

Usability principles to design mobile workplace learning content

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Abstract

L'articolo descrive la progettazione di un intervento di formazione continua attraverso dispositivi mobili per i formatori del Centro Internazionale di Formazione dell'Organizzazione Internazionale del Lavoro (ITCILO). Lo scopo principale è di fornire ai formatori uno strumento che permetta di ricordare le informazioni al momento del bisogno e continuare a imparare in un contesto specifico. Pertanto è stato creato un set di carte dotate di elementi virtuali (realtà aumentata). Per l'ideazione dei contenuti sono stati presi in considerazione principi di usabilità per dispositivi mobili ed è stata condotta una attività con i formatori allo scopo di testarne l'usabilità e l'apprendibilità. I risultati mostrano che l'integrazione di elementi fisici (carte) ed elementi virtuali (realtà aumentata) dà ai formatori la libertà di scegliere come recuperare le informazioni; infine, tale caratteristica contribuisce ad un'alta usabilità delle carte, e pertanto alla loro efficacia nel contesto.

Parole chiave: apprendimento mobile; usabilità; realtà aumentata; formazione professionale.

Abstract

The article describes the design of a mobile workplace learning tool for trainers of the International Training Centre of the International Labour Organization. The motivation behind is to provide trainers with a practical tool that will enable them to recall information at the moment of need and continue to learn in context. On this purpose a set of visual augmented reality cards was created, taking into consideration the fundamental mobile learning and usability principles. The nature of the article is empirical as it reports an experiment carried out with trainers which aimed at testing cards usability and learnability. Results show that the integration of both online and offline strategies was perceived as an added value as trainers could choose to retrieve information as they mostly like; finally, it also resulted in high usability scores, an aspect that contributes to their effectiveness at the workplace.

Keywords: m-learning; usability; workplace learning; augmented reality.

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1. Introduction

According to constructivism, people learn by observation, processing and interpretation, and then personalise the information into personal knowledge (Cooper, 1993). Mobile technology is creating new opportunities to impact the learning experience as it allows learners to learn wherever they are located and in their personal context so that learning becomes more meaningful (Sharples, 2000). In many settings it may be valuable for learners to be able to access learning materials via their mobile device while performing a task. In particular at the workplace, mobile technology may facilitate learning by providing workers with just-in-time information and support them when required. As a result many organizations, institutes and companies have been focusing on the added value of mobile technologies and methodologies to enhance learning activities and innovate learning at the workplace.

However, when designing materials for mobile devices, certain elements must be kept in mind such as the type of mobile infrastructure to be used, the audience's familiarity level with mobile technology and, last but not least, the screen size of mobile devices.

In addition to this, proper navigation must be built into the system to allow learners to move between different screens and sections using the smallest amount of text (Ally, 2004). According to the theory of dual coding (Paivio, 1986), memory is indeed enhanced when information is presented both in the verbal and visual form.

Therefore, when it comes to mobile devices it is even more important to combine different media such as videos, audios and images to support text as reading on a the screen is definitely more difficult than reading on paper.

On the other hand, research on readability and comprehension with small screens shows that even for very small displays of only a few lines of text, users can read and understand information well (Uther, 2002). Therefore, small devices can be used effectively for presentation of information. Nonetheless, there is also evidence that to a certain point, the size of the display and the amount of information presented will impact on the users' performance. Learners' most common negative comments when dealing with mobile learning materials show common frustration with the design and usability of the information: e.g. too much reading from a small screen.

It is therefore clear that although mobile learning offers many advantages to learn in the context and in a flexible way, it is important to take into account how learning materials are presented and delivered. The design of the materials must be based on sound learning theories and instructional design principles (Ally, 2004). On this purpose, the following characteristics should be taken into account for the incorporation of mobile learning into education environments: using authentic contexts, targeting learners who are mobile, providing enough time for exploration of mobile technologies, blending mobile and non-mobile technologies together, employing the learners' own mobile devices (Herrington, Herrington & Mantei, 2009). In particular, it should be highlighted the importance of keeping the learner's interface simple in a way that it contains only information that can fit comfortably on the screen (Elias, 2011).

This article at hand provides an example of the integration of mobile learning principles to facilitate workplace learning for professional trainers of the International Training Centre of the International Labour Organisation (ITCILO). In particular, the article

describes the design principles taken into consideration to deliver learning content mediated by mobile devices. The aim of the design intervention is to create a mobile learning solution that enable trainers to recall needed information in context through reading and understanding on a mobile device, and help them to achieve the desired learning outcomes.

