An Examination of Special Education Teachers’ Digital Practices

Abstract

The aim of this study is to understand how mobile devices are being used to support students’ learning (i.e., mobile learning) in specialist schools, and in specialist support units within mainstream schools. A validated survey instrument is used to examine these practices through the lens of a sociocultural digital framework that highlights distinctive mobile learning approaches. One hundred and twenty-six teachers responded to the survey. The findings provide a nuanced understanding of teachers’ current digital pedagogical approaches, and show potential benefits for students, including increased agency. Possible directions for the development of special education teachers’ digital practices are also provided.

Introduction

The rhetoric of mobile technology–enhanced learning promises great potential for effective, future-oriented learning, but the reality often falls short (Selwyn et al., 2017). Much research has focused on mainstream school teachers’ approaches to supporting their students’ learning with mobile devices (mobile learning or m-learning). In special education settings, research has tended to focus on the use of mobile technologies - such as tablets, smartphones, laptops and their associated applications (‘apps’) - to support explicit instructional approaches for development of specific skills, and for accessibility and communication. Less attention has been given to examining special education teachers’ pedagogical approaches with mobile devices from a socio-cultural perspective (Wertsch, 1991). This perspective emphasizes the social and contextualized nature of learning, and the dynamic relationship between technologies and their users (Salomon & Perkins, 1998). Informed by a socio-cultural perspective, the researchers aimed to provide valuable insights into contemporary teaching practices that utilise mobile devices (i.e., mobile pedagogies) in this specialist context. A sociocultural digital pedagogical framework was adopted to underpin the study. This framework highlights three distinctive mobile pedagogies: personalization, authenticity, and collaboration (Kearney et al., 2012, 2020). The researchers used a validated survey instrument (Kearney et al., 2019) that was designed to examine teachers' adoption of these three pedagogies in a task they had recently implemented to support the learning of their students with disabilities. The researchers provide a contemporary snapshot of school teachers' digital pedagogies for students with disabilities in special education settings by addressing the following research questions:

1. What types of mobile learning tasks are special education teachers enacting?
2. How are special education teachers adopting personalized, authentic, and collaborative mobile pedagogies?

With an ever-growing market of mobile technologies being promoted to teachers of students with disabilities, this study is timely, and findings will help to provide digital pedagogical insights for special education teachers.

Background

Mobile Learning and Students with Disability

Recent Literature Reviews

There have been several literature reviews on the use of mobile technologies by students with disabilities, reflecting the increasing ubiquity of these technologies in daily life and education. Stephenson and Limbrick's (2015) review of 34 studies about people with developmental delays revealed that devices were used primarily for communication and leisure activities. Using mobile devices to teach functional living skills was found to be effective, based on the 18 studies reviewed by Goo et al. (2019). Further, they found that the use of devices facilitated students' independent functioning across multiple contexts, including home, school, community, and employment settings.

In relation to students with disabilities in education settings, Chelkowski et al. (2019) found that most studies had focused on accessibility issues rather than how mobile devices were used for teaching and learning. The reviewed studies reported mostly positive results, although the researchers conceded that these might be short-term gains due to the relatively recent implementation of m-learning (Chelkowski et al., 2019). Also examining student outcomes, Cumming and Draper Rodríguez (2017) concluded from their meta-analysis of 40 single-subject studies that mobile technologies were used to support students in seven areas: daily living and life skills; academic skills; communication skills; task engagement and completion; transitions between activities and settings; vocational skills; and reducing challenging behavior. Further, a review of 20 single-case studies by Ok and Kim (2017) revealed that mobile devices were effective in enhancing both academic performance and the engagement of students with disabilities. Most of the studies focused on the use of apps to teach targeted academic skills and deliver explicit instruction lessons.

Benefits of using Mobile Technologies

To date, much of the research on m-learning in special education contexts has focused on the affordances of mobile devices for students and their effectiveness to apply pedagogical practices common in special education settings. For instance, teachers of students with disabilities have used the multimodal features of mobile technologies to differentiate the curriculum and provide diverse ways to present material (Clarke & Abbott, 2016). Students learning with mobile devices can work at their own pace and with tailored plans (Smith et al., 2016; Stephenson, 2016). Mobile devices can also provide customized learning environments for students with different disabilities or degrees of disability, and their portability allows for use across settings (Larwin & Aspiranti, 2019).

An overview of the literature on special education law, policy, and technology use (Thomas et al., 2019) recommended evidence-based mobile technology solutions for students' learning. Mobile technologies were recommended to support students with disabilities who struggle with self-regulation of behavior, task completion, attention, and academic performance (Thomas et al., 2019). The use of video modeling (Kellems et al., 2019) was also recommended because it allows students to see others or themselves performing a task successfully and thereby provides a readily accessible model for social learning (Thomas et al., 2019). Mobile devices make video modeling more effective because they can be accessed independently across settings.

Many studies have also reported increased engagement among students using mobile devices. Cumming and Draper Rodríguez (2013) observed that students with language-based difficulties had improved engagement and required fewer prompts to stay on task when using a tablet. Skiada et al. (2014) found that students with learning disabilities would rather take tests on mobile devices than on paper, and their teachers credited the use of the mobile devices with improved student attention. Flewitt et al. (2015) observed the use of tablets for literacy instruction in special schools for learning disabilities. Their teacher participants commented on their use of the tablet for engaging children in their work and on the use of interactive apps to heighten their concentration levels and create enjoyable and flexible learning experiences.

