# M-Learning In Practice: Language Learning Mobile Application

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**Abstract***: Serious debate continues on the issue of m-learning, even though it was defined by UNESCO in 2013. Many scholars "know" that mobile learning (m-learning) is just another type of e-learning, and this conviction is given greater validity than the definition. Nevertheless, we have designed and developed a mobile application to study the principles of m-learning, to establish whether it is merely a different name for e-learning or if it constitutes a shift in the concept. With the mobile application (BlaBla™) for language learning (Slovene for foreigners), we went beyond the favorable natural science area, which is always more appropriate for media learning demonstration. In the article we present an exploration of both the constraints inherent in using mobile devices and the preparation of m-learning materials. We also present the mobile application and a small-scale practical experiment. From our experience with e-learning and in comparing it to m-learning, we can confirm other researchers' finding that m-learning is not just e-learning with mobile devices, but does represent a shift in the learning concept.*

Keywords: m-learning, design, language learning, mobile-assisted language learning (MALL), information and communications technology (ICT)

## 1 Introduction

Any scholar, parent or careful observer can see that children love haptic user interface devices. This preference probably originates in the fact that a haptic user interface does not need mediation between the desired input and input device behavior. We all need to learn that the command *Mouse up* actually means mouse forward and is not an instruction to lift the mouse into the air. A haptic user interface has many advantages, along with some drawbacks. Some of us still cannot imagine writing a long letter or an article on the touch screen, and even simple text editing is quite difficult. This obstacles provides the first hint that portable devices are not as similar to computers as many would like to persuade us. Nothing beats a keyboard for text editing. Should we therefore consider portable devices only as toys? Is it true that m-learning is for fun only? What precisely is m-learning?

> *Mobile learning involves the use of mobile technology, either alone or in combination with other information and communication technology (ICT), to enable learning anytime and anywhere. Learning can unfold in a variety of ways: people can use mobile devices to access educational resources, connect with others, or create content, both inside and outside classrooms. Mobile learning also encompasses efforts to support broad educational goals such as the effective administration of school systems and improved communication between schools and families* [56].

The primary motive for m-learning is not the learning or mobile technology itself but their mutual combination [15], in such a way that learning materials can be used outside the classroom and without scheduled time constraints. M-learning comes from e-learning that combines ICT and web for teaching and learning; however, it is conceptually different because of the constraints of mobile devices (Figure 1). Learning materials for computer use are not suitable for portable devices because of the following issues: (a) visual constraints of mobile devices, (b) employment of the haptic user interface, and (c) education supported by the haptic user interface [37] [38] [32].

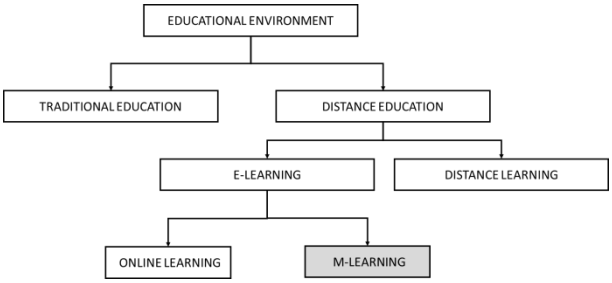


Figure 1: Mobile learning environment [34]

Until 2009 m-learning was considered as just a form of mobile e-learning or distance e-learning [54]. Today, however, the differences are so huge that these learning modes share only a common background [16].

In the last decade many digital and web innovations have been introduced and embraced in education [40]. Nevertheless, many educational institutions implement new technologies into their educational system slowly because of many complex reasons: insufficient budget, established technological infrastructure, organizational

rigidity, and unsupportive leadership [1]. With the new capacity to use mobile ICT for learning, many new studies are being conducted in the area of m-learning and ultra-portable devices with a haptic user interface [58]. One such study was conducted at our educational institution, using the mobile application BlaBla™ (mobile learning of Slovene language) [43].

The application of m-learning to traditional learning results in blended learning (also known as hybrid learning, the blended learning model or B-learn). At the start of the 21st century when the theory of e-learning was emerging, blended learning was considered as adhering to the e-learning principles. There still exists convergent naming for learning with ICT: CBL (Computer Based Learning), CAI (Computer Assisted Instruction), TBT (Technology Based Training) and other less common designations [39].

