SENSORIMOTOR DISTRACTIONS WHEN LEARNING WITH MOBILE PHONES ON-THE-MOVE

Soledad Castellano and Inmaculada Arnedillo-Sánchez
School of Computer Science and Statistics
Trinity College Dublin

ABSTRACT

This paper presents a discussion on potential conflicts originated by sensorimotor distractions when learning with mobile phones on-the-move. While research in mobile learning points to the possibility of everywhere, all the time learning; research in the area suggests that tasks performed while on-the-move predominantly require low cognitive processing. This work uses Bloom's taxonomy to identify low and high order thinking activities associated to the functionalities of a mobile phone. It also provides preliminary results from a survey identifying correlations between high and low cognitive processing tasks and locations involving users' sensorimotor engagement.

1. INTRODUCTION

The advent of mobile phones in the educational field has prompted investigation into how these devices could contribute to enhancing teaching and learning. Mobile phones provide possibilities for everywhere, all-the-time learning without the constraints of physical connection to networks (Kaneko et al., 2015; Sailer et al., 2015). The increasing usage of phones on-the-move is well documented. For instance Sharples et al. (2007) reported that 49% of everyday adults' learning episodes happened away from home or the work place and, a study on 5013 adult mobile phones users concluded 87% of them use smartphone on-the-go (Media, 2011).

While being on-the-move demands the engagement of gross motor skills and senses, engaging in a learning task demands cognitive resources; if performed simultaneously, cognitive resources are divided between the two tasks. To this end, tasks demanding little thinking and concrete answers, require Low Cognitive Demand (LCD) (Stein & Smith, 1998) and may be compatible with the use of mobile phones on-the move. On the contrary, tasks requiring High Cognitive Demand (HCD) seem to be harder to perform when on-the-move. This paper explores how on-the-move interaction with mobile phones, which engage gross motor performance and senses, may affect the performance of HCD learning tasks. Applying Bloom's taxonomy to data of mobile phone usage, we identify situations in which on-the-move tasks with mobile phones are those requiring LCD.

2. RELATED WORK

M-learning has been largely studied from a techno-centric perspective as learning through mobile and handheld devices (Dyson et al., 2009) which facilitate learners' mobility. From this perspective, mobile phones provide access to instructional materials and connection with others while at home, work, or on-route (Kaneko et al., 2015). They afford learners 24/7 access and everywhere learning without the constraints of physical connection to networks (Georgiev et al., 2004; Sailer et al., 2015). However, limitations related with performing learning tasks while on-the-move are reported. For instance, Kim et al. (2005) indicate using mobile Internet requires participants to be static involving immobile legs, low visual and auditory distractions, few people around, and low interaction. Furthermore, contextual features may also affect how learners engage with technologies and in-turn influence learning processes. Spaces, such as leisure or work spaces, associated with comfort or a relaxed state of mind (Kukulska-Hulme, 2012) improve the conditions for learning and, body posture and movement (standing, sitting and walking position) are recognized as an important feature of context (Bristow et al., 2004). To this end, Tabuenca et al., (2012) illustrate reading mainly happens while on the train (50.33%), on the bus (40.82%), or accompanying the car driver (36.73%), while listening takes place while walking (48.3%). Thus, studies on users' habits with mobile phones indicate that while activities performed on mobile phones requiring low cognitive workload are compatible with body movement; those involving high cognitive workload are not suitable for learning on-the-move.

Bloom's taxonomy offers a systematic method for classifying the cognitive domain associated with cognitive activity, according to increasing levels of demand (from lowest:1. Remembering; to highest: 6. Creating). The taxonomy has also been applied to digital tools to classify activities arising from their use into cognitive levels according to their demand. Similarly, Patten et al., (2006) propose a mobile learning functional framework which classifies mobile applications according to their functionality and the pedagogical approach they afford to identify the type of learning they support. Arising from Bloom's Taxonomy the table below identifies the relation between a) the different levels of cognition from Bloom's taxonomy, b) the related activities with digital tools and, c) learning approaches associated with functionality of mobile phones. Thus, within the context of this work, the taxonomy offers the potential for identifying the cognitive level of tasks performed with mobile phones while on-the-move.