There are also benefits to using mobile devices to assist students with communication disorders. Mobile devices can be used as speech-generating devices, enabling students to make requests, which increases independence and peer interactions for some students with autism spectrum disorder (ASD) and intellectual disabilities (Mancil et al., 2016). Researchers have also found that students with learning disabilities who typically struggled with writing assignments were more comfortable communicating with friends through text messages (Vue et al., 2016). Once students are familiar with using mobile devices for learning, there can be increased opportunities for peer interactions (Mancil et al., 2016; Puckett et al., 2017; Yuen et al., 2014). This existing body of literature highlights many positive outcomes for students with a variety of disabilities, in a range of contexts, through their participation in m-learning activities. It suggests the value of mobile devices to support evidence-based special education pedagogies, such as explicit instruction (Hughes, Morris, Therien & Benson, 2017). In this study, the researchers seek to broaden this focus using a sociocultural perspective to uncover how distinctive m-learning pedagogies are adopted by special education teachers.

The iPAC Mobile Pedagogical Framework

In this study, the researchers examined current mobile pedagogies adopted by practicing teachers in Australian special education settings through the lens of a robust mobile pedagogical framework called the iPAC framework (Kearney et al., 2012). This framework highlights three distinctive mobile pedagogies or "constructs"—personalization, authenticity, and collaboration—hence the acronym "iPAC." It is underpinned by a sociocultural perspective (Wertsch, 1991), acknowledging that learning is facilitated by social interactions between people (Vygotsky, 1978) and is mediated by tools such as mobile devices and applications (Pachler et al., 2013). The framework recognizes the malleable boundaries of "time and space" (or context) in m-learning, meaning that learning mediated by the use of mobile devices does not necessarily occur at a fixed place, pace, or schedule. Instead, how learners generate their own learning context influences their experience of these three mobile pedagogical features. The framework has been developed and refined over the past decade (Kearney et al., 2020) and currently comprises six "subconstructs" (two per iPAC construct).

Personalization is widely recognized as a key feature of m-learning. In well-designed m-learning activities, students typically have enhanced agency (Pachler et al., 2009), with greater control over the place (physical or virtual), pace, and time they learn, and autonomy over the learning content and sequencing (*agency* subconstruct). Furthermore, students' learning experiences can be customized by their use of the device through individually tailored settings and feedback (*customization* subconstruct).

It is generally accepted that authentic tasks provide real-world relevance and personal meaning to learners. Mobile technologies can support students' experiences of authenticity through having rich, situated contexts. Learning settings can be both physical and virtual in the mobile world, enabling learners to experience what it is like to learn in situ and at a time and place suggested by the topic (*context* subconstruct). Task authenticity refers to the extent to which activities are relevant and personally meaningful for students, and also refers to how students use apps and tools in realistic ways, akin to real-world practitioners (*task* subconstruct).

Finally, m-learning can allow student collaboration by leveraging rich connections to other people and resources, mediated by a mobile device. The networking capability of mobile devices can create shared, socially interactive environments, allowing students to easily converse (Sharples et al., 2016) and communicate multimodally with peers, teachers, and other experts (*conversation* subconstruct). Learners can also cocreate digital content, sharing information and artifacts across time and place (*cocreation* construct).

Application of the iPAC Framework to Examine Mobile Pedagogical Practices

The iPAC framework has been used to inform research on m-learning in school education (Kearney et al., 2015; Yates et al., 2021). Survey methods have often been used to interrogate practicing teachers' adoption of mobile pedagogies. For instance, Kearney et al. (2015) examined school teachers' use of distinctive m-learning pedagogies using a teacher survey (*n* = 107). The primary (elementary) and secondary school teachers were mainly from Australia (64%) and Europe (20%). Eighty-six percent described a formal task that was classroom-based, and participant ratings of authenticity were high. However, their ratings for the constructs of personalization and collaboration were lower, with weaker ratings in aspects of student control and autonomy and lower ratings in online conversations and networking.

In a later study, Kearney et al. (2020) elicited the views of 385 Australian secondary school teachers about their use of mobile devices for student learning, with a particular focus on the practices of math and science teachers. The main similarity between the two groups' practices was their tendency to predominantly use traditional, school-based classrooms to enact their m-learning tasks, similar to the participants of the 2015 survey. That is, there was little consideration given to learner-generated contexts. Students' self-pacing was a stronger feature of teachers' tasks in this study and was rated highly, but other aspects of personalization were less evident. Online learning tasks that were more collaborative and networked were seldom mentioned, with low levels of genuine community-based activities.

Student surveys have also been used to consider contemporary mobile pedagogies using the iPAC framework. For example, Burke et al. (2021) reported on a study of 928 secondary students from four Australian schools with a reputation for exemplary use of mobile pedagogies. Students were asked to comment on their m-learning experiences in either mathematics or science. Personalization was a feature of their experiences, but authentic and collaborative learning were not as frequently reported. Most recently, Yates et al. (2021) surveyed 1975 New Zealand secondary school students in their final 2 years of schooling about their experiences learning at home with their mobile devices. Students had favorable perceptions of their experiences of authentic and collaborative learning. They enjoyed greater agency over their use of time but often lacked the skills to manage this flexibility productively.

These studies involving mainstream school teachers and students have provided a more detailed understanding of teachers' contemporary mobile pedagogies in order to guide future practices. However, similar studies are needed to interrogate teachers' m-learning practices in supporting students with disabilities. Therefore, this study examined these practices in specialist schools for students with disabilities and in specialist support units within mainstream schools.