Blended learning is a concept of teaching and learning where traditional (frontal) education embraces different learning principles and educational technology [29]. The definition of blended learning has not yet been academically established; thus, four distinct concepts of blended learning can be found [18]:

1. Combination of different web technologies to achieve educational goal (i.e. virtual classrooms, self-learning, cooperative learning, streaming video, audio and text).
2. Combination of pedagogical approaches to achieve optimal learning result with educational technology or without it (i.e. constructivism, behaviorism, cognitivism).
3. Combination of any type of educational technology with frontal lecturing (i.e. AV technology and web).
4. Combination of educational technology with actual work assignments to achieve harmony in learning and work.

However, many authors advocate only definitions that have emerged since 2006, ones in which blended learning is defined as combined learning in a formal educational program where learners use learning materials partly on the web--where time, place and pace are self-regulated-- and partly at the educational institution (away from home) [13]. With this definition in mind, we come to m-learning, where "whenever and wherever" form the substrate for all modern definitions [56].

# 2 Considerations about mobile devices and mobile applications

We have conducted a research experiment in learning Slovene as a foreign language. For the purpose of the blended learning experiment, we designed and developed a mobile application for android devices that would facilitate Slovene language learning. The foundation for the language learning was the intensive course in Slovene for visitors--ERASMUS EILC--where foreign students first meet with the new language. The mobile learning application was developed as a prototype for a few multimedia supported topics (text, graphics and sound). We assumed that foreign students would be sufficiently proficient in English, so all explanations were in English. The application called BlaBla™ follows the principles of personalization and individualization of language learning processes. There are two distinct settings for female and male learners and, depending on these settings, the application selects the topics for vocabulary acquisition. This application was developed to our design specifications by professionals from the Melionet and Gimag companies. The nature of the human-computer interface is a paramount consideration in designing mobile user interfaces, one that requires knowledge of the learning topics and of learning topic design, while also demanding an understanding of user psychology.

In the design and development we needed to consider the minimal and recommended system requirements. Ignoring the minimal system requirements will result in frustration on the part of the user. It is therefore wise to prevent application installation if minimal system requirements are not met [23].

It is necessary to understand the differences in the design of desktop and mobile applications. A mobile application is not a scaled down or downgraded version of a desktop application [9], but is an autonomous entity that functions in the distinct mobile environment under "conditions of use, multitasking, motion and connection" [44]. Mobile applications are undergoing constant, rapid evolution, and at any given time on the market there are a multitude of devices with significantly different hardware (processors, memory, screen sizes and operation systems). In such an environment, we need to specify a system that is good enough to run our application [25].

The selection of such system requirements was not easy; however, according to our survey, most of our exchange students (79%) have mobile phones that meets minimal system requirements. Therefore, we were able to form an experimental group from half of the students; the rest were in the control group.

# 3 User interface

The user interface is one of the most important parts of the computer program and determines the quality of user communication with the program logic [48]. Today most computer programs use GUI (Graphics User Interface) for user-computer communication. Navigational elements (toolbars, windows, buttons, and icons) are thus selected with keyboard, mouse, touchpad or haptic screens [4]. GUI controls program behavior and has become standard in all operation systems. A good user interface ensures user friendliness and enables interaction with software and hardware in a natural and intuitive way [52].

# 4 Design guidelines

General guidelines for the design of user interfaces for handheld devices [22] evolved from the basic rules for

facilitating effective interaction between human and PC (Personal Computer) "*Shneiderman's Golden Rules of Interface Design*" [47]. Because the haptic user interface has matured, the contemporary interaction model is different. Mobile devices are not considered as portable, low capacity PCs. Effort is focused on the users' behavior and on achieving optimal connectivity with the internet, given the capabilities of a haptic user interface [17]. Therefore, haptic mobile user design requires some changes [24]:

1. Simple, clear, and consistent navigation is a must (#consistency).
2. User friendly application must enable users to master the application in minutes (#ergonomics).
3. Learning materials must not require frequent screen scrolling (#scalability).
4. Flexibility of the screen is an extremely important feature for the usability of the interface (#flexibility).
5. Only information relevant to the learning process need be displayed; all other irrelevant information is considered didactic noise (#relevance).
6. Amount of text needs to be minimized, with images or animation used to decrease cognitive load and maintain motivation (#less_is_more).
7. Educational processes are exclusively controlled by users (#control).

