NEW WINE IN NEW BOTTLES: APPLYING FLOW EXPERIENCE TO MOBILE LEARNING

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ABSTRACT

A key assumption of mobile learning is that its built-in experiences will be enjoyable and proactive, empowering the user with the knowledge and ability to self-manage. This implies that the benefits and critical success factors of mobile learning are not based on learning performance alone. To empirically demonstrate this premise, we report on the flow experience of three different learning spaces, where learners explore a building environment as part of a simulated security guard education program. Our results showed that mobile learning would not significantly enhance learning performance, but nevertheless could provide a better learning experience in terms of attention, curiosity and playfulness. These results can help us to clarify the benefits of mobile learning, and also imply some issues that need to be addressed in the development of mobile learning systems.

KEYWORDS

Flow experience, mobile learning, learning performance

1. INTRODUCTION

It is a hard thing, being right about everything all the time. At least, it is quite true to *mobile learning* in learning superiority. Not everyone likes learning with small handheld devices, and we know many cases where mobile learning never really helps us anything in the first place. Many mobile learning projects are based on the perceived advantages of providing personalized content via the mobile phones that have become so pervasive in recent years (e.g. Horwood 2003.) These projects are designed to generalize the critical success factors that we assume lie behind uptake of these new learning technologies. However, the benefits of mobile learning are not predicated only on *learning performance*. Indeed, the learning performance advantages from several successful mobile learning projects (e.g., Rodgers et al 2005) seem to be very marginal against more traditional pedagogies, hence many educational practitioners still are not entirely sure what advances and benefits mobile learning actually brings to learning activities.

In this regard, Vavoula and Sharples (2002) were right to point out that mobile learning should be '*only*' viewed in particular settings, and integrated into our lives, which implicitly represents a seamless flow of learning experiences. Thus it might be said that is less useful to focus on the outcomes or learning performance from mobile learning, but rather there is a need to understand the ways in which learning activities are enhanced and experienced in context. This article reports on the learning experience and performance of three types of learning systems with which learners explored a physical (or virtual) workspace to be trained as security guards. With this empirical and exploratory study, the paper argues that mobile learning has significant benefits to learners' *flow experiences* and as a consequence one can see the benefits and limitations of the mobile learning environment and the choices we must make when designing learning experiences within it.

2. FLOW EXPERIENCE AND LEARNING PERFORMANCE

Any educational or learning activity concerns itself with improving learning outcomes or performance, and this is also true of mobile learning. However, mobile learning needs to be measured on more than simply enhancing learning performance, since it is not easy to observe any significant benefits from mobile learning against institutional pedagogy (or distance learning) where it has special and important frames of reference for what we believe as *legitimate learning* activities.

Consider a practical successful mobile learning example. In Japan, the Nintendo DS console has been widely used as a multimedia-based English learning tool, which holds out the promise of fun and playful access to an otherwise frustrating learning activity beyond traditional institutional boundaries (Cited in the *Guardian Weekly* 08 August, 2008). The learning outcomes were simply measured by counting how many English words had been remembered by those using the Nintendo DS, as opposed to others who had not used it, and this showed a preference for mobile learning. Although the learning performance measurement seems sufficient to indicate the utilitarian benefits of mobile learning, it cannot alone justify the assumption that the costs and difficulties of a mobile platform do not outweigh the advantages. The potentials of mobile learning have been widely discussed, but while we are combining sophisticated technologies for marginal perceived benefits in learning outcomes, we do not always address how to present learners with appropriate learning experiences, and very few empirical studies on how to measure these learning experiences have been made.

To take the systematic measure of users' experiences, *flow experience* (Csikzentmihalyi, 1990) has been widely applied as a tool for understanding user experience in the human-computer interaction (HCI) domain, to evaluate how satisfied the user is with various aspects of the given system (Hoffman and Novak, 1996, Webster and Martocchio, 1992). It is generally said that *flow* is a holistic control sensation where one acts with total *involvement* or *engagement* with a particular activity, with a narrowing of *focus of control* (Csikzentmihalyi, 1990). From our perspective, it implies that, in order to experience flow while engaged in a mobile learning activity, learners must perceive a balance between their controls and the challenges of the activity, by which we present learners with playful interaction, exploratory behavior and positive subjecting experience (Hoffman and Novak, 1996). *'Seamless Flow'* in mobile learning is central to this article, in that we suggest it is a useful construct for describing and measuring the benefits of mobile learning.

