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An Anatomy of a Mobilized English Preposition Lesson: Toward Personalized Learning

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Abstract: With the proliferation of mobile computing devices by the current school generation, significant opportunities have emerged for supporting personalized learning experiences through mobile devices. In our pilot study in introducing mobilized curricula to a class, we observed an inspiring mobilized lesson that made the students moved beyond classroom activities and exploited the affordances of mobile learning to provide multiple learning pathways for elementary grade (primary) 2 students. We analyzed how the affordances of mobile computing enable personalized meaningful learning in the lesson from four aspects: (a) allowing multiple entry points and learning pathways, (b) supporting multi-modality, (c) enabling student improvisation in-situ, and (d) supporting the creation and sharing of student artifacts on the move. A key property of mobile technology that enables these affordances lies with the high degree of portability of these devices which make them non-obtrusive in the students' learning spaces. Through the analysis, we hope to inspire the m-learning field to explore further what the affordances of mobile technology can enable in order to inform the design of more effective mobilized lessons.

Keywords: mobile learning, mobilized lesson, personalized learning

Introduction

Ready-to-hand access of light-weight mobile devices creates the potential for a new phase in the evolution of ICT-enhanced learning. They provide affordances for supporting instructional activities in K-12 education that enable personalized learning experiences by the students. In this paper, we present the analysis of an English preposition lesson implemented in a grade (Primary) 2 classroom that shows the potential of creating personalized learning experiences with the affordances of mobile technologies. By analyzing the instructional activities in a real classroom, we want to depict in a lucid way the affordances of the mobile technology for supporting personalized learning.

The curricular unit under study is in the context of intervention research in a primary school in Singapore. We will describe the curriculum design and the actual enactment of one mobilized lesson [1]. By "mobilized lesson", we mean a lesson that starts with an existing lesson design but then is transformed to make use of the mobile technologies. In particular, we will discuss the students' personalized learning during the enactment from the perspective of how the affordances of mobile learning support (a) multiple entry points and learning pathways, (b) multi-modality, (c) in-situ student improvisation, and (d) the sharing and creation of student artifacts on the move. In conclusion, we argue that having one-to-one usage of the mobile device, and the portability of the devices are necessary conditions for unravelling these affordances to provide an integrated learning experience.

1. Theoretical Background

In today's classrooms, there are students who are academically, linguistically, and culturally diverse. Therefore, the number of students that need personalized attention increases, as do the pressure on teachers to meet their needs. When teachers continue to use one-size-fits-all methods for teaching and learning, their students will not succeed. Personalized learning is a pedagogical approach that aims to meet the needs of diverse learners. While "personalized learning" is defined differently by researchers, much of the interpretations converge along the lines of empowering the learners with more autonomy to chart their learning paths. As a result, educationists should prescribe less and encourage more discourse between them and the learners. A successful personalized learning environment will proffer learners with individual learning pathways, more room for creativity, collaboration, communication, content creation, multi-modal learning, problem solving, and to develop students into pro-active learners [2]. Students will be able to demonstrate and access wide-ranging skills and knowledge that may fall outside the 'core' curriculum and/or exist in sites outside schools [3].

When compared to the wide range of technologies, m-learning (mobile learning) is well-positioned to epitomize the benefits of personalized learning. Traxler [4] posits that "mobile learning offers a perspective that differs dramatically from personalized conventional e-Learning in that it supports learning that recognizes the context and history of each individual learner and delivers learning to the learner when and where they want it." (p.7) This is useful in sustaining "porous and flexible boundaries" [3, p.23] between the school and the community. Constant contact with the mobile devices also promotes a sense of ownership, as Low and O'Connell [5] argue that the highly personalized nature of mobile devices provides an excellent platform for the development of learner-centric educational experiences. Along converging lines, Ally [6] makes a case for m-learning by underscoring its ability to contextualize learning, predicated on the grounds that learning and collaboration can take place at any place and anytime. All the above culminate into learner-centric activities marked by flexibility, customization, collaboration, active participation, co-creation and critical reflection [7][8]. Most importantly, m-learning gels with the principles of constructivist principles where multiple learning pathways and scaffolding activities can be constructed, and knowledge can be explored in multiple ways and in multiple contexts that best resonates with the needs of the users [3].

