

The Design of MicroLearning Experiences: A Research Agenda (On Microlearning)

Silvia Gabrielli, Stephen Kimani, Tiziana Catarci

Università di Roma "La Sapienza" (Roma, Italy)
Dipartimento di Informatica e Sistemistica

Abstract: In this paper we focus on the interaction design properties of microlearning experiences to outline relevant research directions and main challenges of the field. We start by analyzing current efforts in the area of educational technologies in terms of their support of anytime-anywhere access to learning resources, which is a core property of microlearning environments. We also overview learning theories that are relevant to address the lifelong dimension of informal everyday activities of knowledge acquisition. From this discussion a set of design requirements and evaluation issues are derived to inform future investigation and experimentations in the microlearning area.

1. Introduction

Technological innovation has made our society a knowledge intensive one, where successful performance of individuals or groups heavily relies on the acquisition and use of relevant information contents and suitable communication means to achieve task objectives. Microlearning is a new research area aimed at exploring new ways of responding to the growing need for lifelong learning or learning on demand of members of our society, such as knowledge workers [6][11]. It is based on the idea of developing small chunks of learning content and flexible technologies that can enable learners to access them more easily in specific moments and conditions of the day, for example during time breaks or while on the move. In this paper we analyse, from an interaction design perspective, which are the core requirements, as well as some main challenges, in the design of microlearning experiences. We start by focusing on the spatial and temporal dimensions of learning to identify possible differences and synergies of microlearning with other current approaches to educational technologies. In section 3 we briefly discuss learning theories that are relevant to inform microlearning environments, while in section 4 we list a minimum set of requirements that should be met by this type of learning contexts. Section 5 suggests possible methodological

approaches for the design/evaluation of microlearning concepts and scenarios, according to the requirements listed above. It also raises a number of issues, such as the evaluation of lifelong microlearning experiences, that seem to have been particularly difficult to tackle by learning studies till now [1]. We conclude the paper by sketching some interesting areas of inquiry for microlearning that should be part of its research agenda.

2. Anytime-Anywhere Access to Learning Resources

Microlearning activities, by definition, rely on access to learning resources which may happen at the time of breaks or gaps in learners daily work/life activities. Since these gaps may take place in many different space locations and moments of time, microlearning is definitely the most typical form of anytime-anywhere learning. Also, research literature has shown that much learning in life is often informal, in fact "opportunistic and strictly under the control of the learner" [10]. Marchionini and Maurer say that learners take advantage of other people, technology, and the context during informal learning. Some research also indicates that informal (science) learning outside the formal class setting significantly contributes to the motivation to learn [17]. It is rather interesting to note that nearly 85% of students' time is spent outside formal classroom settings [3].

In Fig. 1 we compare different typologies of educational environments and technologies that might support informal learning by taking into account their temporal-spatial dimensions. Pervasive learning environments, for example, are characterised by the presence of embedded technologies and a series of small devices like tags, sensors, badges etc., that are dedicated to detect, observe and build dynamic models of the environment and learners' activities, so as to adapt to (and possibly support better) learning processes [11]. Among interesting applications of pervasive technologies, we mention mixed realities environments for learning [12], that recently have been developed to transform or augment traditional learning activities carried out indoor (classroom) or outdoor by designing innovative interfaces between the physical and the digital world [13][14]. However, the complexity of design and dedicated nature of these environments make their use quite limited and localized in terms of time/space dimensions [11].

A more desktop-based type of experience is provided by Computer Assisted Learning Environments and Web-based applications on which most of eLearning systems and activities typically rely on. In some way, the large availability of desktop computers and simple network connections in everyday environments (like home, work etc.) increases the level of anywhere/anytime access to eLearning by its users. However, a pos-

sible disadvantage of this conditions is that the devices and learning contents typically used for eLearning are not particularly easy to move or transfer from one place/device to another, neither specifically suitable to be accessed while on the move. To remove this problem mobile learning environments are more appropriate to use, since they are based on portable devices like PDAs, cellular phones etc., supported by wireless network connections to enable a flexible and seamless accessexchange of learning contents anytime and anywhere. This is particularly important for microlearning experiences, that due to their ubiquitous emergence and lifelong duration, need to integrate the mobility capabilities of these devices with the computational power and support provided by pervasive/ubiquitous environments. This would be expected to effectively support learners in their access and transfer of learning resources across different surroundings, as microlearning requires. Moreover, it has been observed that in mobile computing user activities tend to be implicit, opportunistic, and informal. Mobile users tend to rely on (or indirectly take advantage of) the context, including aspects such as: location, infrastructure/resources, environment, time, and other people. Considering the previous observations reported in [10] [17], mobile computing does therefore afford a great opportunity for supporting (micro)learning [7].