Study Design

Methods

An online survey was used, adapted from a validated iPAC survey instrument that was used with mainstream teachers (Kearney et al., 2019). The version of the survey used for the present study was developed over several iterations. An initial version was developed by the authors in consultation with three external researchers (two from Australia and one from the United Kingdom) who had expertise in special education, and with regular feedback from the codesigners of the original pedagogical framework (Kearney et al., 2012). This process identified the need for adjustments to ensure that the language was more relevant to teachers of students with disabilities and the specialized contexts in which they were working. Some of the examples provided at the end of each survey item (see Appendix) were adapted for similar reasons.

Inter-researcher validation was achieved through frequent discussions among the researchers to critique each version of the survey and consider how well the items aligned with the iPAC framework's dimensions and the underlying sociocultural theory. A well-developed version of the survey instrument was trialed as part of a pilot study with 10 preservice teachers toward the end of 2020. Ensuing team discussions focused on how well the items elicited data relevant to the three iPAC dimensions. These discussions and the feedback from pilot survey participants informed final refinements. Final versions of the items are shown in the Appendix.

The 21-item core of the survey required teacher participants to consider one recently implemented task that required their students to learn with mobile devices. These core items required the teachers to consider the behavior of students when undertaking their chosen task, in relation to the constructs of the iPAC framework. There were seven items per construct (see Appendix), and keywords were italicized to stress the link between each item and the construct.

Teacher participants were asked to select the discipline area and cohort (e.g., literacy and upper primary) that was most relevant to their implemented task. This context was subsequently "piped through" by the survey software to be included in the main stem for the core iPAC items: "When my <cohort> student(s) with disabilities used mobile devices to learn in this <discipline> activity, s/he: …." After completing these 21 core items, teachers were presented with five additional items requiring them to consider their students' overall experience in their chosen m-learning activity (see Appendix). These items were developed in our past project to cover elements of learning outcomes with respect to the overall perceptions of learning, enjoyment, understanding, and difficulty (Aubusson et al., 2014). The final survey also elicited background data about the teachers, the nature of their students' disabilities, and further details about the activity, including the number of students, intended learning outcomes, the task settings, and the technologies used.

The survey was disseminated nationally via email to all special education schools (N=410) and some mainstream schools with support units (primary N=296 and secondary N=217) and across both government and nongovernment school systems in Australia. In accordance with ethics clearance, emails were sent to school administration email addresses, not directly to teachers. One hundred and twenty-six respondents completed the survey in full.

Analysis

Data from the 21 core iPAC items were analyzed according to the three themes of personalization, authenticity, and collaboration. In these items, and in the five items about overall learning, participants used a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*), where a score of 3 was neutral. The means and standard deviations for all measurement items and each iPAC subconstruct were calculated (see Appendix). A descriptor "high" indicates an average rating between 3 and 4 (out of 5), and "very high" for ratings above 4.

The validity and reliability of the reflective multi-item measures were evaluated using factor analysis. Based on inadequate factor loadings, the analysis suggested the removal of C1 ("Communicated with others around them about work displayed on their screen") as a reliable measure of collaboration-conversation. Similarly, L3 ("My [cohort] students found it difficult learning [discipline] using mobile devices in the activity") was also removed as a measure of overall learning. The factor analysis confirmed the reliability of the remaining measurement items and validity of the constructs. In particular, the average variance extracted (AVE) for all constructs was above 0.5 to establish convergent validity, whilst the composite reliability (CR) were all above .7 to establish reliability (Fornell & Larker 1981). Discriminant validity was also established by confirming that the squared correlation between construct pairings was less than the AVE of either construct (Fornell & Larker 1981).

The data set from the open-ended responses was condensed, categorised, and connected over time (Huberman & Miles, 1998) according to the iPAC themes. An interpretive approach was employed for this analysis, providing insights into teachers' perceptions of their digital practices (Cohen, Manion & Morrison, 2011). Example activities were chosen that rated high or very high on at least three subconstructs, hence showing distinctive aspects of m-learning.

Participants and Context

Teacher Participants

Respondent teachers worked in specialist schools or in support units within mainstream schools. These schools were located in New South Wales (71%), Western Australia (9%), Victoria (6%), Queensland (6%), South Australia (5%), the Australian Capital Territory (2%), and Tasmania (1%). The majority of participants were experienced teachers: 31% had taught for over 20 years; 42%, for 11–20 years; 23%, for 2–9 years; and only 4%, for less than 2 years. Similarly, most participants were experienced with using mobile devices in their teaching: 12% described themselves as very experienced; and 57%, as experienced. Only 2% said they were inexperienced with using mobile devices in their teaching.

Students' Disabilities

Using the disability categories from the New South Wales Department of Education, the two most common categories of disability, reported by over 90% of the teacher participants, were intellectual disability and/or ASD. Other categories reported, albeit less frequently, were mental health (social/emotional) disability and physical disability. Fifty-one percent of teachers nominated a task they had implemented with students with the same primary category of disability. Seventeen percent of these activities were implemented with students who were significantly affected by their disability; 53%, with students who were moderately affected; and 14%, with students who were mildly affected (16% contained students with mixed levels). The remaining 49% of teachers chose a task that was implemented with students who had multiple categories of disabilities. Twelve percent of these activities were implemented with students who were significantly affected by their disability; 15% with students who were moderately affected; and 17% with students who were mildly affected (56% contained students with mixed levels).