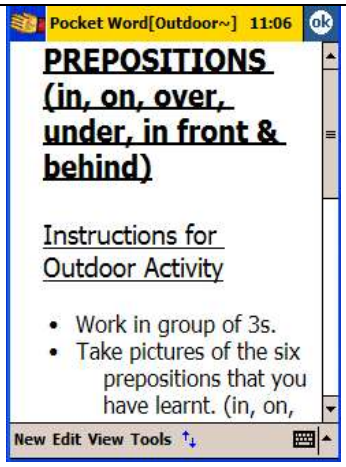
While the potential of mobile technologies for providing and facilitating personalized learning has been well discussed, the detailed design process to achieve such goals is rarely reported, which makes it difficult to localize and contextualize findings across different research projects: What are the conditions for successful personalized learning supported by mobile technology? What are the impacts and challenges that teachers and students are likely to experience in mobilized lessons? Therefore, this paper aims to present the detailed description of the design and enactment of one mobilized lesson and to discuss how the affordances of mobile technology are used to provide personalized learning experiences.

2. Context of the Study

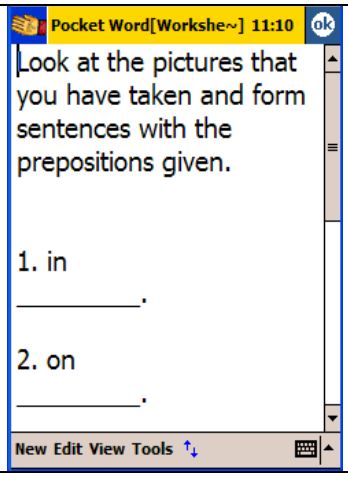
A class of 30 Primary grade 2 (8-year-old) students participated in the pilot study. The adopted mobile device is the HP RX3715 running MS Windows MobileTM 2003. This PocketPC is integrated with features like a digital camera, Wi-Fi, internet browser, voice recorder and text input. We have also installed the GoKnowTM Mobile Learning Environment (MLE) which enables teachers to create mobilized lessons, and students to personalize their learning experiences. Figure 1 depicts how MLE supports teachers in

creating coherent lessons that employ multiple media (text, graphical, spreadsheet, animations, etc).

Project screen in MyProjects of the lesson prepared by the teacher



Outdoor instructions in MS Pocket Word for the photo activity



Worksheet on the photo activity

Figure 1: Screenshots of PocketPC showing project, activity and instructions

The mobilized lesson for the class was an English lesson on the topic of prepositions that lasted 2 hours. The learning outcomes are for the students to be able to use the prepositions such as in, on, over, under, in front and behind; and to form sentences using the prepositions appropriately. Essentially, the lesson consisted of two major activities: (1) Students in groups of three went out of class to designated areas of the campus, took photos and made sentences with their PocketPC's to illustrate the prepositions learnt; (2) Students were given a worksheet (a half-completed story "template" about a "little red ball" (see Figure 2), and were asked to complete the story with their own nouns. They then created animations with SketchyTM, a bundled animation tool of GoKnowTM, to illustrate the story. Table 1 summarizes the flow of instruction in the curricular unit chronologically. For each activity, we depict the functions of mobile technology which support the activity. In order to help understand how students actualize their personalized learning, we have two columns that show the observed teacher-directed moves and student-directed moves when the lesson was enacted in the classroom.