# 5 Touch screen – haptic input device

For the design of m-learning user interfaces, two facts should be taken into consideration: (a) users have a wildly differing set of dimensions (screen sizes) on their ultra-portable devices, all of which require (#flexibility) automated positioning of navigation elements and learning content on the screen; and (b) differences between PC and mobile devices; while the haptic interface on mobile devices enables direct sensor-motoric coordination of content [8], the computer mouse is an indirect device [27], and an indirect computer interface always presents a significant cognitive challenge in mental transformation [14].

Direct interaction through body movement (a finger touch) does not require mental transformation and is much more suitable for learning because of the low cognitive load [12]. Effective interaction is governed by #ergonomics; a phone's touch screen is often used with one hand only. In such cases it is fundamental to place key elements on the ellipsoid path of the thumb. For those who use a phone with two hands, the size of the screen elements is more important. There is a negative correlation between the size of the screen elements and the probability of incorrect entry or selection of invalid program functions. This is also why elementary functions should be moved away from the basic movement of the thumb or be made small enough to retain their navigational functionality, while at the same time minimizing the risk of accidental selection [5]. The zones of thumb movement and positioning of the elements are shown on the image (Figure 2) where [26]

1. is the primary zone used for repeating actions on learning content (selection, movement, play), and
2. is the secondary zone reserved for single system commands (exit, undo, confirm, delete etc.).

The reader should be aware that a mouse is not the same as a touch screen. Mouse actions always retain the same meaning, but touching the screen can differ from application to application [20].

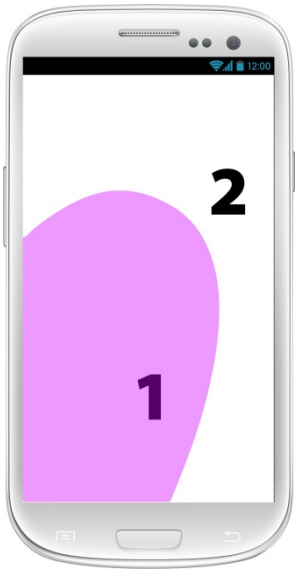


Figure 2: Thumb zones on the phone screen (right-handed user)

# 6 Navigation

Good user interface design should always obey the system-wide navigational pattern. There are differences between Android, iOS and Windows mobile navigational patterns, and for the sake of #consistency, we need to design navigation accordingly. In our case we decided to place the navigational elements on screen according to the Android philosophy of navigation (see Figure 3)

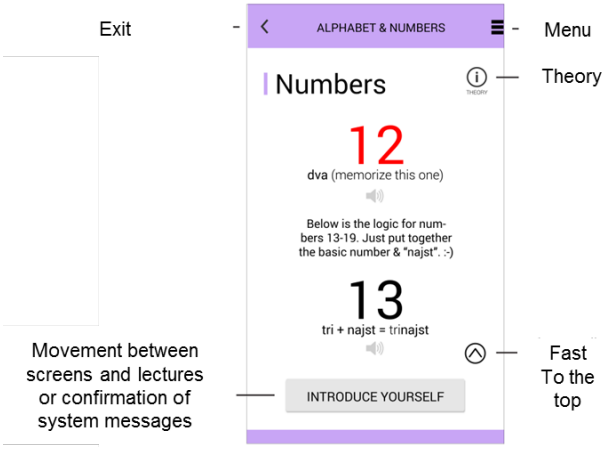


Figure 3: Position of navigational elements

# 7 Design foundations

In our mobile application BlaBla™, we chose to use a minimalistic approach--#less_is_more. In the study "Empirical Explorations of HCI for Mobile CSCW" [34], it was shown that too many visual stimuli on a mobile device distracts the user from the content. Therefore, we chose not to use rich gradient elements but to employ simple single-color or text components subordinate to the content [57]. We also use pictograms wherever feasible. It was particularly useful in the lecture "Know your garment" (Figure 9), where the picture of a single garment item proved to be much less mentally demanding than highly ambiguous text for those whose primary language was not English (students involved in the experiment had varying levels of competency in English). Such an approach was therefore more suitable from the perspective of cognitive load theory (CLT) and optimizes intellectual capacity for the perceptive activities important for learning, since different information sources can induce cognitive overload and complicate the learning process [11] [50]. With this strategy, we also observe the "spatial and temporal contiguity principle," where it has been proven that learners retain more knowledge/facts if corresponding words and images are displayed in the immediate spatial vicinity [36].