The nature of this article is empirical as it reports a research based on experiments and observations. It is structured as follows: in the next section we describe the research questions, the context and the target audience involved; then, the mobile learning principles adopted. Finally, we introduce the methods used to gather feedback about the mobile learning solution proposed. Results will be reported and limitations and conclusions are discussed.

2. Research questions

From a pedagogical perspective, usability is about ensuring good educational experiences and enabling successful interactions. Learners will reject learning materials that are not usable; therefore usability has an impact on learning effectiveness and efficiency (Traxler & Kukulska-Hulme, 2005). Based on these assumptions, the research questions for this study were:

- can mobile devices, and therefore mobile content support learning in context for trainers?
- despite technology limitations, is mobile content usable and simple?

The study at hand tries to describe the design principles taken into consideration to produce a reliable, learnable and usable tool for ITCILO trainers. Methods and instruments used were focused on determining whether mobile learning and usability principles are an appropriate basis for delivering effective instructional content.

3. Context

The International Training Centre of the International Labour Organisation (ITCILO) is an advanced vocational training institute based in Turin, Italy. It provides training and related services that develop human resources either in campus or in field countries all around the world. Their staff is therefore by definition mobile as trainers and facilitators are often performing outside the traditional classroom settings provided in the Turin campus. In this case, mobile workplace learning interventions would facilitate ITCILO employees to stay up-to-date.

A staff learning needs analysis was conducted between December 2012 and March 2013 in order to organise staff development activities more strategically. Overall, staff indicated that more investment in alternative learning modalities other than formal training on campus would be welcome.

Speaking of alternative learning modalities, mobile learning is often linked to freedom of time and space. Nevertheless it should be framed in a specific context, a concept not acknowledged by “anywhere, anytime”. In fact, learners tend to take their learning tools with them to the most appropriate places (Parsons, 2014). Therefore, it is important that

any mobile learning action strategically uses already available tools and integrates them into workplace learning initiatives.

To facilitate meaningful learning interventions for ITCILO trainers, it was decided to focus on an already available tool and make it mobile for trainers to acquire knowledge in the context and at the moment of need. The Compass is an ITCILO project which uses the metaphor of a navigational instrument to guide trainers through a repository of participatory learning, training and knowledge sharing methods. It orients the design of learning and training activities and provides inspiration in the search for useful, effective and relevant learning and training methodologies. It contains sixty participatory knowledge sharing methods and technologies to be used in any workshops or meeting. These methods have already been developed and validated in workshops all over the world, and are available online on a dedicated website (<http://compass.itcilo.org>) (Figure 1) where it is possible to find step-by-step guidance for each method together with examples and case studies.



Figure 1. Screenshot from the Compass website.

The Compass is an useful workplace learning tool for trainers as it helps them to achieve their training aim, offering activities which suit different kinds of learners, group sizes, time limits and learning targets. Moreover, it helps trainers to make informed decisions about the development of learning activities and choice of appropriate methods, tools and resources to undertake them.

To encourage the exploration of methodologies by ITCILO colleagues, it was decided to make the Compass even more accessible to trainers. This decision was informed by prior request by trainers who asked to make the Compass available offline as well as online in a handy format to be easily carried and used on the spot, while travelling or while planning a training session in field countries. At first some trainers asked for the creation of a mobile application to be downloaded on smartphones but this option was not taken into consideration as colleagues without a smartphone will not be able to access the application. It was therefore decided to develop a fully mobile set of cards that trainers and facilitators can take with them while travelling.

Cards are as portable as a mobile device; they can be carried on field missions and can support informed decisions even when internet connection is unstable. From the point of

view of mobile learning principles, they allow integration of both traditional and digital information. They are suited for workplace learning as they represent a quick-reference learning tool and as a visual support to explain to stakeholders show participatory the training will be. Finally, cards are not only a performance support tool but can be used in training sessions to describe methods.

4. The Compass method cards: design principles

The design of cards as workplace performance support tools for trainers takes into consideration one of the foundation of the mobile learning principles: blending mobile and non mobile technologies, and the opportunity to use different media for delivering learning content and information. For these reasons, it was decided to use the cards to deliver both paper-based and digital information. The former is constituted by an image on the front side of the card (Figure 2) visualizing space patterns and how learners move in the space, summarising the main steps needed to implement each method and highlighting its participatory nature. Each image is an architectural description on how people occupy the space during the method implementation, including people, tables, walls and phases.