Table 1: The Flow of Instruction in the Curricular Unit

ID	Activity	Use of mobile technology	Teacher-directed moves	Student-initiated moves
A1	Introduction of 6 prepositions	(none)	Teacher talked to prepare for the lesson	
A2	Groups of 3 students go out of the class and take pictures using their handhelds to illustrate the 6 prepositions	Camera function for photo-taking; MS Word™ for making sentences with the prepositions.	Teacher provided a broad task/instruction	Students created their own spatial relationships to illustrate a preposition.
A3	Whole class activity: each group shares their pictures and the associated prepositions	Each group connects their handheld to the teacher's notebook which is then projected for the class to view.	Teacher commented on each group's work	Students clamored to present their work next; when presenting, voiced out the preposition sentences.
A4	Red ball activity: each student is given a story worksheet, asked to fill	MS Word™ for filling in the worksheet; Sketchy™ for	Teacher gave instructions to students to do the paper	Students personalized their experience by

	in the blanks, and to "animate" the story	animating.	worksheet first.	different pathways. Students did not mimic the teacher.
A5	Whole class activity: selected students share their worksheet and Sketchy illustrations	Each group connects their handheld to the teacher's notebook to present.	Teacher commented and praised students' work and animation artifacts.	Students clamored to present their work next; when presenting, voiced out the ball story.

3. How Mobilization Matters

The development and adoption of mobile technology is advancing rapidly. While the devices are changing fast, what remains constant is mobility. The section below describes how the mobilized lesson exploits four affordances of the mobile technology to enable personalized learning.

3.1 Affordance #1: Supporting Multiple Entry Points & Multiple Learning Paths

Supporting drill-and-practice, worksheets typically require students to produce the same answers following the same learning path. However, the "red ball" worksheet created in GoKnow's MLE afforded students a range of starting or entry points and a range of paths through the lesson. Such creative activities support personally meaningful learning [9] and promote a greater sense of ownership in the task [10]. As well, it supported "personalized learning;" that is, students could start with tasks they preferred and continue doing tasks that met with their personal preferences. While all students completed the lesson, they may not have followed the instructions to the letter. Figure 2 shows the story completed by a student and Figure 3 shows a few screenshots of the animation created by the same student.

> The red ball was in my school's PE room. It bounced out and landed on an Angsana plant. Then, it started to roll under the tall, tall lamppost and over the bright sky. The red ball eventually stopped right in front of hot Mars but then it rolled again to finally stop behind the wonderful Earth.

Figure 2: Story completed by a student

Mobile technologies are physically small and do not take up much desk space. As such, they can comfortably coexist with pencil-and-paper medium in the same, often small, student workspace. Since their devices did not dominate their workspace, the 2nd graders in this research moved seamlessly between the two mediums. Furthermore, the task layout in the red ball worksheet supported the students in their fluid movement between the two mediums. For example, in Figure 1 we see "tiles" that express the tasks that the teacher has asked the students to do. There is an implicit order in some of the tasks, e.g., the students needed to take pictures that illustrated the prepositions before they could do the subsequent tasks. However, there is no real order for the next set of tasks. Students took advantage (and from the quality of the work, good advantage) of the lack of specificity in the task ordering. Even students who started with the same task actually took different paths through the subsequent tasks. Here are some examples of the different paths:

- students completed the paper story template by adding nouns to the story, then used Sketchy™ to illustrate each sentence, and then went back to words;
- students did the Sketchy™ first and then went back to fill in their sentences;
- students used Sketchy™ to create their animations first, and then wrote the story;

- students typed the story template in MS Word™ on the handheld and added nouns, then used Sketchy™ to illustrate each sentence, and then went back to words;
- students did the Sketchy™ first and then fill in sentences in Word™ on the handheld;
- students just used Sketchy™ and refused to use paper at all.