# 8 Multimedia in language learning

Along with curriculum and learning activities, learning materials are key elements in the design of a language learning method which defines language learning as speaking, understanding spoken language, understanding text and being able to write in the foreign language [46]. Research into m-learning in multimedia language learning spans the range of activities: from strategic analysis of multimedia learning materials, to the cognitive psychology of multimedia theories [42]. Our research was therefore based on an interactive perspective on foreign language learning, where learning has three key functions: understandable input, interactivity, and understandable language production [31] [35] [42] [49]. The m-learning user interface is designed with words, sound recordings and images and presented in the continuum of "input" - "intake" - "output" [41] to accomplish #relevance and encourage receptive understanding and language reproduction.

# 9 Customization and differentiation of the user interface

Any language differentiates between typical male and female subsets of language. To encourage intrinsic user motivation, we follow the didactic differentiation in accompanying social gender substrate [53]. This implies effective development of morphological, morphosyntactic and phonological abilities of learners in two distinct versions: male and female. We used a common color coding for male (blue) and female (purple) in the user interface (Figure 4) and appropriate use of either a male or female voice to satisfy a gender-based approach to pronunciation accuracy [28]. Female and male speakers do self-differentiate in many attributes: pitch and the shorter vocal tract of the female voice [2]; moreover, males more often reduce vowels in verbs in rapid speech. We should never use a male voice to impersonate a female and vice versa, since it sounds unnatural [55].

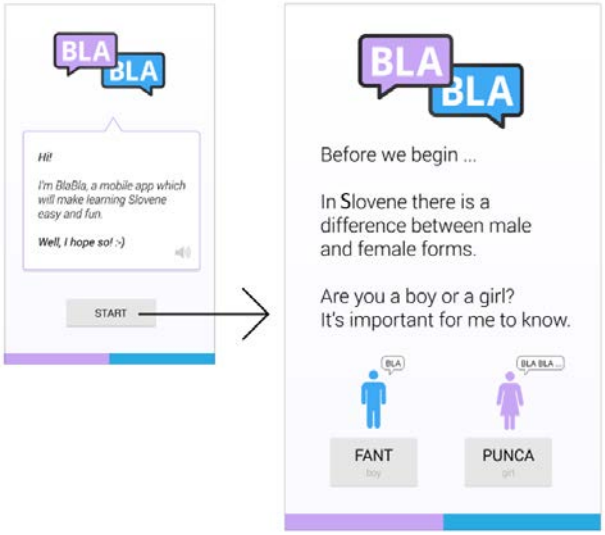


Figure 4: Gender differentiation of the application setting

# 10 Mobile application topics and didactic implications

Though we initially aimed to prepare a mobile application for the whole EILC course, it soon become evident that we lacked the manpower to do so. The skeleton topics can be sketched easily; the design process, on the other hand, takes time, since we need to minimize the content to fit the screen. The necessary additions (multimedia elements, interactive quizzes, theory) require even more time. These constraints limited us to the following topics:

1. Alphabet and numbers
2. Introduce yourself
3. Describe your family,
4. What are you wearing? and
5. Playground

**Alphabet and numbers** (Figure 5)

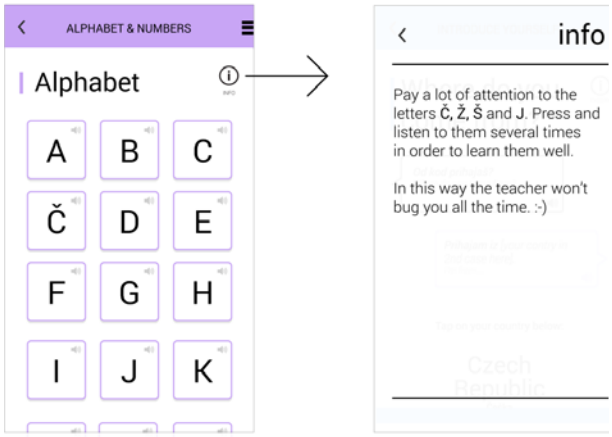


Figure 5: Alphabet in mobile application with theory

This topic is not just the list of letters and numbers used in Slovene. It is necessary to give learners the knowledge of how to pronounce different letters singly and in the text. Slovene uses only three glyphs (exclusively a breve) and does not use any diacritics to guide users in pronunciation. In the matter of numbers, the Slovenian language differs from other Slavic languages in the combination of numbers (we use reverse order in two cipher numbers: i.e., 21 is combined as one and twenty). Each of these peculiarities requires a small but accurate explanation (theory).

