * indicating $p < .05$ and ** indicating $p < .001$

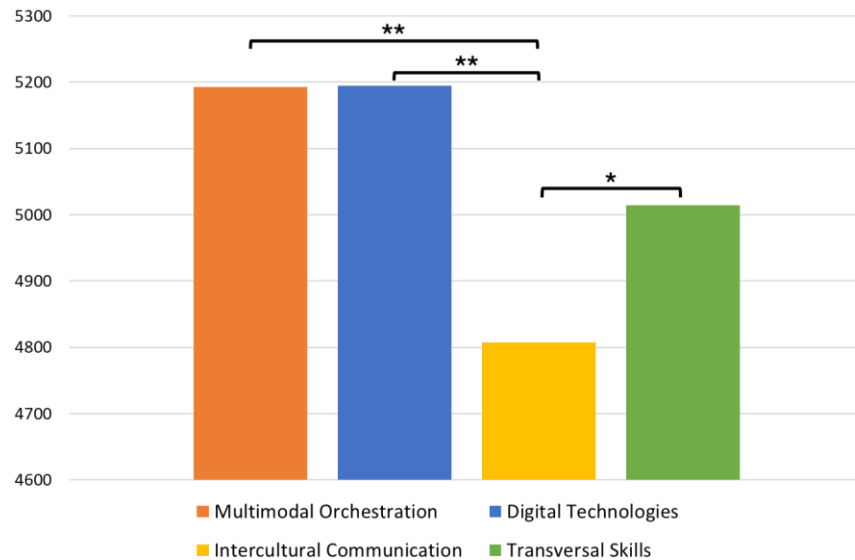
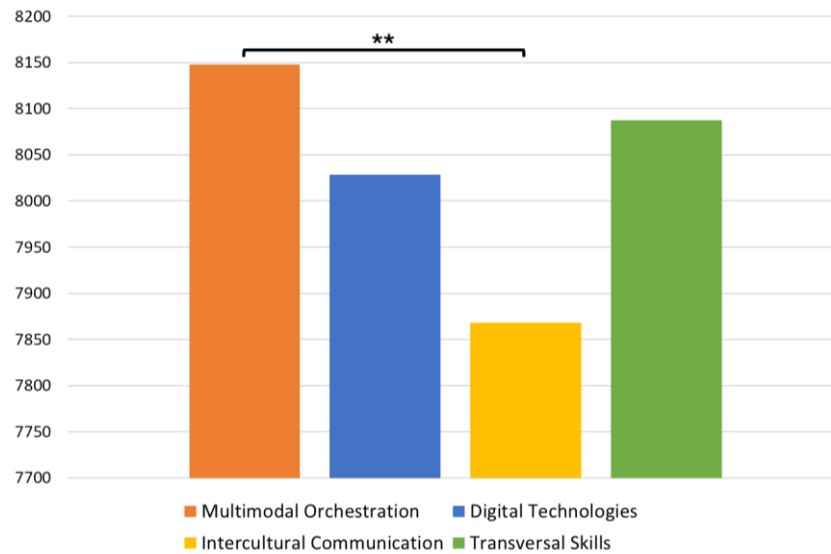


Figure 2

Mean ranks across dimensions for Secondary 3 students. Ranks were derived from responses on a 5-point Likert scale and calculated using the Kruskal-Wallis test. Note: Bars indicate significant differences, with ** indicating $p < .001$.



Within dimension SES, gender and education level effects

The following results section is organised by the four digital literacies dimensions (Multimodal Orchestration, Digital Technologies, Intercultural Communication, and Transversal skills). For each dimension, we present model fit indices, followed by the main effects of gender, SES, and education level, and then interaction effects (e.g., Gender x SES).

Multimodal orchestration

To investigate the effects of SES, Gender and education level within the dimension of Multimodal Orchestration, a structural equation model (SEM) was fitted to the data. The model demonstrated a good fit to the data: normed $\chi^2 = 2.21$, CFI = 0.949, TLI = 0.933, RMSEA = 0.049, SRMR = 0.039, reliability = 0.887. To account for potential shared variance among seven items that began with the same scenario (i.e., making slideshows), a bifactor structure was added. Additionally, two error covariances were included to account for two scenarios that each involved two items. These modifications resulted in improved model fit.

Main effects

Gender effects. A significant gender effect ($\beta = -0.356$, $p = 0.001$) was found, with boys and girls rating their competencies, beliefs, and preferences in multimodal orchestration

differently. Girls demonstrated more positive evaluations, suggesting they place higher value on combining and manipulating multimodal resources such as speech, writing, images, music, sound, and layout in digital communication.

Corroboration with FGD Insights: This difference may arise from how boys and girls prioritise and use these resources. In FGDs with secondary school students, boys reported using stickers when they "had no time to type," while girls used stickers, extra exclamation marks, and emojis to express feelings and understand their friends' emotions. While both boys and girls use these elements to facilitate communication, boys appear to use them for brevity, while girls use them to enhance emotional expression. These findings suggest that girls engage more naturally with multimodal orchestration, whereas boys may benefit from more active involvement and encouragement from teachers to explore the full potential of combining different modes for meaning making.