Table 1. Bloom's taxonomy & mobile learning with handheld devices

Bloom's taxonomy	**Activities**	**Activities with digital tools**	**Patten, Arnedillo-Sánchez & Tangney (2006)**
6.Creating	Designing, constructing, planning, producing, inventing, devising, making	Programing, filming, animating, blogging, video blogging, mixing, re-mixing, wiki-ing, videocasting, podscasting, directing.	*Collaborative applications:*
5.Evaluating	Checking, hypothesizing, critiquing, experimenting, judging, testing, detecting, monitoring.	Blog commenting, reviewing, posting, moderating, collaborating, testing	*Collaborative applications*: encourage knowledge sharing while making use of the learner's physical context and mobility.
4.Analyze	Comparing, organizing, deconstructing, attributing, outlining, finding, structuring, integrating.	Hacking, mashing, linking, validating, cracking	*Interactive applications*: transcend information management and content delivery by focusing on engaging users through a 'response and feedback' approach.
3.Applying	Implementing, carrying out, using, executing	Running, loading, playing, operating, uploading, sharing with groups, editing	*Microworld:* support the construction of knowledge through experimentation in constrained models of real world domains
2.Understanding	Interpreting, summarizing, inferring, paraphrasing, classifying, comparing,	Boolean searches, advanced searches, blog journaling, tweeting, categorizing, tagging, commenting, annotating, subscribing	*Data collection / reference applications:* Enable access to content and its manipulation
1.Remembering	Recognizing, listing. Describing, identifying, retrieving, naming, locating, finding, matching	Bullet pointing, highlighting, book marking, group networking, share bookmarking, searching	*Administrative / referential applications:* not driven by any real pedagogical philosophy

3. METHODOLOGY

A survey to analyze mobile learners' behavior was undertaken. The survey collected data on activities performed with portable devices such as mobile phones, tablet or laptops in different locations which require users body-engagement and non-body-engagement. Building on previous work (Sharples et al., 2009), the survey focuses on the learner's mobility as the core construct to be analysed and considers four dimensions of mobility: a) *Technological* considering the mobility of users through different devices; b) *Spatial* including mobility in physical space; c) *Conceptual* involving mobility at a cognitive level when shifting attention between learning tasks; and d) *Social* encompassing mobility across different social groups. A questionnaire was the chosen data collection method for this study because it affords the opportunity to generalize from a sample to a population (Babbie, 1990) and possibility to collect a large set of data from a sizeable population in a highly economical way (Saunders et al., 2009, p. 144). Demographic questions include gender, age and country. Participants were asked to indicate from a matrix of choices, with multiple answers allowed, a sequence of association between: a) device and location, b) device and task, c) task and social group, and finally, d) device and social group.

The survey collected data from 511 participants. The gender distribution of the sample was balanced with 51,38% man and 48,62% women. Responses were received mainly from Spain, but also from central and south American countries such as Argentina, Brazil, Chile, Colombia, Mexico, Portugal, Venezuela, and others. The average age of participants was 36 - 40-year-old (22,3%) followed by those age 31- 35 at 16,5% and those 26 - 30 at 15,2%.

4. RESULTS

This paper identifies the performance of tasks with mobile phones. The tasks have been classified following Bloom's taxonomy as follows: High Cognitive Demand (HCD) tasks are associated to the two highest categories identified in Bloom's taxonomy, Creating and Evaluating; Moderate Cognitive Demand (MCD) tasks to Analysis and Application; and, finally Low Cognitive Demand (LCD) tasks Understanding and Remembering (table 2).