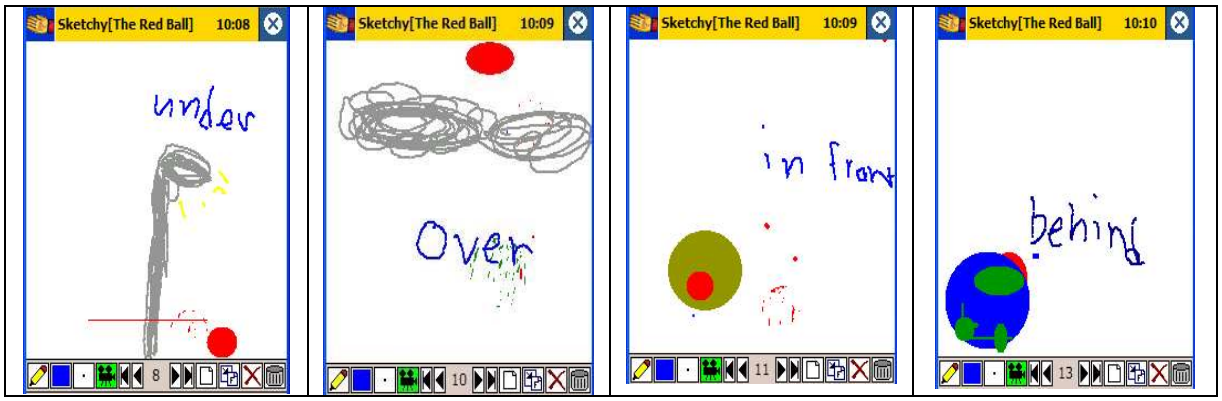


Figure 3: Sketchy™ frames of story by the student

3.2 Affordance #2: Multi-Modality

Multi-modality is an affordance of computer technology; but with mobile technology, students have these devices at hand whenever they need to view or create a different modality that suits their personalized learning. They can address more than one modality such as typing text, drawing concept maps or animations, taking pictures and annotating them, recording or hearing audio clips, and recording or watching videos. The mobility of the devices in this lesson allowed the students to engage with the surrounding environment, and to take photos to record manifestations of the spatial relationship to illustrate their created sentence which used a certain preposition. Their Sketchy™ animations exhibited their conceptual understanding of prepositions, and provided space for much diversity in the range of artifacts produced. The students demonstrated their understanding in different modalities. If they do exercises just on a paper worksheet, they are likely to perceive the activity as that of an assessment. By using mobile devices, they have access to authentic contexts by going out of the classroom and creating a contextual demonstration of a prepositional relationship, and nurturing and promoting more constructive learning from peers.

The lesson brought physicality into cognitive learning by combining physical movements, interacting with objects in the environment, and acting out. The coupling of physical and cognitive activities creates an opportunity for learners to engage in the meaning-making process from their experiences [11][12]. Specifically, the lesson could be characterized as multi-modal in two dimensions – process and product. The lesson provided much variation in the spatial-kinesthetic elements (multi-modal process): students were allowed to wander out of the classroom in the photo activity and worked in groups; they worked individually on the red ball story, and they shared their stories. Mobile technologies uniquely provide support for "multi-modal process." Indeed, even lightweight laptops would not afford the type of in situ, personalized learning experiences that were enabled by the use of PocketPCs. Regarding the product dimension, students wrote on paper on the worksheet as well as sketched animations on the handhelds (multi-modal products).

3.3 Affordance #3: Supporting Student Improvisation In-Situ

Improvisation has been used for many centuries in art and literature classes. It allows students to use their imaginations and push beyond the present to discover new worlds of ideas and experiences [13]. This technique fits well with the one underlying goal of all teachers: to encourage students to think creatively and experience the topic being taught [14]. While improvisation is not a unique affordance of mobile computing, mobility makes it unique by enabling students to do improvisation in-situ. A teacher can set one task for all students, but each student can personalize her own learning by leveraging several degrees of freedom of improvisation that mobile devices enable.

In this lesson, one of the pleasantly surprising findings is students' ability to improvise to create meaningful contexts. When students took photos of arrangements that illustrated each preposition, they were expected to capture naturally occurring arrangements. However, when students found that objects in their zone of the environment did not represent the six prepositions, they enacted the arrangements by changing bodily posture. That is, they exercised their creativity in the context of the space configuration around them. For example, there were two boys standing below the basketball net so as to create a situation for expressing the preposition "below." The mobile technology was a key element in supporting such in-situ improvisations. The students were not intimidated by moving about with the technology and were willing to engage in physical movements to create the illustrative situations. Laptop computers with built in cameras are available; but it is hard to believe that the students would have used those devices in the same flexible manner as they did with the handhelds. A different form of improvisation was also found in the students' attempts to complete the open-ended red ball worksheets where they were told by their teacher to "make up their own stories". While some students created stories similar to the one presented by the teacher, others constructed creative stories using their imagination. Through this engaging activity, students reflected upon the proper contexts in which each preposition could be used, thus achieving the effect of deep learning.