SES effects. The analysis revealed a marginally significant effect of socioeconomic status (SES) ($\beta = -0.476$, $p = 0.06$), indicating that students living in public housing – representing lower SES – tended to rate their competencies lower on average than those in private housing, which signifies higher SES, by approximately 0.804 units, when controlling for age and gender.

Education level effects. Significant differences were found between Primary 5 and Secondary 3 students in the dimension of Multimodal Orchestration, with Primary 5 students rating the items more positively than their Secondary 3 counterparts ($\beta = -0.272$, $p = 0.02$). This may suggest that younger students have a more favourable evaluation of their competencies, beliefs, and preferences regarding the integration of resources for meaning making in digital texts and online interactions.

Interaction effects

SES x Gender interaction. There was also a significant interaction effect between SES and gender ($\beta = 0.281$, $p = 0.02$), indicating that the impact of SES on Multimodal Orchestration ratings varies between male and female students. Specifically, the adverse effects of lower SES are more pronounced for girls, with boys experiencing a smaller decrease of 0.436 units compared to a larger decrease of 0.804 for their female counterparts. In other words, girls from lower SES backgrounds are more negatively impacted than their male peers in similar circumstances.

There was no significant interaction effect between education level and SES ($\beta = 0.457$, $p = 0.11$).

Digital technologies

The model fit indices for this dimension demonstrated good fit: normed $\chi^2 = 2.33$, CFI = 0.954, TLI = 0.936, RMSEA = 0.051, SRMR = 0.041, reliability = 0.89. Two bifactor structures were incorporated to account for two scenarios, each consisting of three items: making slideshows and making videos. Two additional error covariances were included for two scenarios relating to the use of technology and Zoom.

Main effects

Gender effects. Gender has a marginal effect ($\beta = -0.228$, $p = 0.05$) on the dimension of Digital Technologies, with girls rating the items more positively than boys. The lack of a statistically significant difference between the two groups suggests that both boys and girls evaluate their abilities, preferences, and beliefs regarding digital technology (including devices, apps, and software) similarly when navigating the digital landscape.

Corroboration with FGD insights: Supporting this finding, data from FGDs revealed that girls participate in activities traditionally associated with boys, such as playing video games. Not only did they report engaging in computer games, but they also expressed enthusiasm when discussing the various games they play. This indicates a potential shift in gender stereotypes over time, leading to a reduced gap in perceptions regarding Digital Technologies between boys and girls.

Interaction effects

SES effects. There were no significant SES effects on students' ratings on this dimension ($\beta = -0.356$, $p = 0.184$).

Education level effects. Primary 5 students rated the items related to Digital Technologies more positively than Secondary 3 students, with a significant difference observed ($\beta = -0.328$, $p = 0.006$).

SES x Gender interaction. While no significant SES effect was observed, a significant interaction effect between SES and gender was identified ($\beta = 0.309$, $p = 0.02$), indicating that the impact of SES on ratings for Digital Technologies differs between boys and girls. Specifically, the negative influence of lower SES is more pronounced for girls than for boys, with girls experiencing a reduction of -0.470 units compared to -0.154 units for boys, indicating that lower SES has a stronger adverse effect on female students.

Given the interconnectedness of Multimodal Orchestration and Digital Technologies, similar underlying factors may explain the observed trends. Girls from lower SES backgrounds, often adhering to traditional gender roles, may face greater restrictions on their access to digital resources, particularly subscription-based ones. In addition, their social circles may reinforce these limitations, hindering their opportunities to gain exposure and practice with digital tools. During FGDs with Primary 5 students, lower SES girls reported limitations on their device usage, while boys did not express such constraints. The boys shared about their engagement in a variety of digital activities – such as playing games, attending tuition via Zoom, and learning about technology on platforms like TikTok and YouTube – often alongside their friends and cousins.

There was no significant interaction effect between education level and SES ($\beta = 0.267$, $p = 0.37$).

Intercultural communication

The model fit indices for this dimension indicated good fit: normed $\chi^2 = 2.18$, CFI = 0.934, TLI = 0.917, RMSEA = 0.048, SRMR = 0.040, reliability = 0.866. One bifactor structure was incorporated to account for the scenario relating to communicating online, consisting of four items. One error covariance was included for two items that shared the scenario relating to making videos.

Main effects

Gender effects. For the dimension of intercultural communication, which encompasses awareness of socio-culturally diverse contexts and community-specific practices, girls exhibited more positive ratings than boys ($\beta = -0.247$, $p = 0.03$). This indicates that girls are more open to, interested in, and curious about diversity, engaging with various resources without prejudging others' representations, expressions, and behaviours in digital texts or online interactions.

Corroboration from FGD insights: During the FGDs, when asked about their interest in exploring countries and cultures online, boys indicated that they typically search for information if they encounter intriguing cultures on TikTok, if their friends describe something as interesting, or if they are traveling to a specific destination. They also mentioned gaining cultural exposure through watching foreign films, particularly anime and horror movies on Netflix. In contrast, while girls similarly reported looking up cultures mainly when traveling, they provided more detailed explanations of their interests. One girl stated that she “[tries] not to be ignorant about other cultures” and actively watches anime, even in different languages, as well as Thai series because her mother is Thai, and she wants to understand and communicate with her relatives in Thailand. Other girls expressed curiosity about cultural aspects such as festivals, educational systems, and cuisine. For instance, they mentioned enjoying how other countries celebrate Chinese New Year and wondering about the school system in America after seeing “grade 6” referenced in a book.