**Introduce yourself (**Figure 6**,** Figure 7**)**

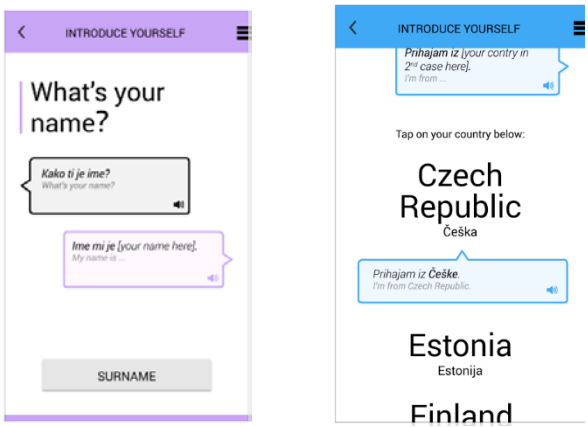


Figure 6: Your name and home country

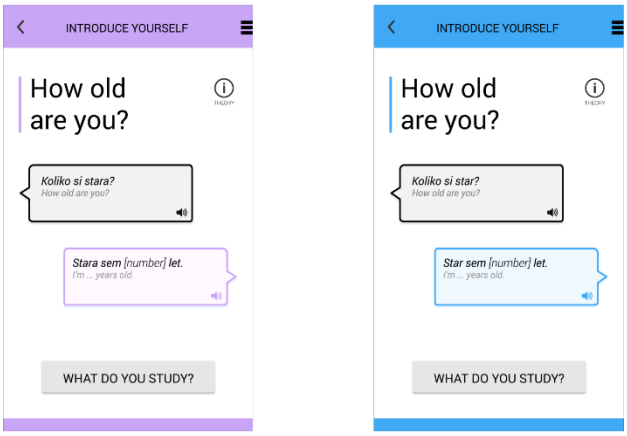


Figure 7: Age of female/male

**Describe your family (**Figure 8**)**

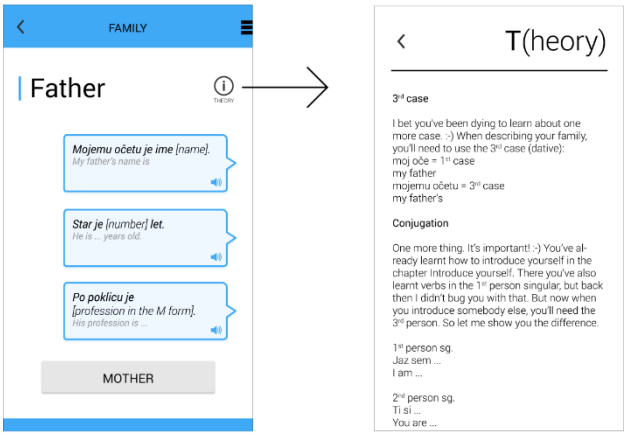


Figure 8: Describe your father (name/age/profession) with the theory

**What are you wearing? (**Figure 9**)**


| What are you wearing? | |
|---|---|
| **Vprašanje** | **Odgovor** |
| ***Kaj imaš na sebi?*** *What are you wearing?* | ***Na sebi imam [clothing in the 4th case].*** *I'm wearing ...* |
| **Slika** | **Izjava** |
|  | ***Na sebi imam [color] čevlje.*** *čevlji (shoes, M. pl)* |
|  | ***Na sebi imam [color] škornje.*** *škornji (boots, M. pl)* |
|  | ***Na sebi imam [color] športne copate.*** *športni copati (sneakers, M. pl)* |
|  | ***Na sebi imam [color] hlače.*** |

Figure 9: Colors and garments (scenario)