Findings

The findings reveal the teacher participants' adoption of distinctive mobile pedagogies in tasks designed for students with disabilities. There are two parts to this section. The authors initially address the first research question by presenting the types of m-learning tasks reported by teachers, including five illustrative examples. These examples provide contextualized details linked to the iPAC Framework, showing how distinctive mobile pedagogies are adopted by special education teachers. The authors then address the second research question, drawing on an analysis of the quantitative data linked to items in each of the three constructs of the iPAC framework, as well as teachers' impressions of students' overall learning.

Types of m-learning tasks reported by teachers

This subsection presents general details of the m-learning tasks reported by the participating teachers, showing a diversity of digital practices in special education contexts. Five tasks are then shared to illustrate aspects of the iPAC constructs. These examples were chosen because they were associated with high ratings (average between 3 - 4, out of 5) or very high ratings (average above 4) in at least three subconstructs, and provided sufficient contextual detail relevant to the use of mobile pedagogies to support students with disabilities.

Descriptions of participants' activities

The digital learning activities described by survey participants were completed by a wide range of cohorts and age groups. Fifty-seven percent of teachers nominated a task completed by primary-age children; 43%, by secondary school students. English/literacy was the most frequently chosen discipline in the teachers' nominated tasks (59%). A range of other disciplines were also chosen as the main curriculum/discipline area, including math/numeracy (10%) and social science (6%); 14% percent of teachers said their focus was on communication.

Most teachers (71%) nominated activities that were implemented with small numbers of students, either 2–5 or 6–10. Fourteen teachers nominated tasks that were completed by just one student. The remaining tasks were undertaken by more than 10 students.

Teachers also reported on the setting(s) for their nominated task. Many teachers (37%) said they implemented their task in the formal classroom; 12%, at home; and 25%, in both. Four teachers mentioned a "sensory space" in conjunction with the classroom; 22% of teachers mentioned multiple settings (see Table 1).

[Insert Table 1 here]

The large majority of tasks were implemented using a tablet such as an iPad (63%). Other devices included laptops (27%) and smartphones (6%). Twenty-nine percent of teachers reported that their students owned their devices. The communication app Proloquo2Go was the most commonly mentioned application, followed by Seesaw and Google Classroom. A range of discipline-specific apps, such as Reading Eggs and Mathletics, was reported. However, most apps mentioned were more generic or discipline-agnostic in nature, such as Google's suite of apps. Half of the teacher participants (49%) reported on a task for which students only used one app. The remaining teachers (51%) nominated a task for which students were required to use more than one app: 24% required two apps, 17% required three apps, and the remaining 10% required students to use more than three apps.

M-learning activities reported by teachers often involved the use of new media. One teacher reported on the use of Clickview videos with teacher-inserted questions for students' consideration as they viewed the video (with immediate corrective feedback). Another teacher required students to scan a QR code with their mobile devices to access a specific story (which was sometimes read aloud to students). Students would then answer questions about the story using Touchchat. Many teachers designed tasks with a learner-as-designer approach that required their students to utilise media production processes such as recording, editing and sharing photos or videos.

Five specific task examples are presented in the next sub-sections. These show how special education teachers' adopted the distinctive iPAC mobile pedagogies.

Secondary School m-learning activities

In this sub-section, examples A–C describe teacher participant reports of their m-learning activities that were implemented with six to ten Year 11 and 12 students. The students in each of the examples had disabilities that were categorized by their respective teachers into three areas: intellectual, mental health (social/emotional), and ASD. The three secondary teachers reported that their students experienced mild to severe levels of disability. The three examples show features of personalization—especially agency—as well as aspects of coconstruction and task authenticity.

Example A. Teacher no. 126 reported on a digital learning task that involved in situ learning, allowing students to exploit learner-generated contexts. The task focused on the English/literacy area and was designed to develop students' functional living skills, particularly aiming at independent travel. The students used transport apps, text messaging, and camera apps on (their own) iPads in a range of school and non school settings. The teacher said that the "students use text for safety purposes, bus and train apps to check timetables, and the camera to send staff a photo if they are unsure where they are." The teacher elaborated on the benefits of this activity for the students: "I have found teaching students how to use their mobile phone correctly and safely has improved their independence and confidence."

The personalization subconstructs for the task were rated by the teacher very highly (agency: *Mean(M)* = 4.8; customization, *M* = 4.3), as were task authenticity (*M* = 4.3) and overall learning (*M* = 5.0).

Example B. Teacher no. 109 nominated a digital learning activity that was implemented in the classroom, targeting math/numeracy and aiming to develop students' functional living skills. The teacher offered the students a choice of four self-paced tasks that required the use of the Keyplan 3D app on their school-owned iPads. The first two tasks were more prescriptive, while the last two were more open-ended. In the first task, for example, the students were asked to "design a bathroom, but with a specific sized room, numbers of windows, doors, and items which had to be included." In the more sophisticated fourth task, students were required to "design a three-bedroom home, with one bathroom and an outdoor entertainment area, and with no restrictions on furniture or features." According to this teacher, a benefit of this design-based approach was that students could see "a 3D version of what they had created. This made a huge difference to their understanding of what a plan was, and what it would look like in real life."

The agency subconstruct for this task was rated highly by the teacher (*M* = 3.5), especially student pacing (Item P2: score = 5.0), choice of place, and choice of content (Items P1 and P3, respectively: scores = 4.0). Task authenticity was rated highly (*M* = 3.0), especially participation in real-world activities (Item A5: score = 4.0). Overall learning was rated very highly (*M* = 4.8). Although the collaboration construct rating was low overall for this task, the teacher indicated that students "shared digital content" (Item C6: score = 4.0).