SES effects. There was no significant main effect of SES on Intercultural Communication ratings ($\beta = -0.319$, $p = 0.27$).

Education level effects. The difference in ratings for Intercultural Communication between Primary 5 and Secondary 3 students was marginally significant ($\beta = -0.203$, $p = 0.08$), indicating that both groups had similar perceptions. Notably, this dimension received the lowest ratings from both groups. During FGDs, students expressed that their interest in exploring other countries and cultures was primarily instrumental, often tied to practical reasons like preparing for family vacations. This suggests a general lack of intrinsic curiosity about cultural learning, as many students reported not accessing news about other countries through digital media. Overall, the findings indicate a more insular approach to digital engagement, reflecting limited interest in global diversity.

Interaction effects

SES x gender interaction. There was a marginally significant interaction effect between SES and gender was observed ($\beta = 0.248$, $p = 0.05$), indicating that the impact of SES on these ratings differs between boys and girls. Specifically, the negative effect of lower SES is more pronounced for girls, with girls rating Intercultural Communication items as 0.231 units less positively than boys at low SES levels. For girls, the effect of lower SES on Intercultural Communication ratings is a decrease of -0.384 units, whereas for boys, it is a smaller decrease of -0.153 units. This suggests that girls from lower SES backgrounds are more likely to disagree with statements related to Intercultural Communication compared to boys.

There was no significant interaction effect between education level and SES ($\beta = 0.249$, $p = 0.397$).

Transversal skills

The model fit indices for Transversal Skills demonstrated good fit: normed $\chi^2 = 1.89$, CFI = 0.965, TLI = 0.952, RMSEA = 0.042, SRMR = 0.033, reliability = 0.903. To account for the scenario relating to doing projects, which was shared among seven items, a bifactor structure was added. Another bifactor structure was incorporated for the scenario relating to using social media, which was shared by four items. Finally, an error covariance was included for two items that shared the scenario relating to doing online projects.

Main effects

Gender effects. There was a marginally significant difference between genders, with girls rating Transversal Skills more positively than boys ($\beta = -0.188$, $p = 0.09$).

SES effects. There were no significant effects of SES at the dimensional level ($\beta = -0.316$, $p = 0.21$).

Education level effects. There were no significant effects of education level on students' ratings ($\beta = -0.177$, $p = 0.11$), suggesting that both groups face similar challenges in the dimension of Transversal Skills.

Interaction effects

SES x Gender interaction. There was a marginal interaction effect between gender and SES ($\beta = 0.204$, $p = 0.09$). According to findings from the FGDs, most students reported that they had not encountered serious disagreements or cyberbullying online. Instead, they demonstrated a capacity for resolving conflicts amicably without adult intervention. For instance, some students mentioned employing more passive strategies, such as "shaking it off" or acknowledging differing opinions without escalating tensions, while others opted for more active approaches, like using humour to diffuse situations or addressing conflicts directly, either online or face-to-face. This direct engagement allows them to "clarify" misunderstandings and fosters better communication.

There were no significant interaction effects between education level and SES ($\beta = 0.232$, $p = 0.407$).

Discussion

This study aimed to explore the digital literacies profiles of Primary 5 and Secondary 3 students in Singapore, while examining the influence of gender, SES and education level on their self-evaluations across four dimensions: Multimodal Orchestration, Digital Technologies, Intercultural Communication and Transversal Skills. We analysed how students rated themselves across these dimensions and showed trends that enhance our understanding of their digital literacies. Below, we discuss how the findings address our research questions in turn.

In addressing RQ1, 'How do students' ratings differ across the four dimensions of digital literacies', we found notable differences across the four dimensions, with students rating themselves highest in Multimodal Orchestration and Digital Technologies and lowest in Intercultural Communication. This pattern aligns with the distribution of the most and least dominant profiles identified in our study. These findings suggest that Multimodal Orchestration and Digital Technologies are concepts that learners find more accessible, as it can be translated into concrete, actionable tasks. Conversely, Intercultural Communication was rated the lowest, which may indicate that students in Singapore may not fully grasp the value of understanding and learning from other cultures, which can broaden their perspectives and encourage empathy. Findings from the FGDs revealed that while students enjoy multicultural events like "International Friendship Day" and "Racial Harmony Day," they feel schools could do more to educate them about different cultures and promote sustained engagement with different cultures. Such initiatives could stimulate interest and encourage independent research. Intercultural communication is essential for developing empathy, critical thinking, and interpersonal relationships, while promoting tolerance and acceptance of diversity. For decades, scholars have emphasised the importance of nurturing intercultural sensitivities, with calls for education systems globally to adapt pedagogies to impart knowledge and skills that extend beyond local contexts (Süssmuth, 2007; Messelink et al., 2015; López-Rocha, 2021). In today's highly globalised society, where cross-cultural interactions are increasingly commonplace and influential even for students, this need is even more pressing. Identifying factors that promote intercultural communication skills and nurturing them from an early age would more effectively equip students to navigate and succeed in a world that is interconnected and culturally diverse (Braslauskas, 2021).