**Playground (**Figure 10**)**


Figure 10: Pick an activity

**Didactic implications**

From past experience with the development of e-learning materials, we know the importance of finding a way to stimulate learner activity. Some e-learning materials produced in the previous project [3] [51] were used in schools and proved to be less efficient than we had envisaged [19] [33]. It has become evident that we need to add topics where we stimulate creativity on the part of learners. This used to be achieved through individual written assignments. In the mobile world we cannot do the same. It is impractical, if not impossible to prepare a large textual input on a mobile device. Therefore, we need to use mobile devices in a manner totally different from that of computers (even laptops). Instead of providing guidelines for learners, m-learning materials provide "just in time learning". Learners receive general guidelines on what to do, and the mobile device provides the necessary data when it becomes relevant – not in the classroom but in the real environment outside the classroom. Preparing such mobile learning materials means anticipating the learner's needs and providing fast searching and efficient navigation. The learner should not be inundated with information but should gain access to just the right amount of information elicited by a specific situation. Many studies have already compared e-learning and m-learning [6] [7] [10]. To better explain the differences between e-learning and m-learning, we have prepared a table (Table 1).

Table 1: Differences between e-learning and m-learning

| | e-learning | m-learning |
|---|---|---|
| processing power | Computer or laptop, enough computing power for any learning materials | mobile device, limited computing power. Even web browsing is slow |
| screen size | large, any content fits the screen | small, limited even at higher resolution |
| interaction with the device | mouse, keyboard | haptic (touch screen), not suitable for long textual input, limited editing possibilities |
| intended usage | computer classroom, special working place, indoor, established learning environment (institution or home) | mobile, outside, in real environment (world). |
| outside influences | almost none | environmental sound, light, weather, battery capacity |
| information access | provided by infrastructure (wired or wireless) | limited access to outside information sources and internet |
| didactic strategy | self-learning, blended learning, support for learning, search for new information, (self)evaluation, | mobile learning (extension of learner's capability). e.g. *I know that the facts/ answers/ instructions are in my phone* |
| application | review and study experiments again (after school presentation), learn from the materials, prepare reports | support for experimental work or field work |
| learning methods | different | learning on demand – situation-based. |
| materials attributes | any type of learning materials | specially designed for small screens, scenario based materials, minimalistic |
| aim | activated learning with multiple presentation techniques, long term retention of knowledge, for in-depth study, "just in case" | provides support for real world experience, information access on demand, learner's portable memory, "just in time"/ "just enough" / "just for me" |
| time constraints | no constraints, on demand | real time |
| interactivity | any kind of interactivity, | limited to effective navigation |

These differences between e-learning and m-learning and our experience with both types of learning have persuaded us that m-learning in not just e-learning with mobile devices but is a distinct concept.

# 11 Experiment

The mobile app BlaBla™ was developed specifically for the needs of a pedagogical experiment in which we established both mobile user preferences and the potential of m-learning as part of the organized intensive language course EILC (Erasmus Intensive Language Courses). Prior to the development of mobile applications, we monitored the dynamic aspect of learning Slovene as a foreign language and researched current theoretical foundations of mobile learning; the results are included in the concept of the user interface and content chunk size, with which we aimed to confirm m-learning as a promising form of foreign language education.

A free EILC course in the Slovenian language is available to all foreign students who study in Slovenia. It is funded by the EU through Erasmus student exchange funds. In 2013 and 2014 two courses were held at the Faculty of Arts at the University of Maribor.

In 2013 we gained valuable insight into the foreign students' activities, learning behavior, common faults and mistakes, major problems faced in language learning and motivation. This first course was used for software specification, while the second was used to verify the efficiency and didactic value of the m-learning application in foreign language learning.

Between January 31, 2014 and February 14, 2014; 24 foreign students attended the EILC. We separate them into two groups, where the first group (experimental) consisted of (12) students whose mobile phones matched or exceed minimal system requirements for the mobile application BlaBla™. This experimental group used the devices (smart phones) during the course and for individualized learning. The second group of students formed the control group and used textbooks. On the test at the end of the course, neither learning materials nor a phone was allowed.

These students came from both Slavic language speaking countries and non-Slavic speaking countries. (5 - Czech, 1 - Slovak, 5 - Finnish, 4 - Spanish, 1 - Hungarian, 1 - Lithuanian, 1 - Turkish, 1 - Norwegian, 1 - Portuguese, and 1 - Estonian). EILC does not take into account differences between students from varying language backgrounds, although we know that Slavic speaking students have fewer problems with the pronunciation of Slovenian words. The course is intended as an introduction to the Slovene language at the level of A1 or A2 on the EU language scale. Our m-learning application did not cover the whole EILC course but only some topics to prove the concept. All participants in the experiment also answered a questionnaire, where we gathered detailed student feedback about our application.