Example C. Teacher No. 103 nominated a digital learning task in the English/literacy area, designed to develop students' communication and social skills. The teacher reported that students used Proloquo2Go and the camera apps on their own iPads in the classroom. This media production task involved voice recording, typing, and taking a photograph. Students accessed the task in Seesaw and uploaded their completed media product to share with their teacher. The teacher perceived the use of mobile devices as leveraging "options for recording and sharing information", and facilitating an activity that was "tailored to their individual interests."

Like in Example A, the personalization subconstructs for this task were rated very highly (agency: *M* = 4.5; customization: *M* = 3.7), as was task authenticity (*M* = 4.5) and overall learning (*M* = 5.0). The coconstruction subconstruct was rated highly (*M* = 3.3), especially for the way that students "shared digital content" (Item C6: score = 5.0).

Primary (Elementary) School m-learning activities

The following two examples reported by teacher participants describe activities implemented with 2–5 children. The tasks show features of student agency and collaboration, especially coconstruction. The students in each of these three examples had disabilities that were categorized by their respective teachers into two areas: intellectual and ASD. The students experienced mild to severe levels of these disabilities.

Example D. Teacher no. 29 nominated a digital learning task for Year 3–6 children in the English/literacy area. It was designed to develop their communication skills. Making use of their school-owned iPads, the children with moderate intellectual disabilities used Seesaw, their camera, and the dictation-to-text facility of their word-processing app to produce books that would eventually be showcased to their parents. They chose their own content, worked on the books at their own pace, and could choose to work in or outside of the classroom (but at school). The teacher emphasized the children's use of their devices in the tasks to express their views:

> When completing a book report, they are able to take photos of the cover, then use the word processing, i.e., dictation to text, to communicate their ideas, opinion, and connections to the book. Once work was completed, they were able to share their report with family at home on their parent's/family device.

This digital task was rated very highly by Teacher No. 29 for most subconstructs of the iPAC framework. The coconstruction and agency ratings were rated very highly (*M* = 5.0 for both). The teacher also rated the task highly for the authenticity construct (context: *M* = 4.0; task: *M* = 4.0) and very high for overall learning (*M* = 5.0).

Example E. This activity was reported by teacher no. 40. K–2 children used school-owned iPads to complete the task. The aim of this health and physical education task was to develop functional living skills. Children used the camera app to take photos while cooking and gardening. Their photos were "later printed out and pasted into their scrapbooks, so they could label or make comments, and describe plants/ingredients on the photos, as if in a journal."

This task was rated highly by the teacher for student agency (*M* = 3.3)—especially their ability to "choose the place to do the activity" (Item P1: score = 4.0)—and very highly for overall learning (*M* = 4.0). Aspects of context authenticity were also rated highly in this task, including learning "in a place suggested by the topic" (Item A1: score = 3.0) and "at a time suggested by the topic" (Item A3: score = 3.0).

Quantitative evidence of teachers' adoption of iPAC pedagogies

This subsection reports on the quantitative findings from the survey (n=126). Analysis revealed that the teachers perceived their m-learning tasks as having stronger features of personalization—especially the provision of student control over task pacing—than other constructs of the iPAC Framework. Their ratings for the constructs of authenticity and collaboration were lower, as shown in Table 2 (ratings for individual items are shown in the Appendix).

[INSERT TABLE 2 HERE]

Personalization

Teacher participants rated student agency more highly than the other five subconstructs when considering the distinctive mobile pedagogical approaches underpinning their chosen digital learning activity (see Items P1–P4 in the Appendix). In a similar result to the 2020 study of mainstream secondary teachers (Kearney et al., 2020), the teachers in this study particularly emphasized students' control of the pace of their digital learning tasks (Item P2: $M = 3.6$), with a high average rating for this item. The customization subconstruct was the second most favorably ranked subconstruct, with teachers emphasizing students' guidance by "app(s) based on their past use" (Item P5: $M = 2.8$).

Authenticity

Teachers in this study did not rate items linked to the authenticity construct as highly as those in the personalization construct (see Appendix). This result was also similar to our 2020 study of m-learning practices for mainstream schooling. Task authenticity was rated slightly more favorably than context authenticity, though ratings were still low compared to the personalization subconstructs. For instance, some teachers had designed tasks for students' engagement in "activities related to everyday life" (Item A7: $M = 2.7$), but there was less emphasis on designing tasks for places or times "suggested by the topic" (Item A1: M = 2.0; Item A3: M = 1.9) or requiring students to work in realistic, discipline-specific ways (Item A4: M = 1.7). Like our previous studies, the most common setting for tasks was the formal classroom, though there was a noticeably greater number of tasks in this study designed for multiple settings, especially a combination of classroom and home settings (see Table 1).

Collaboration

In the collaboration construct, conversational features of teachers' nominated tasks were rated relatively low (see Appendix). The rating by teachers regarding their students' face-to-face communication "with others around them about work displayed on their screen" suggested frequent learning conversations during tasks (Item C1: M = 3.2). However, the pattern of ratings was inconsistent with other collaboration items – which referenced online forms of interaction – and, as reported, subsequently this item was not retained as a reflective measure of the collaboration construct owing to its low factor loading. Like the mainstream school teachers in previous studies (Kearney et al., 2015, 2020), teachers in this study rated the coconstruction subconstruct more favorably than the conversation construct. For example, many teachers required their students to "share digital content" (Item C6: M = 2.4), while fewer teachers reported on tasks that supported students' "online communication" with peers (Item C2: M = 1.8) or with others (Item C3: M = 1.2).