To summarise the findings for RQ2 – 'To what extent do (a) gender, (b) socioeconomic status (SES) and (c) education level influence ratings on each digital literacy dimension', the analyses showed several key patterns. Girls tended to rate the items more positively

than boys, low SES impacted girls more negatively than boys in the dimensions of Multimodal Orchestration and Digital Technologies, and younger students rated themselves higher in both Multimodal Orchestration and Digital Technologies than Secondary 3 students. The following sections unpack these findings in greater depth, exploring possible explanations and their broader implications.

Examining gender differences in students' digital literacies profiles (RQ2a), we found that while all students rated themselves to be strongest in Multimodal Orchestration across all four dimensions of digital literacies, girls rated themselves higher than boys in this dimension. According to Tannen (1990), girls often use relational and expressive communication styles that aim to foster social connections and emotional bonds. This process can be enhanced through multimodal orchestration, where a variety of communication modes enrich media interactions and provide non-verbal tools for self-expression. For example, emojis can convey underlying facial expressions and tones, as well as the speaker's mood and intent (Kaye et al., 2016; Schnoebelen, 2015), thereby reducing ambiguity and potential misunderstandings. In addition, the use of various modes—such as capitalisation and emojis—allows individuals to express emotions more vividly, facilitating greater emotional connectivity, empathy, and the development of deeper trust (Ayres, 2014).

Although our analysis of SES effects as part of RQ2b revealed generally positive trends across all backgrounds in Singapore, the interaction effects we found between gender and SES point to the need for future research to delve into the subtle disparities that may exist between genders, particularly among lower SES students. Gender differences identified in prior research (Johnson, 2011) favouring males may be less pronounced among Singaporean students, largely due to equitable access to digital devices in schools, where all secondary students are provided with personal computing device for learning. This institutional provision alleviates concerns regarding unequal access to digital technologies between genders at home. Research has shown notable gender differences in screen-based activities, with girls generally participating less than boys (Gracia et al., 2022; Gracia et al., 2023). These disparities may be exacerbated in lower SES households, where varying priorities and gender expectations can limit girls' access to digital resources, including devices and applications (UNICEF, 2023). This limited exposure, combined with a lack of support and practice, as well as a generally lower intrinsic interest in technology compared to boys (Stocchetti, 2014; Tobishima, 2020), can lead to girls having a less favourable view of their skills and interests in multimodal orchestration.

In economically disadvantaged societies, studies have shown that girls often receive less access to digital technologies than boys, influenced by prevailing gender roles and societal expectations (Andrews, 2008; UNICEF, 2023). In addition, girls from lower SES backgrounds are less likely to engage in online gaming compared to boys, with differences

in background knowledge and belief systems shaping their gaming interactions (Kafai et al., 2009). While the Singaporean educational context provides equal access to digital devices, girls from lower SES backgrounds may still face indirect restrictions on digital usage due to cultural and socioeconomic factors dictating how they are expected to use these tools. Research also indicates that adolescents from lower SES backgrounds tend to experience heightened negative emotions in digital environments and have limited access to resources that support healthy online communication (Gracia et al., 2020; Ragnedda, 2018). Moreover, studies reveal that girls are more vulnerable than boys to negative emotions, such as distress, from daily online experiences (Smahel et al., 2020). These findings underscore the potential for adverse interactions between low SES and being female, suggesting unique challenges for girls from lower SES backgrounds in navigating the digital landscape.

Our investigation into educational level effects (RQ2c) showed that younger students tended to rate themselves more positively across all dimensions except transversal skills than older students. Possibilities for this could be that the Secondary 3 students, who have had three to four more years of exposure to technology than Primary 5 students, are likely to have developed greater expectations of themselves in terms of their digital literacies. As they face increased digital demands – such as using complex applications and evaluating online information – they may feel less confident in their skills. It could also be that younger students may be more susceptible to social desirability bias; they might report what they think is “correct” instead of expressing their genuine feelings or opinions, especially given their limited exposure to surveys. We also posit that having been exposed to a wider range of digital media, and for a few years longer than Primary 5 students, Secondary 3 students would have developed critical thinking skills and higher sensitivities to nuances in digital communication, including the use and manipulation, and reception of various modes and elements in different contexts. Consequently, they may have developed a more realistic perception of their competencies and a heightened awareness of what they wish to learn, while the younger students may be more confident and optimistic about their skills.

Insights gathered from FGDs further illustrate the need for educators to understand the changing digital landscape among students. While it may seem logical to consider online and offline spaces as distinct realms, with “real life” often synonymous with face-to-face interactions, many young people today experience a merging of these environments due to the constant connectivity provided by mobile devices. When students were asked how their behaviour differs online compared to in person, many responded that they behave “exactly the same in real life and in messages,” noting that they are “used to it and talk the same way.” This perception illustrates how online communication and in-person interaction, are increasingly regarded as the same reality or “real life”. This blurring of boundaries may be

traced back to students' early and ongoing exposure to technology, as digital tools are now integral to various aspects of their lives – ranging from entertainment like video gaming and watching shows to socialising via social media and engaging with digital learning platforms. Furthermore, widespread internet access in modern cities also facilitate constant online access further blurring these distinctions. While this integration of digital and physical experiences brings significant advantages, it also highlights the urgent need for proactive efforts to understand and cultivate in students the digital literacies necessary to engage with the opportunities afforded in the digital age safely, critically, and meaningfully.