3. METHOD

The experiment described here was suggested by our prior understanding of the *flow experience*. To empirically investigate this research question, a learning program that might be used for security guards was developed. This learning program was intended to allow security guards to explore a physical (or virtual) space to become competent in securing a specific premises. Three types of learning system (paper-based, mobile-based, and virtual game-based) were developed to see the differences in both the learning performance and flow experience. The paper-based learning system was regarded as a control condition, and the virtual game-based system was built upon the fact that game-based learning activities would present a highly engaging learning experience (Prensky, 2000).

3.1 Participants/Experimental Design

A total of 53 subjects voluntarily participated in the study, none of whom had physically explored the premises before, and around half of them were females.

The experimental design was a between-subjects factorial. The three types of system given were the main between-subjects independent variable, and the participant's spatial capability was considered as a nuisance independent variable in the corresponding analysis. In particular, the paper-based learning was a control condition, and only nine out of 53 participants were assigned to this treatment. The dependent variables used the ratings on the questions (see below) regarding the flow experience and the number of correct answers about the five rooms measured the learning performance.

(a) (b) (c)

Figure 1. Three experimental conditions (a) Paper-based learning; (b) Virtual game-based learning; (c) Mobile learning

3.2 Apparatus/Procedure

As depicted in Figure 1(a), the paper-based learning system contained the five rooms to be visited and their names, the virtual game-based learning (see Figure 1(b)) was created on Active Worlds™ (activeworlds.com) with the same information, and a PDA with narrative information was used for mobile learning as shown in Figure 1(c). After the participants completed the learning session (the building contains 23 rooms, and the participants were guided by the system given to visit five of them), all of them were asked to write down the locations of the five rooms and their names on the map, and then were then asked to give their ratings on the flow experience questions (Webster et al, 1993) as follows:

- *Control* – 'When using the mobile device (paper/game), I felt in control', 'I felt that I had no control over my interaction with the mobile device (paper/game)', and 'The mobile device (paper/game) allowed me to control the interaction';
- *Attention focus* – 'When using the mobile device (paper/game), I thought about other things', 'When using the mobile device (paper/game), I was aware of distractions', and 'When using the mobile device (paper/game), I was totally absorbed in what I was doing';
- *Curiosity* – 'Using the mobile device (paper/game) excited my curiosity', 'Interacting with the mobile device (paper/game) made me curious', and 'Using the mobile device (paper/game) aroused my imagination';
- *Playfulness* –'Using the mobile device (paper/game) bored me', 'Using the mobile device (paper/game) was intrinsically interesting', and 'The mobile device (paper/game) was fun for me to use.'

4. RESULTS

We noted that the learners with the virtual game-based learning system performed the experimental task poorly, when compared with the other two systems, which might indicate limitations to this type of learning application (Table 1). However the virtual game-based learning did not allow the learners to physically visit the rooms, so the performance measure was not of great value. Comparing the paper-based and mobile systems seems to indicate that a non-sophisticated learning material (paper-based learning in this case) would have the same benefit that the mobile learning application can present (differences were not statistically significant.) Note that both systems asked the learners to physically visit the five rooms.

Table 1. Learning performance (max: 100)

System	N	Learning performance Mean (s.d)	sig.
Paper	9	68.89 (28.48)	
Mobile	24	61.67 (39.53)	$p \leq .05$
Game	20	31.75 (29.53)	

A one-way analysis of variance was conducted on the learning performance, revealing that there was significant effect of the system given ($F_{2,50} = 5.51$, $p \leq .05$). A Tukey test (at $p \leq .05$) was performed to further examine the effect of the systems, indicating the virtual game-based learning program was worse than the other two, which were not significantly different from each other.