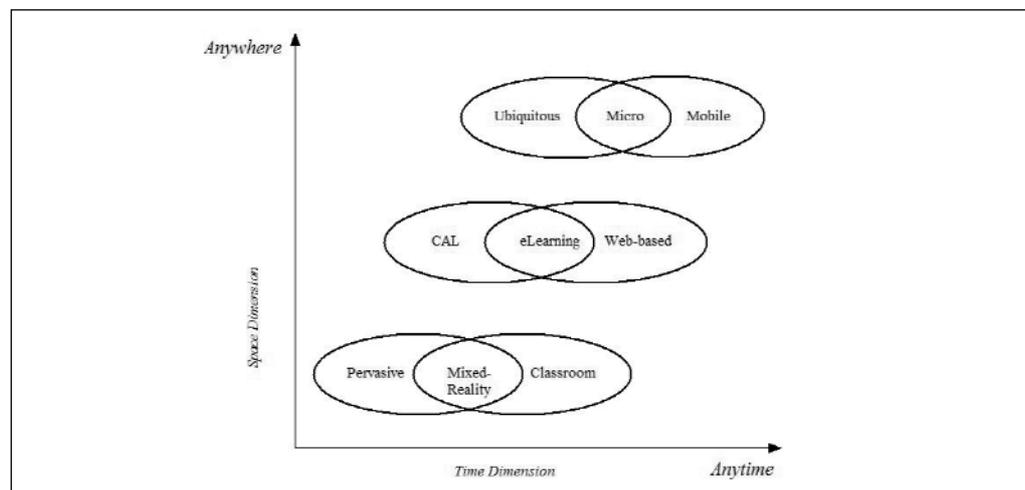


Fig.1: Types of Learning Environments according to Temporal-Spatial Access

3. Learning Theories for MicroLearning

All the learning environments mentioned above share the same foundation on constructivism and/or social cultural theory as a common understanding of knowledge acquisition [4][5][20][21]. Microlearning makes no exception to that, but can also be informed by a range of more recent learning approaches, projects¹ and studies, that have focused on investigating the characteristics of adult learning during lifelong activities [8][18]. A main observation from these studies has been that most adult learning happens outside formal education. It often responds to the need for a personal/professional growth of individuals that dedicate part of their (informal) daily activities to the acquisition of new competences or to an updating of their knowledge, motivated by changing conditions or circumstances in life (for example getting prepared for a new job).

Also, informal learning typically is based on task specific activities, where learners are interested more to access very specific pieces of information instead of a complete body of knowledge, in order to support decision making or the acquisition of a certain skill [18].

Mobile and ubiquitous technologies are particularly indicated to support this type of learning; in the case of microlearning they should be designed to enable a natural blending of it within the flow of everyday activities carried out by learners.

It is also worth mentioning that these technologies are suitable to support both intentional and unintentional types of learning; the former are characterised by intensive and deliberate efforts to acquire new knowledge by a learner, the latter consist of not deliberate learning experiences derived from conversations, observations in the world, accidents etc., that cannot be planned in advance, but are potentially enabled as unexpected outcomes from the informal learning activities [8][18].

Microlearning is thus to be considered a contextual lifelong learning process, that according to [15] is most effective when it can enable activities such as:

- i) the construction of knowledge, by means of finding new solutions to problems or creating connections between past and current experiences,
- ii) conversation with both the social/physical world and with oneself (like in reflection, experimentation in the world and interpretation of results) as well as,
- iii) learner control over any continuing cycles of experimentation and reflection.

¹ See, for instance, some results of the MOBIlearn EU Project "Guidelines for Developing Mobile Learning Deliverable"

4. Main Requirements of MicroLearning Experiences

In the light of the microlearning properties discussed above, we now provide a list of requirements that should guide the design of both technologies and contents for microlearning experiences.

According to our analysis, they should be:

1. highly transferable and unobtrusive of the learner's activities, so that learners can easily download and upload the didactic materials they have been provided from one device to another. This should also enable learners to work always on the most updated version of the learning material wherever they are, by using the most appropriate device according to the specific conditions in which they happen to carry on learning activities. This would also entail the study of natural interfaces for multimodal interaction with the learning system to support the learners in situations such as: multitasking, hands-free or eyes-free interaction, exposure to possible distractions (noise, interruptions, etc.) from the surrounding environment.
2. Easily available and user-friendly, enabling anytime-anywhere access to it, supported by the use of mobile phones, PDAs or other wireless communication devices connected also by Local Area Networks (LANs). Usability aspects of microlearning technologies and contents should be analysed carefully, in such a way to enable the most intuitive and straightforward interaction with them by people with different levels of expertise with technologies.
3. Persistent, meaning that the learning environment including all the modifications operated on it by a learner in a lifetime, should be independent from its physical instantiation on a certain device, thus easily accessible at anytime through the specific technology at hand. The use of a persistent user profile may enable the learner freedom in accessing her same profile from different devices, settings and for different services.
4. Useful, especially through enhancing the different activities contributing to the achievement of the learning goal(s). This is only possible if technologies are able to present an adequate and simple image of the learning environment to the user, no matter how complex its inner organization might be. For microlearning, appropriate system metaphors, especially 'off the desktop' ones, should be uncovered and studied in order to fulfil this requirement.
5. Individual as well as sharable, so that they adequately support individual learning activities but also enable learners to get or provide support from/to peers, tutors or other experts by the use of communication technology.
6. Adaptable and/or adaptive to learners' needs, so that different interaction styles can be selected by learners according to their preferences or skills (for instance,