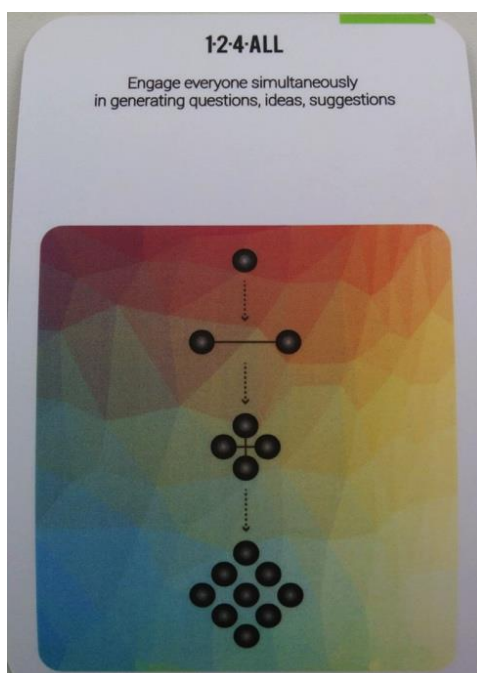


Figure 2. Card front side: the image describes the participatory nature of the method which starts with an individual reflective phase; then a peer-to-peer discussion; a four people discussion and finally a group interaction.

The image is also complemented by text on the back side of the card (Figure 3), where the trainer can find information related to the time, number of learners and main reasons to use a method. The trainer can also find a shortened link to retrieve the extended information on the Compass website.



Figure 3. Card back side: on the top part, a group of icons describes the nature of the method, the time needed and the number of participants. Below a short paragraph summarising the nature of the method, its main aims and a short link.

In order to bring this mobile set of cards to a further stage, cards were embedded with augmented reality which allow trainers to retrieve information in a digital format. By doing so, it was taken into consideration the fact that the interface needs to be simple and use a proper navigation. Moreover, digital information needs to complement the paper-based one. The augmented reality application selected for this experiment is called Junaio (<http://www.junaio.com/>) (Figure 3) and it allows overlaying information available on the card with additional materials. The application was selected for its userfriendliness and for providing no cost for the end-user.

Once downloaded the Junaio application on their mobile devices, trainers can choose between two buttons overlaying the image on the card. The first button will redirect them on the Compass website, while the second button will present a short animated video which illustrates the main steps involved in the implementation of the method and the main strengths for using the method through use of images.



Figure 4. While scanning the Compass card, two buttons will appear for the user to choose between visiting the website or watching an instructional video.

5. Methodology

A mobile workplace learning activity was organized in July 2014 at ITCILO campus. Its main objective was to let ITCILO trainers use the mobile set of Compass cards while interacting with informal space settings. In this way it was possible to re-create the potential situation in which trainers are not working in traditional workplace settings and need to recall information about methodologies.

Participants were divided into four groups of about five trainers of different age, gender, background and expertise. Each group was assigned a specific informal space within the campus and a Compass method to use in order to conduct a brainstorming activity in a participatory way (Figure 5). The Compass methods chosen for generating ideas were: Participatory 3D Modelling, Top 100 list, 25/10 Crowdsourcing. Overall each group received a Compass card, a legend with instructions on augmented reality and materials such as paper, pens and post-it to do the brainstorming.



Figure 5. A group of ITCILO trainers scanning the Compass cards to prepare a brainstorming session in the courtyard of the campus.

6. Target

The activity addressed ITCILO staff working in training departments, namely trainers, facilitators and programme assistants. Overall 23 staff participated to the session belonging to different departments. Among them, 78% (n=18) were women and 28% (n=5) were men. The majority 33% (n=8) was between 41-50 years old; following 51-60 years old (28%, n=6), 31-40 years old (22%, n=5) and 20-30 years old (17%, n=4).

As for mobile technology, 33% (n=8) of them stated that they already owned a smartphone and a tablet; 52% (n=12) only owned a smartphone; 5% (n=1) of them owned a low-end phone and a tablet; 10% (n=2) of them owned a low-end phone but reported to be familiar with a tablet.

Only 15% (n=3) of the participants stated that they regularly used augmented reality; 20% (n=5) of them could give a definition of it; the vast majority, 45% (n=10) said to have heard about it and finally 20% (n=5) never heard about it.