Overall Learning

In the final set of survey items, teachers rated their students' use of mobile devices to support overall learning in their chosen task highly (Items L1, L2, L4, L5: M = 3.8), as shown in the Appendix. These results are somewhat unsurprising, given that teachers who volunteered for the survey were also likely to be enthusiastic about the use of technology in their teaching. They also chose to examine one task they had recently implemented that was likely to have been effective. Teachers emphasized that their students "enjoyed using mobile devices" to learn about the topic (Item L2: M = 4.0) during their nominated tasks.

Comparisons across teacher and activity characteristics

The results were also considered in relation to statistically significant differences across each of the iPAC constructs, as well as overall learning, in terms of characteristics describing the teachers, their students or the m-learning activity (see Table 3). With respect to personalization, the majority of differences related to the subconstruct of agency. In particular, student agency was significantly higher for activities: i) implemented with 6 or more students; ii) outside the classroom conducted at home; iii) completed by students with mild rather than severe levels of disability; iv) involving students with mental health (social and emotional) related disabilities (as reported by their teacher). The same pattern of results was generally observed in relation to these same characteristics where more extensive use of authentic tasks was reported, and also in activities involving increased use of both forms of collaboration (conversation and coconstruction).

[Insert Table 3 here]

Overall learning was reported to be significantly higher in m-learning activities: i) facilitated by teachers familiar with m-learning technologies as compared to inexperienced or occasional users; ii) involving more than 6 students; iii) involving students with mild levels of disability rather than profound or severe. Overall, no significant differences were observed for the iPAC variables and overall learning with respect to the number of years of teaching experience, or to the curriculum area linked to the activity.

Discussion

The majority of study participants were experienced practitioners who volunteered to complete the survey, and the tone of their open-ended responses indicated that many were proud of the recent task they had selected to scrutinise. Hence, the survey data captured the current mobile pedagogical practices of a select group of experienced and enthusiastic teachers of students with disabilities. The results should be interpreted in this light.

Findings revealed that participant teachers were applying some distinctive mobile pedagogical practices to support the learning of their students with disabilities. Student agency, often overlooked in relation to students with disabilities (Brock, Schaefer & Seaman, 2020), was emphasized by participants. Teachers in this study were evidently designing and implementing activities that offered their students opportunities to use mobile devices in a way that builds independence and develops autonomy, particularly over their pacing through the activity.

The overall low ratings for the authenticity construct are not dissimilar to recent studies of mainstream teachers (Burke et al., 2021; Kearney et al., 2020). The constraining factors reported in those studies (e.g., the scheduled nature of school timetables, the predominance of traditional formal classroom settings, formal curriculum requirements, and the plethora of apps that emphasise content and rote learning) may also limit the practices of special education teachers. Further, cybersafety concerns and school-based technology restrictions may also be impeding online initiatives that support authentic learning. These types of barriers (and enablers) need to be identified in further studies. The use of emerging technologies to enhance authentic learning, such as augmented reality, virtual reality, and simulations for students with disabilities, demonstrates promise (Carreon et al., 2019; Khowaja et al., 2020). However, such technologies were seldom mentioned by the teachers in this study.

However, the low rating by special education teachers for the subconstruct of task authenticity was somewhat unexpected, given their primary focus on functional skill development. Those activities where task authenticity did rate highly, as shown in our five examples, demonstrate ways in which multi-step tasks, often involving apps used in everyday life, have the potential to engage students in developing functional living skills across a range of curriculum areas through their access to 'community' beyond the classroom. The potential for special education teachers to develop multi-layered activities that incorporate the use of several apps—or 'app smashing' (Stevenson, Hedberg, Highfield, & Diao, 2015)—suggest a level of sophistication and complexity can be achieved in specialized school environments.

Most teachers in this study nominated tasks that were implemented in the formal classroom or at home, as shown in Table 1. However, unlike our previous study of mainstream teachers (Kearney et al., 2020), there was evidence of teachers in this survey exploiting learning across multiple settings (or "seamless learning," as discussed by Toh et al., 2013), and there were significantly higher ratings of personalisation and authenticity for out-of-classroom settings. The five examples featured in this article also demonstrate the potential for m-learning to support the generalization of skills in and beyond the classroom, and provide special education teachers with illustrations of m-learning experiences that draw on some of the contexts that students operate in outside of school.

Overall, teachers were positive about the levels of enjoyment that their students derived from the m-learning tasks, and about their overall learning in the topics nominated for those tasks (see Items L1–L5 in the Appendix). In addition, more frequent levels of personalisation, agency, collaboration, and overall learning were evident among teachers with more experience in using mobile technologies to support pedagogy, but not with teaching experience more broadly. These results highlight a need for professional learning to develop special education teachers' confidence levels and proficiency with mobile pedagogies suited to their context-specific needs, regardless of overall teaching experience.