Table 2. Tasks associated with Bloom's taxonomy

	HCD tasks		**MCD tasks**		**LCD tasks**	
Bloom's taxonomy	**Creating**	**Evaluating**	**Analyze**	**Applying**	**Understanding**	**Remembering**
Tasks	Reading Creating video presentations Making video conferences Working with documents Working with databases		Chatting Geolocation Listening to music Recording audios Recording videos Searching the internet Sending-receiving audios Sending emails Sending-receiving videos Playing Writing notes		Social networking Managing agenda Send/receive instant messages Send/ receive pictures Receive emails Set reminders Take pictures	

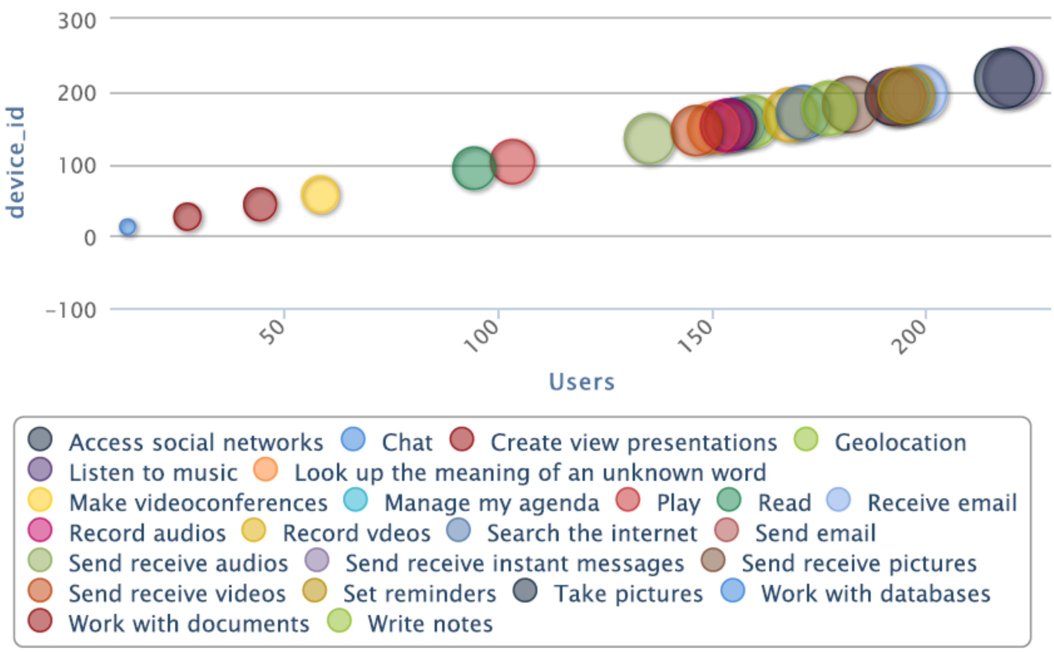

Figure 1. Type of task performed with smartphone on the street

Preliminary results show how the performance of tasks that require HCD are mainly carried out in situations where users don't have to split their attention while carrying out to activities simultaneously. Namely, and activity requiring sensorimotor and cognitive engagement at once. Although mobile phones lend themselves to be used in a wide range of locations, it appears there are limitations regarding task performance when using highly portable devices while on-the-move. For instance, while the most popular tasks to perform on a mobile phone are taking pictures and sending and receiving messages; other activities such as reading and searching the internet trigger users to switch devices to less portable ones.

The bubble chart (figure 1) illustrates correlations between the type of tasks performed with greater or lesser use of mobile phones on-the-move and cognitive demand of tasks. For instance, HCD tasks such as working with database or creating presentations and low usage of smartphones. However, the use of smartphones increases as the task requires less cognitive demand.

5. CONCLUSION

The usage of smartphone has been associated with 24/7 access and everywhere learning providing the potential to learn while moving around. However, the results of this study provide some insight into the impact of using mobile phones on-the-move. Tasks that require HCD seem to be incompatible with the use of mobile phones while on-the-move. These results suggest that there is a conflict when performing HCD tasks simultaneously with a motor activity requiring users to split their attention. Future work will involve an in-depth analysis of the correlation between HCD tasks and a simultaneous motor activity.

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