Limitations

The study has several methodological limitations that should be considered when interpreting the findings and assessing their broader applicability. It used housing type as a proxy for SES, which may not accurately reflect SES compared to direct measures like parental income, and the sample lacked participants from the extremes of the SES spectrum, limiting conclusions about SES differences. This proxy was used given the age of the participants, who were not well-positioned to answer more nuanced questions related to SES such as family income in the questionnaire or other detailed SES indicators. Furthermore, operationalising SES as a single variable may risk obscuring meaningful intra-group differences. Consequently, interpretations of SES-related differences should be treated as preliminary and may not capture the full complexity of socioeconomic inequalities in digital literacies. Future research should incorporate more comprehensive SES indicators such as parental education, income and occupation. Additionally, the relatively small sample size of 198 Primary 5 and 315 Secondary 3 students reduces representativeness, and because participation depended on school and parental consent, the study relied on a form of convenience sampling. While entire cohorts within participating schools were invited across a broad cross-section of Singapore's public schools, the reliance on schools' agreement and parental consent means the sample cannot be considered representative of all Singaporean students. As such, findings should be interpreted with caution when generalising beyond these age groups and participating schools, and future studies should aim to include a larger and more diverse population.

It should also be noted that the findings are based on students' self-reported perceptions of their digital literacies, which may be subject to social desirability bias. In addition, students' self-assessments may be influenced by cultural factors, for example, modesty norms or differing interpretations of rating scales, which may shape how they respond to certain items. The findings thus reflect perceived instead of objectively established digital literacies. Establishing a common language around digital practices could improve self-evaluation accuracy, and future research could adopt a mixed-methods approach that

triangulates self-reports with performance-based tasks, teacher assessments, or observational data to provide a more balanced and culturally sensitive understanding of students' digital literacies and to identify specific areas for teaching interventions. While the qualitative findings from the FGDs provided contextual insight into the quantitative survey findings, more systematic integration such as explicitly matching qualitative themes to specific dimension ratings could enhance explanatory depth. This represents a valuable direction for future research. The study's cross-sectional design also limits tracking changes in digital literacies over time, and the findings may not generalise to other age groups. Observed differences between age groups should therefore be interpreted carefully as they may reflect cohort effects in addition to age-related differences. Longitudinal studies with a broader age range are recommended to better understand the evolution of digital literacies and inform targeted educational programs. Lastly, because competencies, beliefs and preferences were analysed as integrated constructs within each dimension, the study was not designed to distinguish the specific contribution of each subcomponent to the observed patterns. While this integrative structure aligns with the underlying framework, future work may benefit from developing expanded subcomponent scales to enable more fine-grained diagnostic insights about skills deficits, attitudinal factors, and motivational differences.

Conclusion

The findings from this study indicate that the digital literacies profile of Primary 5 and Secondary 3 students in Singapore is characterised by higher self-evaluations in the dimension of Multimodal Orchestration. In contrast, the dimension of Intercultural Communication received comparatively lower evaluations. When exploring the influence of gender on ratings across each dimension, we found that girls rated both Multimodal Orchestration and Intercultural Communication more positively than boys. The interaction effects of gender and SES also suggest that lower SES may have a greater negative effect on girls than on boys.

The findings from our study offer implications in the design of the digital literacies curriculum in schools as well as on building the digital literacies of students. First, a digital literacies curriculum could benefit from encompassing all four dimensions of multimodal orchestration, digital technologies, intercultural communication, and transversal skills. In particular, it should pay special attention to the dimension of intercultural communication, given that it received comparably lower ratings in this sample. Technology serves as a vital tool for students to engage and interact with others across boundaries of geography. This aligns with existing studies indicating that digital communication is an essential support for teenagers facing the complexities of this phase of life (Ehrenreich et al., 2020). Moreover, participation in online communities across cultures cantered around common

digital interests has been recognised as a positive result of youth's media use (Ito et al., 2009; Lim et al., 2024). Thus, fostering skills and interests in intercultural communication can better prepare students for collaboration and understanding in a globally connected world, where digital interactions are essential across personal and professional contexts.

Second, it is also important to ensure equitable access for low SES students to develop their digital literacies. Although the digital divide influenced by SES in this study was not significant overall, the significant interaction with gender suggests that lower SES disproportionately affects girls more than boys. Lower SES students may face challenges such as reduced access to quality resources and guidance, highlighting the importance of equitable access to digital devices and learning experiences. To address these disparities, schools may consider providing high-quality digital resources, library subscriptions, and quality digital learning experiences to support all students, particularly those from lower SES backgrounds.

The SDLP tool offered insights on students' digital literacies across four dimensions, in terms of their competencies, beliefs and preferences. This holistic approach is informed by the understanding that digital literacies extend beyond the mere use of digital tools and technologies; they include diverse modes of meaning-making that allow individuals to express their ideas, experiences, and identities while engaging with others in communication and interaction. The SDLP tool has since been used in other contexts, such as China (Lim et al., 2026) and Indonesia offering cross-country comparisons of the findings on the digital profiles of students in different educational systems.