7. Instruments

To assess the usability and learnability of the Compass method cards, it was decided to compile qualitative information resulting from observing trainers during the activity, together with quantitative information collected through a questionnaire provided at the end of the activity. The questionnaire was based on Brooke (1996) System Usability Scale (SUS) which provides a quick reliable tool to evaluate mobile devices giving a global view of subjective assessments of usability. The SUS questionnaire consists of ten items with a 5-point Likert scale that range from strongly agree to strongly disagree. However, SUS does not only measure usability of tools, but also the dimension of learnability. In particular, items four and ten of the questionnaire can be reported as a separate measure of learnability (see Appendix 1 for the full instrument).

8. Qualitative results

During the activity, it was noted that some people had difficulties in using augmented reality as rich-data information was not loading. The problem was caused because internet connection within the campus was not highly stable therefore it was difficult to download videos and links. In these cases, trainers had to rely on the information provided on the card itself or accessing the short web link provided on the card by typing it manually on their mobile device. Below a selection of comments reported by ITCILO trainers who took part in the activity:

- “I consider cards good and useful. I just have a comment about the augmented reality that does not always work, depending very much on the connection”;
- “The cards are excellent for professional facilitators to remind them of the existence of the methods”;
- “The embedded QR code is great; same for the legend that goes with the cards. Great product!”.

9. Quantitative results

A SUS questionnaire was provided via email at the end of the mobile workplace activity. 65% (n=15) of the trainers who participated completed the questionnaire.

According to literature, the average SUS score is a 68. A SUS score above a 68 would be considered above average and anything below 68 is below average.

Figure 6 provides an overview of the results collected. The Compass method cards had a SUS mean of 79,8 that can be split into two dimensions: usability and learnability.

SUS	Usability	Learnability
79,8	80,0	79,2
67,5	71,9	50,0
95,0	93,8	100,0
82,5	90,6	50,0
87,5	84,4	100,0
75,0	75,0	75,0
92,5	90,6	100,0
77,5	75,0	87,5
87,5	87,5	87,5
77,5	78,1	75,0
62,5	65,6	50,0
87,5	84,4	100,0
92,5	90,6	100,0
60,0	62,5	50,0
80,0	78,1	87,5
72,5	71,9	75,0

Figure 6. SUS scores results from 15 trainers.

From Figure 6, both usability and learnability scored above average.

Converting the scores to percentile rank (Figure 7), the Compass method cards has higher perceived usability than 87,61% than all products; 83,98% of hardware; and 96,32% than mobile devices.

A raw SUS score of 79,8 has a higher SUS score than:

All products	87,61%
Hardware products	83,98%
Mobile devices	96,32%

Figure 7. Converting SUS score to percentile rank.

Finally, given the high scores on learnability ($m=79,2$), Compass cards are considered as simple and easy to understand.

10. Conclusion

The creation of the Compass method cards for ITCILO trainers was motivated by the demand of providing alternative learning modalities at the workplace. They are meant to be a performance support tool for mobile trainers having to design face-to-face sessions through participatory methods. The cards were conceived as a mobile learning solution embedding both offline (paper) and online (augmented reality) content and were designed by taking into consideration learning and usability principles for delivering mobile content. This study provides a description of the design steps undertaken and of the

activity used to assess their effectiveness at the workplace. During the activity it was possible to carry out brainstorming exercises having ITCILO trainers using the cards to implement a specific method outside traditional classroom settings. Generally trainers appreciated the visual nature of the cards and perceived them as a “good and useful” performance support tool with high perceived usability. However, it is important to stress that they also highlighted some limitations while using the augmented reality due to unstable internet connection. On the other hand, the fact that cards provided both online and offline information was perceived as an added value as trainers could choose to retrieve information as they mostly like or according to internet connectivity. By comparing the usability scores with available benchmarks, it results that the cards have a high rank with respect to both mobile devices and hardware products. Learnability is also closely linked to usability: the better the learnability of an application, the less training and time it will take for a person to use it. This aspect is particularly important when creating a tool for professional use as employers are less likely to invest time for training.

Overall, it can be stated that despite technology limitations the Compass cards deliver usable and simple content which supports trainers making informed decisions in the context.

As a further step towards the evolution of the cards, a new usability and learnability test should be conducted on a new sample of trainers to compare the results and eventually improve the information delivered both online and offline. In addition to this, a qualitative survey can be conducted to ask if different or extra information should be integrated on the card also.

Appendix 1

The System Usability Scale (SUS) questionnaire

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

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