their level of expertise with the learning environment) or automatically suggested by the system according to specific learner profiles or models developed during lifetime interactions with the microlearning environment. Personalization features should be carefully designed to avoid making user interaction more complex or running against principles such as transparency, predictability, control etc.. By contrast, the aim of this requirement is to support a more natural and consistent interaction of the learner with digital (learning) resources, according to the opportunities and affordances provided by everyday environments.

As far as microlearning contents are concerned, below we mention a number of meta-requirements that, according to the theoretical approaches cited in section 3, should be fulfilled. In particular, they should:

1. promote the acquisition of basic skills such as flexibility and adaptability in learners, making them aware of the very rapid and changing nature of knowledge in everyday environments,
2. foster the development of creativity skills, as well as problem solving and managing competences,
3. capitalize on learners communication abilities as a way of supporting the social production and reconstruction of knowledge during learning and working activities and try to improve them by providing learners ways of analysing their own communication styles as recurrently practiced in the field.

5. Design and Evaluation Approaches

So far we have discussed possible suggestions for developing effective microlearning experiences. However, due to the early stage of work in this field much experimentation at the level of design and evaluation of microlearning environments is required. If we analyse research in innovative design areas such as ubiquitous computing, we can observe that participatory design approaches or observation of users' activities in authentic everyday settings have been the most appropriate methods applied to generate relevant data to inform design [12][16]. We claim that adopting this approach would also be key for microlearning, due to the need of uncovering original and effective combinations of microcontent with natural interfaces to support learners during their lifelong knowledge acquisition. Ethnographic observations, as well as participatory design techniques, may provide interesting hints for developing design concepts to be tested in microlearning scenarios of use. Previous studies have demonstrated how technological possibilities, if appropriately presented to users within meaningful

and (possibly) authentic scenarios, can be of inspiration for developing creative and useful design solutions that would hardly be found by following more traditional design approaches [12]. As we mentioned before, new metaphors beyond the ones currently used in distant education should be devised and investigated to present a more appropriate microlearning system image to its users. This should be founded on indepth and longitudinal analyses of learners actions and interactions with the physical world and with microlearning resources as they are experienced and reused for knowledge acquisition.

Evaluation studies on microlearning would also be key to inform a better design of these systems. For what concerns evaluating microlearning technologies, usability approaches could inform the analysis of microlearning concepts and scenarios. However, assessing usability of cutting edge technologies for which usually only proof-of-concepts or early prototypes are available, might be particularly difficult. This is because task centric evaluation techniques are not ideal to be applied for studying informal everyday activities and also because it is unclear how it would be possible to apply quantitative evaluations or controlled experiments to assess lifelong learning processes. For the evaluation of more advanced and robust microlearning systems some adapted usability techniques may turn out to be useful, for instance, recent efforts towards developing usability heuristics for the evaluation of mobile environments/applications (such as [9], [19]) and shared environments (such as [2]). Somewhat problematic would also be measuring the effectiveness of microlearning experiences in terms of the learning objectives achieved. Specifically, a main challenge would be to assess achievements at the level of metaskills acquired by the learner through a life long assimilation and personal (re)interpretation of the contents provided. This is an area where currently more investigation is required. If microlearning research will undertake this challenge it is likely to provide interesting insights for a better understanding of learning activities as instantiated within everyday informal settings.

6. Conclusion

This brief excursus in the field of microlearning theory and technological development has shown that there are several areas and opportunities for future inquiry that promise to advance the state of the art in microlearning and also to bring relevant results to the HCI community interested on educational technologies. To summarize, some main directions to be included into the microlearning research agenda are the following:

- Experimentation into the design of anytime anywhere access to digital learning resources by devising ubiquitous computer interfaces and suitable interaction metaphors enabling flexible use of microlearning environments by learners during informal lifelong learning activities.
- The development and application of different combinations of HCI methodologies for a better analysis and understanding of lifelong learning practices within authentic scenarios of use, by means also of iterative and participatory generation of design concepts and solutions, suitable to match learners' needs.
- The design of cutting edge technologies and prototypes responding to the list of microlearning requirements mentioned in section 4 and possibly to an extended list of them as informed by current and future research on everyday use of ubiquitous/mobile technologies.
- The study of more suited evaluation methods for microlearning environments that would properly take into account the lifelong dimension of learning, as well as any future advancement of teaching methods and models more specifically addressed to match the emerging requirements of informal learning activities.

7. References

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