Appendix A – Survey items from the student digital literacies profiling tool (Yee et al., 2025)

No.	ITEM	RATIONALE	DIMENSION	SUBTYPE
1	I like learning how to use technology, even if I do not have to.	<i>Enjoy seeking opportunities for self development and to keep up-to-date with the digital evolution.</i>	Digital Technologies	Preferences
2	I like learning about people from different kinds of backgrounds through watching videos from other countries.	<i>Shows openness towards, interest in and curiosity for diversity through different resources (i.e., language, gaze, gestures, etc.) without applying prejudgments on the others' representations, expressions and behaviour while interacting with a digital text or</i>	Intercultural Communication	Preferences

		<i>participating in online communication.</i>		
3	I like searching online for information about cultures (e.g., races, countries) that I do not know about.	<i>Can understand culture-specific information and different systems of values in a multimodal text or online communication.</i>	Intercultural Communication	Preferences
4	When I see my friends engage in certain activities (e.g., creating online videos, building virtual worlds) that I do not do, I like to find out why they do it.	<i>Enjoy interpreting and explaining culture-specific and/or online affinity-based elements while keeping an open mind.</i>	Intercultural Communication	Preferences
When I am communicating online,				
5	I can use casual language (emojis, short-forms) or formal language (e.g., proper grammar, full spelling) when I need to.	<i>Can understand whether and to what extent the meaning-making resources used in a multimodal text are suitable and adequately used to fulfil the communicative purpose both in formal and informal contexts.</i>	Multimodal Orchestration	Competencies
6	I should try to understand viewpoints from people of a different culture (e.g., race, country).	<i>Respects otherness by being willing to suspend one's own belief about what is 'natural' and/or 'fair' on the basis of one's own cultural perspective and by being open to what others believe as 'natural' and/or 'fair' in tune with the context of the digital text or online communication and/or online affinity spaces.</i>	Intercultural Communication	Beliefs
7	When I am communicating online, I can respect everybody even though they are younger than me.	<i>Respects otherness by being willing to suspend one's own belief about what is 'natural' and/or 'fair' on the basis of one's own cultural perspective and by being open to what others believe as 'natural' and/or 'fair' in tune with the context of the digital text or</i>	Intercultural Communication	Competencies

		<i>online communication and/or online affinity spaces.</i>		
8	When I am communicating online, I can understand that people from different backgrounds might misunderstand my words.	<i>Is aware of the possibility of different evaluations of one's statements/values by audiences of different sociocultural backgrounds and demographics.</i>	Intercultural Communication	Competencies
9	When I am communicating online with people from different backgrounds, I can make sure that everyone has a chance to talk.	<i>Manages an equal and fair participation in the digital text or the online communication event, inclusive of sociocultural diversity.</i>	Intercultural Communication	Competencies
10	When someone from another culture asks me about my traditional food online, I should explain to them using examples that they know.	<i>Can balance communication in making accessible what is culturally specific and not known and combining it with what is more generally shared.</i> <i>- e.g., "I can discuss either popular topics/topics of international interest"</i> <i>- e.g., "I can use more 'universal' or common concepts to explain culture specific ones."</i>	Intercultural Communication	Beliefs
When I am making a video				
11	When I am making a video about my school, I can add words and music so that my video becomes better.	<i>Can complement different resources, for example, writing and images, through adding, repeating and so on.</i> <i>- e.g., I can fit music and/or lyrics to the visual and the verbal (e.g., superimposed text) in tune with the context and the intended audience.</i>	Multimodal Orchestration	Competencies

12	When I am making a video about my favourite character, I can mix different video clips together to create a remix content.	<i>Can assemble and edit the available resources of the medium to serve specific communicative purposes of the digital text or online communication.</i> <i>- e.g., I can select, assemble and edit moving images to create a remix product.</i> <i>Higher level:</i> <i>- e.g., I can maintain the coherence of the audio-visual narrative across scenes consistently and in a manner which is appropriate for the communicative purposes of the video (e.g., smooth transition from one scene to the next, intended breaks or pauses between scenes).</i> <i>- e.g., I can show competency in editing (e.g., sequencing and alternating moving and/or static images without unintended interruptions in the narrative of the video).</i>	Multimodal Orchestration	Competencies
13	When I am making a video about my school, I can decide what content to include to help people learn more about my school.	<i>Can assess the kind of information that needs to be gathered and search for data and information which are relevant to the content of the digital text or online communication.</i>	Digital Technologies	Competencies
14	When I am making a video about my school, I can find online materials for that content.	<i>Can navigate online sources of information purposefully to serve the purposes of the digital text or online communication.</i> <i>- e.g., I can search online to find websites with relevant focus so as to get inspiration for my</i>	Digital Technologies	Competencies

		<i>website and find ways to differentiate it from the others.</i>		
15	When I am making a video about my school, I can decide which online content is better (e.g., accurate, reputable, useful) for my video.	<i>Can analyse, compare and critically evaluate the credibility and reliability of online sources of data and information and the usefulness of their content to serve the purposes of the digital text or online communication.</i> <i>- e.g., Before producing a weblog, I can look at what others do and critically evaluate the meanings expressed.</i>	Digital Technologies	Competencies
16	When I am making a video in English for all people around the world, I should have subtitles in other languages.	<i>Shows openness towards, interest in and curiosity for diversity through different resources (i.e., language, gaze, gestures, etc.) without applying prejudgments on the others' representations, expressions and behaviour while interacting with a digital text or participating in online communication.</i>	Intercultural Communication	Beliefs
17	When I am making a video about a culture that is different from mine, I like finding the content for it.	<i>Enjoy searching out, asking for and acquiring new knowledge about others, their practices and products as well as integrate new knowledge with already acquired cultural knowledge.</i>	Intercultural Communication	Preferences
When making slideshows/powerpoint slides				
18	When I am making a fun slideshow on my hobbies, it should have pictures to accompany words.	<i>Can complement different resources, for example, writing and images, through adding, repeating and so on.</i>	Multimodal Orchestration	Beliefs
19	When I am making a fun slideshow (e.g., hobbies), I like to use emojis and links.	<i>Can embed graphical icons (e.g., emoji) and links purposefully in the written component of the digital text or online communication.</i>	Multimodal Orchestration	Preferences