Limitations and Future Directions

The iPAC survey instrument used in this study was not designed to evaluate learning outcomes. Instead, it has been purposefully designed to identify distinctive and robust mobile pedagogies that might be evident in a specific task. Results need to be interpreted by stakeholders through the lens of their own specialized teaching contexts. Indeed, the findings raise further questions about how the distinctive mobile pedagogies examined in this study can be further exploited in specialist education contexts. Aspects of technology-supported collaboration and authenticity that were rated less favorably by participant teachers may be unrealistic for students with certain disabilities, or at least substantiated in ways yet to be captured or explored in these contexts. Further, notions such as authenticity are ultimately contentious (Burden & Kearney, 2016), and learners themselves are the ultimate barometer of how relevant or meaningful an activity is to their lives (Barab et al., 2000). Therefore, future studies interrogating digital practices in specialist education contexts need to use supplementary methods to tease out further, nuanced detail. Such studies need to be sensitive to contextual factors, such as the nature of students' disabilities, and involve a wide range of participants, including students, parents, school leaders, and perhaps app developers. A separate validated survey instrument to capture students' experiences of m-learning has been designed (see ipacmobilepedagogy.com), but further work is required to co-design a version of this tool that would enable access for students with more significant disability, to ensure their voice is added to this body of work.

Whilst significant differences were reported in relation to the iPAC variables and overall learning in terms of various characteristics (e.g., experience teaching with mobile technologies), the ability to detect significant differences in some cases was limited by the number of participants. A large sample in future research and those carried out in other contexts, may offer greater power to account for heterogeneity in this regard. Similarly, future special education research in this area would benefit from the consideration of other variables that may further explain differences across personalization, authenticity, collaboration, as well as overall learning outcomes. For example, the design and implementation of digital activities are influenced by teachers' espoused pedagogical beliefs, as has been reported in other research (e.g., Burke et al. 2018).

Conclusion

In this study, the researchers aimed to capture a snapshot of school teachers' distinctive mobile pedagogies used to support students with disabilities. The context of this investigation was teachers in Australian specialist schools for students with disabilities and in specialist support units within mainstream schools. Based on the findings, there is evidence that some special education teachers are enacting complex m-learning tasks with their students. Further, the potential for using mobile devices to leverage student agency was evident. Moving forward, the researchers suggest that there is scope for special education teachers to consider task designs that exploit a wider range of distinctive aspects of m-learning, especially tasks allowing students with disabilities to work with mobile devices to experience aspects of collaborative and authentic learning. Tasks that take full advantage of the growing diversity of physical and virtual learning spaces may also be useful to consider, including learner-generated contexts where possible.

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Appendix: Mean Ratings for Personalization, Authenticity, Collaboration, and Overall Learning Subconstructs and Items

Construct and Measurement Items	M	SD	λ
Personalisation: Agency (AVE= .626; CR=.869)	**2.95**	**1.10**	
P1. *Chose* the place to do the activity: e.g., chose to work on the bus, at home, in the playground, or a section of the classroom, such as a reading corner or favorite sensory area	2.79	1.47	0.779
P2. *Determined* the pace at which they did the activity	3.56	1.31	0.789
P3. *Decided* what they wanted to learn: e.g., chose their own question, problem, or project to explore	2.58	1.36	0.736
P4. *Chose* their own order of activities	2.87	1.44	0.855
Personalisation: Customisation (AVE= .592; CR=.813)	**2.66**	**1.14**	
P5. Were guided by the app(s) based on *their* past use: e.g., by previous game challenge levels, YouTube recommendations, or Google searches prompted by their previous views/history	2.83	1.42	0.734
P6. *Tailored* app(s) settings to their preferences: e.g., customized location on/off, camera/microphone access, time limit settings	2.77	1.48	0.750
P7. Received *individualized* information through the app(s) about themselves: e.g., progress toward a goal; information about the number of steps walked, calories eaten, hours slept	2.39	1.56	0.821
Authenticity: Context (AVE=.678; CR=.862)	**1.86**	**1.05**	
A1. Learned in a place *suggested by the topic*: e.g., learned about stars under the night sky, pollution at a local stream, history at the site of an ancient battle	2.05	1.34	0.853
A2. Learned in a *realistic*, virtual space: e.g., use of augmented or virtual reality apps, science simulation	1.61	1.14	0.719
A3. Learned at a time *suggested by the topic*: e.g., nighttime observation of stars, weekend analysis of sporting performance.	1.92	1.34	0.888
Authenticity: Task (AVE=.574; CR=.843)	**2.20**	**0.94**	
A4. Worked *like an expert*: e.g., collected data using GPS like a geographer; measured using an inclinometer app like a scientist; composed music or lyrics to a song like a musician	1.67	1.02	0.757
A5. Participated in *real-world* activities: e.g., citizen science project that included real-life experts; environmental task on waste	2.09	1.28	0.860
A6. Learned *serendipitously* in an *unplanned* way: e.g., during a game, research prompted by an unexpected query	2.32	1.25	0.690
A7. Engaged in activities related to *everyday life*: e.g., developing a budget	2.73	1.40	0.713
Collaboration: Conversation (AVE=.627; CR=.832)	**1.58**	**0.83**	
C1.^ *Communicated* with others around them about work displayed on their screen	3.24	1.27	-
C2. *Communicated online* with their friends/peers *about* the work: e.g., exchanged ideas via email, SMS, Skype, online game forums, Facebook, Instagram etc.	1.77	1.19	0.871
C3. *Communicated online*, with people they don't know, about their work: e.g., interacted with a student gamer from another school, contacted a NASA scientist, asked a question to a Brainpop mathematician	1.18	0.58	0.638
C4. *Communicated with others* using a variety of text, image or video modes: e.g., by using Discord, Snapchat, Zoom, Skype	1.79	1.25	0.845