3.4 Affordance #4: Supporting the Creation and Sharing of Artifacts on the Move

With mobile technologies, students can enjoy the ease of creating and sharing artifacts even when they are on the move. During Activity A5, students sitting in close proximity either fully engaged with their learning on their devices or with sharing their personal artifacts with other students. Research has shown that the "audience effects" of "publishing" their work, particularly to a peer audience, motivates students to produce higher quality artifacts [15][16]. In this lesson, the teacher got the students to share their artifacts with each other using the document camera in the classroom. With the incorporation of such sharing activities, the teacher could draw on such "audience effects" during the sharing activities not only for their potential impact of motivation but also for the purpose of peer formative evaluations.

Still further, mobile technology does support the audience effect in that it is easy to "swivel and show" a peer what you are doing. Collaboration is easier since the device is handheld; one does not go to the device; the device goes with the student. Desktop PCs restrict a task to a fixed location, but with mobile technologies, the students can move around while being able to simultaneously access information from both the digital and real worlds [17], and to collaborate around small devices. This affordance allows the students create and share artifacts while they transit seamlessly to different physical spaces, and engaged in different types of activity as individuals or groups.

In analyzing the value mobile devices contributed to this lesson, one affordance is that the software allows the ease of prototyping ideas. Sketchy™ allows low-risk and

low-cost production enabling the students to do quick prototyping of their animations. As compared to paper and pencil, the animations are easy and fast to modify. The form factor of the devices does not seem intimidating to the students. Instead, the smallness of the technology makes them feel empowered, and thus they are willing to take bigger risks, expend more energy and stay on task longer precisely because they are in control. We would not see this same focused activity if the grade 2 students were all on laptop computers seated at their desks.

4. Conclusion

Swan, van't Hooft, and Kratcoski [18] argue that the smaller and less disruptive the device, the more of a chance it stands for becoming a lifelong-learning tool for anyone, anywhere, anytime. Now, the relatively low-cost and small size mobile devices have come to the picture of our classroom learning. This movement toward m-learning is different from the traditional desktop-based computing which often limits learners in fixed physical settings. When learning with mobile devices is carefully designed with consideration given to the unique affordances of mobility, it is possible to create more collaborative and participatory learning experiences. While the lesson was created by the teacher with relatively little prior experience with m-learning, her lesson design manifested the essential features of a mobilized lesson.

In this paper, we presented how a lesson can be mobilized to exploit the pedagogical and technical affordances of mobile devices to provide a personalized learning experience. We postulate other possibilities for further improving the socio-technical design of the use of mobile technologies building upon this one mobilized lesson to further enhance the personalized learning experience. The personalized learning experiences can and should carry on beyond the classroom. If students own their personal device or carry them on a 24/7 basis, then the experience continues out-of-class. The value of mobile technology is significantly enhanced if students learn continuously and seamless with their mobile devices as a ubiquitous mediator [19]. Yet in the classroom, we can already tap the affordances of mobile technology, as in the mobilized lesson discussed in this paper.

In short, this anatomy of a mobilized lesson shows that it is possible in a short period of time to design a compelling lesson activity with appropriate choice of the mobile device, software applications, good activity design, and good teacher facilitation and support. The lesson discussed here provides a microcosm of a mobilized lesson that harnesses the affordances of the technologies to support planned differentiated instruction by the teacher and a kind of personalized learning for students. Our current and future work involves the mobilization of a substantial portion of the primary 3 science curriculum.

Through our observations and analysis of the enactment of these lessons, and artifacts produced, we will have more data to probe the effects of a mobilized curriculum used over a sustained period and effects of 1:1 usage and ownership. We will also do some comparative studies of learning outcomes of classes doing the mobilized lessons and classes that do not use the mobile devices.

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