20	When I am making a PowerPoint slideshow, I can tell the difference in style (fonts, colour, layout) between a 'serious' project (e.g., school) and a fun project (e.g., hobbies).	<i>Can select from a range of available colour and font options to serve the communicative purposes of the digital text or online communication.</i>	Multimodal Orchestration	Competencies
21	When I am making a fun slideshow (e.g., hobbies), I like mixing pictures, words and music	<i>Can complement different resources, for example, writing and images, through adding, repeating and so on.</i>	Multimodal Orchestration	Preferences
22	When I am making a slideshow, I like adding special effects to get the attention of the viewers.	<i>Can establish interactions with the viewer through the use of different resources in tune with the context and have an impact on the intended audience.</i> <i>- e.g., I can use interactive buttons, links and effects at a level which is appropriate for the communicative purposes of the text and I can incorporate them in a way that is functional throughout the website.</i>	Multimodal Orchestration	Preferences
23	When I am making a slideshow that is serious (e.g., for school), my profile picture on the slideshow should be different from my profile photo for Instagram.	<i>Can use various meaning-making resources for the representation of self and manage this according to the needs of different online environments.</i> <i>(Profile picture for Instagram could show my interests and style, but for a school project/class blog, I would choose something more professional)</i>	Multimodal Orchestration	Beliefs

24	When I am making a slideshow about my favourite character, I can first organise all the pictures, facts and video clips that I want to use in my computer.	<i>Can <u>manage</u> data, information and content to be used in the production of a digital text or participation in online communication (e.g., organize and retrieve data).</i> <i>e.g., Before making a fanvid,</i> <i>- I can check copyright permissions for images and videos which I want to use but are not mine.</i> <i>- I can create a mock-up for my customized choices.</i> <i>- e.g., "I can create one or more <u>blog posts</u> either of my own original content or by combining already existing content from <u>other websites</u>, linking embedded excerpts to the sources to acknowledge them."</i>	Multimodal Orchestration	Competencies
25	When I am making a slideshow about my school, I can use apps and software (e.g., Paint, PowerPoint, Windows Movie Maker) to help me make the content.	<i>Can use different devices to produce a digital text or engage in communication online.</i>	Digital Technologies	Competencies
26	When I am making a slideshow, I like to change the style settings (font, colours, music) to express my preferences.	<i>Can use digital technologies in a creative and innovative way to serve the purposes of the digital text or online communication.</i>	Digital Technologies	Preferences
27	When I am making a slideshow, I should add where the pictures I use are from.	<i>Can comply with copyright rules and license conditions when producing/publishing a digital text.</i> <i>or: Can make the necessary references to sources and credit a work or remark by referring to a particular author, artist, or</i>	Digital Technologies	Beliefs

		<i>person in keeping with the conventions of the specific online space.</i>		
When I am using zoom,				
28	When I am using Zoom with somebody who does not speak English well, I can use pictures or emojis to explain my message better.	<i>Can compensate for anticipated communication problems and misunderstanding through selective use of meaning-making resources.</i>	Multimodal Orchestration	Competencies
29	When I am using Zoom for a class, I should try not to type in capital letters so as not to be rude.	<i>Can detect if the conventions typical of the digital text type are employed and adequately combined to successfully fulfil the communicative purposes, appreciating creativity and breaking of conventions in the use of meaning-making resources and their function.</i>	Multimodal Orchestration	Beliefs
30	When I am using Zoom for a class, I can use the different features (e.g., turn on camera, unmute myself, share files).	<i>Can use a range of digital possibilities of software applications or programs for a specific communicative purpose.</i>	Digital Technologies	Competencies
31	When I am using Zoom for a class, and my microphone is not working, I can find another way to communicate with the class.	<i>Can identify technological problems that may arise using the medium and solve them.</i>	Digital Technologies	Competencies
When I am watching a video				
32	When I am watching a video, I should search online if the information is true.	<i>Can critically evaluate the meanings which can be made from the digital text or online communication on the basis of the meaning-making resources.</i>	Multimodal Orchestration	Beliefs
33	When I am watching a video, I can identify the things that show me unique information	<i>Can identify the meaning-making resources employed to express cultural diversity in a multimodal text (e.g., language, gaze, gestures, etc.).</i>	Intercultural Communication	Competencies