Construct and Measurement Items	**M**	**SD**	**λ**
Collaboration: Coconstruction (AVE=.607; CR=.822)	**2.09**	**1.08**	
C5. *Worked together to create* a digital product: e.g., cocreated a video, podcast, photo, iBook, document	1.91	1.33	0.708
C6. *Shared* digital content: e.g., shared a video, podcast, photo, document	2.40	1.51	0.825
C7. *Contributed to* existing digital content: e.g., tagged a photo, commented on a blog post, played a multiplayer game	1.94	1.30	0.800
Overall Learning (AVE=.725; CR=.913)	**3.79**	**0.82**	
L1. Using mobile devices *in the activity* improved my [cohort] student's learning in [discipline].	3.81	0.98	0.870
L2. My [cohort] students enjoyed using mobile devices to learn about [discipline] *in the activity*.	3.98	0.99	0.780
L3^. My [cohort] students found it difficult learning [discipline] using mobile devices *in the activity (R)*.	3.52	1.05	-
L4. Using mobile devices helped my [cohort] students to understand concepts in [discipline] *in the activity*.	3.62	1.00	0.853
L5. Using mobile devices helped my [cohort] students to develop competencies in the [discipline] curriculum area *in the activity*.	3.80	0.98	0.899

λ = factor loading; AVE = Average Variance Extracted; CR = Composite Reliability;
^ Item not used in factor analysis; R=reverse coded;

Table 1

Places Where Students with Disabilities Used Their Devices During Tasks

Setting	***n***	**%**
In the classroom (only)	46	37
In the classroom and at home	31	25
At home (only)	15	12
In the classroom, sensory room/space	4	3
Educational setting outside school (e.g., excursion site, museum)	1	1
Combinations of the above	29	22
Total	**126**	**100**

Table 2

Summary Statistics of Teachers' Mobile Pedagogical Preferences

Construct	Subconstruct	Rating, *M* (*SD*)
Personalization	Agency	2.95 (1.10)
	Customization	2.66 (1.14)
Authenticity	Context	1.86 (1.05)
	Task	2.20 (0.94)
Collaboration	Conversation	1.58 (0.83)
	Coconstruction	2.09 (1.08)

Note. $N = 126$.

Table 3

Summary Statistics across Teacher and Activity Characteristics

	Pa	Pc	Ac	At	Cv	Cc	OL	n
Aggregate Mean	2.95	2.66	1.86	2.20	1.58	2.09	3.80	126
Years of teaching experience								
<10 years	2.66	2.64	1.92	2.17	1.60	2.08	3.85	34
10-20 years	3.09	2.69	1.90	2.22	1.67	2.08	3.73	53
20+ years	3.01	2.64	1.75	2.20	1.44	2.10	3.86	39
Using m-technologies in teaching								
Inexperienced/Occasional	2.87	2.33*	1.79	1.92*	1.33**	1.96	3.51*	39
Experienced/Very experienced	2.99	2.81	1.89	2.33	1.69	2.15	3.93	87
Main curriculum area for activity								
English/Literacy	2.84	2.84	1.76	2.14	1.58	2.16	3.82	74
Maths/Numeracy/Technologies	3.05	2.58	1.79	2.13	1.39	1.81	4.03	19
Other	3.14	2.30*	2.12	2.37	1.69	2.09	3.62	33
No. of students doing activity								
5 or less students	2.70	2.55	1.72	1.95**	1.28***	1.75**	3.59*	62
6 or more students	3.20**	2.77	1.99	2.45**	1.87**	2.42**	4.00**	64
Learning outcome focus^								
Communication skills	2.77	2.75	1.83	2.13	1.57	2.09	3.74	79
Social Skills	3.26*	2.79	1.96	2.38	1.80	2.21	3.84	32
Living or personal care	3.23	2.83	1.94	2.30	1.64	2.11	4.01	33
Other	3.23*	2.71	1.97	2.39	1.69	2.35*	3.99*	50
Disability type of students^								
Autism spectrum disorder	3.05	2.74	1.79	2.16	1.52	2.06	3.87	79
Intellectual	2.84	2.69	1.86	2.22	1.64	2.07	3.71	89
Mental health (social / emotional)	3.44**	2.90	1.76	2.55**	1.95**	2.36	3.93	35
Physical, Sensory	2.78	2.71	1.80	2.22	1.70	2.09	3.48*	30
Disability level of students^								
Mild	3.49***	2.91	1.83	2.59**	1.86**	2.43**	4.14***	44
Moderate	2.85	2.70	1.96	2.23	1.58	2.29	3.85	44
Profound, Significant or Severe	2.44**	2.33*	1.77	1.72***	1.25***	1.46***	3.35***	38
Location mobile devices used^								
In class	2.87	2.71	1.77	2.19	1.52	2.07	3.84	105
Outside classroom at school or excursion	2.97	3.08*	2.34**	2.34	1.83*	2.22	3.82	30
At home	3.20*	2.82	1.88	2.29	1.79*	2.16	3.68	64
Ownership of mobile device								
School, allocated to class for anyone to use	3.02	2.69	1.97	2.09	1.32***	2.01	3.96	47
School, for individual, school use only	2.93	2.68	1.72	2.29	1.67	2.12	3.84	37
School or student - for use at home	2.92	2.78	1.81	2.14	1.51	1.96	3.61	42

Notes:

Pa = Personalisation-Agency; Pc = Personlisation-Customisation; Ac=Authenticity-Context; At=Authencity-Task; Cv=Collaboration-Conversation; Cc=Collaboration-Coconstruction; OL=Overall Learning.

^ Multiple options could be nominated by teacher; totals may not add to 100%

*/**/*** denotes mean significant difference from mean for iPAC & OL dimensions at .1/.05/.01 levels.