These results may be influenced by individual differences in spatial ability (Sjölinder 1998, Stanney and Salvendy 1995), which may be a nuisance independent variable, and additional analyses were thus carried out. Tables 2 and 3 give the mean learning performances by the participant's spatial capability. For high spatial ability individuals, there seemed to be no significant difference; but the low spatial ability individuals seemed not to prefer the mobile system. This is very much in line with Sjölinder's (1998) study.

A two-way (system × spatial ability) between analysis of variance was conducted on the learning performance, revealing that there was no significant interaction effect between the two independent variables ($F_{2,47} = 2.76$, n.s.); but there was a significant simple main effect of spatial ability on the learning performance, particularly in those who have low spatial ability ($F_{2,24} = 3.48$, $p \leq .05$). A Tukey test (at $p \leq .05$) confirmed that mobile system led to significantly poorer performance for those of low spatial ability.

Table 2. Learning performance by high spatial individuals (max: 100)

System	N	Mean learning performance (s.d)	sig.
Paper	6	86.67 (10.33)	
Mobile	17	84.71 (16.63)	n.s
Game	4	77.50 (16.58)	

Table 3. Learning performance by low spatial individuals (max: 100)

System	N	Mean learning performance (s.d)	sig.
Paper	3	33.33 (11.55)	
Mobile	7	5.71 (9.76)	p≤ .05
Game	16	20.31 (18.75)	

Contrary to the performance measure, the ratings of flow experience revealed a rather different pattern. '*Control*' asks whether an activity encourages exploratory behaviors, with the expectation that learners who experienced feelings of control over interaction in learning would give a higher rating. '*Attention*' is a necessary condition for achieving flow experience, being narrowed to a limited stimulus, so higher ratings on these questions mean more engagement in learning activities. '*Cognitive curiosity*' and the desire to attain competence with the learning application may motivate to learn more skills where the challenges are matched by the user's skills, so higher ratings on these questions imply willingness to use the technology again, and finally, Webster et al (1993) termed '*playfulness*' as subjective experiences during interactions that are characterized by perceptions of pleasure and involvement. The higher ratings on these questions mean the learners are so intensively involved in the learning activity that nothing else seems to matter.

Table 4. The ratings of the questions for each contributor were averaged out to give one face value in each column

System	Control	Attention	Curiosity	Playfulness
Paper	3.56	3.78	3.44*	2.78*
Mobile	3.38	3.96	4.04	3.88
Game	3.60	2.90*	3.75	3.75
sig.	n.s	p≤ .05	p≤ .05	p≤ .05

Note: * significantly different from the others by a Tukey test at p≤ .05

Table 4 gives the mean ratings for the three experimental settings across the four contributors to the flow experience, where it can be seen that there is an effect of the system. In most cases, except control, mobile learning gives the highest ratings, and the virtual game-based learning follows, results which differ from learning performance measures . For each factor, a one-way between-subjects analysis of variance was applied, followed by a Tukey test (at $p \leq .05$).

5. CONCLUSIONS AND DISCUSSION

We have empirically investigated the flow effect as one potential framework to explain the benefits of mobile learning, This expermental research provided a naturalistic learning program in the context of different learning experiences. Comparisons of the three configurations allowed us to assess the potential value of the mobile learning experiences available in this experimental context. The first evaluation on the learning performance suggested that a non-sophisticated technology (i.e., paper-based) could be useful to such education activities, which implies no significant benefits from mobile learning technologies. However, the second evaluation on the flow experience quantitatively confirmed the significant advantages of the mobile learning and game-based learning systems over the conventional pedagogy. Neither of these possibilities had been demonstrated empirically before.

Of course, other samples in other contexts may give different results and the generalization of these results can only be tested by further studies, which are now being planned. However, taken at face values the results are encouraging. They suggest that the narrow focus of learning performance does not capture the potential variety and emergent aspects of mobile learning activities. Practitioners, as well as researchers, should instead embrace the notion of learning experiences, for a better understanding of the important values that mobile learning can provide.

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