	about other cultures (e.g., races, countries).			
When I see a social media post				
34	When I see a social media post about me that makes me angry, I can calm myself down.	<i>Can understand and manage self.</i> <i>- e.g., can recognise and manage reactions to triggers</i>	Transversal Skills	Competencies
35	When I see a social media post about my friends that is negative, I can tell how it will make my friends feel.	<i>Can understand and empathise with others.</i> <i>- e.g., Can anticipate the reactions of others and act accordingly.</i>	Transversal Skills	Competencies
36	When I see a social media post about my friends that is negative, I should show concern for my friends.	<i>Can understand and empathise with others.</i> <i>- e.g., Can anticipate the reactions of others and act accordingly.</i>	Transversal Skills	Beliefs
37	When I see a social media post by my friend from a different culture about their unusual tradition, I like to ask questions to learn more about their customs.	<i>Can understand and empathise with others</i> <i>- e.g., Can show empathy for people that show other cultural practices and forms of behaviour.</i> <i>or: Shows empathy towards others' feelings and thoughts while interacting with a digital text or participating in online communication.</i>	Transversal Skills	Preferences
When I am playing an online game with my friend,				
38	When I am playing an online game with my friend who needs more time to respond, I should slow down to match their pace.	<i>Makes use of the experience of others in a digital text or communication online to reflect on issues that are frequently taken for granted within one's own social environment</i> <i>- e.g., I am willing to accommodate and adapt to the other and their interactional style and facilitate the other.</i>	Intercultural Communication	Beliefs

39	When I am playing an online game with my friend, and suddenly the game platform crashes, I can think of another online activity to do.	<i>Can take decisions in relation to the demands of the context.</i>	Transversal Skills	Competencies
When I am doing a project with my classmates online,				
40	When I am doing a project with my classmates online, I can easily decide what each group member should do based on what they are good at.	<i>Can collaborate effectively and can be an effective team member</i> <i>- e.g., Can easily and rapidly identify individuals' skills and distribute roles and tasks to optimize teamwork according to these.</i>	Transversal Skills	Competencies
41	When I am doing a project with my classmates online, I can share my different opinion without making others upset.	<i>Can collaborate effectively and can be an effective team member</i> <i>- e.g., Can express opinions and disagreement in a constructive way without causing obstacles/difficulties/conflicts or frustration (both to self and others).</i>	Transversal Skills	Competencies
42	When I am doing a project with my classmates online, and a group member is talking, I like listening to them.	<i>Can collaborate effectively and can be an effective team member</i> <i>- e.g., Can practice active listening.</i>	Transversal Skills	Preferences
43	When I am doing a project with my classmates online, and a disagreement between group members occurs, I should try to resolve it.	<i>Can cope with pressure and problems.</i>	Transversal Skills	Beliefs
44	When I am doing a project with my classmates online, I should solve any problem that happens.	<i>Can cope with pressure and problems</i>	Transversal Skills	Beliefs
45	When I am doing a project with my	<i>Can cope with pressure and problems</i>	Transversal Skills	Preferences

	classmates online, and something is not working, I like finding a solution to fix it.			
When I have many things to do for an online project				
46	When I have many things to do for an online project, I like to start early.	<i>Can prioritise tasks effectively.</i> <i>- e.g., Can focus on getting the job done well and on time.</i>	Transversal Skills	Preferences
47	When I have many things to do for an online project, I can decide which tasks to do first.	<i>Can prioritise tasks effectively.</i>	Transversal Skills	Competencies
When I am looking at a website				
48	When I am looking at a website about food recipes, having a video should help me understand better.	<i>Can critically evaluate the meanings which can be made from the digital text or online communication on the basis of the digital technologies.</i> <i>- e.g., When watching a fanvid, I can understand if different available technological possibilities (e.g., editing software) have been used for the production of an up-to-date and engaging video</i> <i>- e.g., "I can appreciate the different visual strategies used to highlight the most important passages."</i>	Digital Technologies	Beliefs
49	When I am looking at a website, I can tell if it is for fun or for a serious purpose by looking at the design (e.g., colours, fonts).	<i>Can understand the different levels of formality and register in multimodal texts according to different multicultural contexts and online affinity spaces.</i>	Intercultural Communication	Competencies
When I think about my use of technology				
50	When I think about my use of technology, I should identify what I am good and not good in.	<i>Can understand where personal digital competence needs to be improved or updated.</i>	Digital Technologies	Beliefs

51	When I think about my use of technology, I should find ways to improve.	<i>Seeks opportunities for self development and to keep up-to-date with the digital evolution.</i>	Digital Technologies	Beliefs
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Abbreviations

CFRIDiL: Common Framework of Reference for Intercultural Digital Literacies; Digital Competence Framework 2.1: DigComp 2.1; SES: socioeconomic status; MO: Multimodal Orchestration; DT: Digital Technologies; IC: Intercultural Communication; TS: Transversal Skills

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Author's contributions

Both Fei Victor Lim and Jia'en Yee contributed equally to the study. Conceptualisation and methodology: Fei Victor Lim and Jia'en Yee; Formal analysis: Jia'en Yee; Investigation: Fei Victor Lim and Jia'en Yee; Writing – original draft: Fei Victor Lim; Writing – review and editing: Jia'en Yee and Fei Victor Lim; Visualisation: Jia'en Yee; Project administration: Fei Victor Lim and Jia'en Yee; Supervision: Fei Victor Lim; Funding acquisition: Fei Victor Lim.

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Availability of data and materials

The datasets used and/or analysed in this study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The authors declare that they have no competing interests.

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