# 12 Findings

As mentioned before, we collected data from students of the experimental group (5 female and 7 male) with a questionnaire comprising 26 questions. In most cases questions were closed type. The questions asked were the following – see Table 2:

Table 2: Survey questions

| | | |
|---|---|---|
| 1. | age | number |
| 2. | gender | male / female |
| 3. | country of origin | text |
| 4. | mobile phone | text |
| 5. | number of application installed on mobile phone | number |
| 6. | proficiency in English | A1/A2/B1/B2/C1/C2 |
| 7. | proficiency in ICT | (1) poor, (2) sufficient, (3) above average, (4) excellent |
| 8. | proficiency in mobile technology | (1) poor, (2) sufficient, (3) above average, (4) excellent |
| 9. | learning preferences | text, image, sound, video, interactivity |
| 10. | learning type | (1) traditional – textbook only, (2) mostly textbooks but also web, (3) mostly web, occasionally textbooks, (4) web exclusively |
| 11. | mobile devices as learning aid | (1) exclusively for communication, (2) mostly for communication occasionally other things, (3) small computer fine for education, (4) extension of my body and mind |
| 12. | content: usefulness of learning items | (1) useless, (2) okay, but need more topics, (3) useful, (4) very useful |
| 13. | content: most useful topic | (1) alphabet and number, (2) present yourself, (3) describe your family, (4) what are you wearing? |
| 14. | content: reason for choosing learning items | (1) I like the way it works<br>(2) good introduction to the Slovene language<br>(3) I don't know, I just like it. |
| 15. | content: effectiveness of communication | (1) useless, (2) okay, but would need other types, (3) useful, (4) very useful |
| 16. | content: presentation preference | (1) touch the word, (2) touch the icon, (3) touch the image, (4) all are equal |
| 17. | content: theory | (1) useless, (2) okay, but too complicated, (3) useful, (4) very useful |
| 18. | content: sound recording of native speaker | (1) useless, (2) okay, but I don't need it, (3) useful, (4) very useful |
| 19. | content: learning quiz | (1) useless, (2) okay, but too easy, (3) useful, (4) very useful |
| 20. | content: use of opposite gender in application | yes/no |
| 21. | content: what should be extended | (1) more topics, (2) more sound, (3) more theory, (4) more quizzes |
| 22. | operation: ease of navigation | (1) I'm lost, (2) I need a lot of time for navigation, (3) navigation is natural |
| 23. | operation: sound quality | (1) too quiet to understand, (2) quiet but understandable, (3) okay, (4) excellent |
| 24. | operation: speed | (1) too slow, (2) slow but works, (3) okay, (4) excellent |
| 25. | operation: size of learning chunks | (1) too small, (2) can be read but strains the eyes, (3) optimal for the size |
| 26. | operation: observed faults | (1) no, (2) yes, (3) just some inconveniences |

For the purposes of this article, we use only some of the questions in the analysis.

Students from the experimental group found the application useful (Q12). On a scale from 1 to 4, the mean value was 2.92, with no significant difference between male and female students (Q12 by Q2) ($\chi^2 = 1{,}32, P = 0.516$). There was an observed tendency for students who were more ICT skilled (Q12 by Q8) to grade the application higher than others did ($\chi^2 = 8{,}69, P = 0{,}069$).

The most useful topic (Q13) in the m-learning application is Introduce yourself. The tendency shows that there are some differences between male and female student (Q13 by Q2) in this topic ($\chi^2 = 5{,}60, P = 0{,}061$).

We had assumed that sound support (Q18) would be more important to the students from non-Slavic

speaking language backgrounds, but we could not prove this. Later we discovered that the three Finnish students were very familiar with a Slavic language, since most Finns learn Russian in primary school, and they are quite adept at it [59]. When we exclude the Finns from the non-Slavic group, we see that for the real non-Slavic speaking students, Slovene pronunciation was very useful (Q18 filtered for non-Slavic natives) – all 6 of them grade it the same as "very useful" (the highest possible score).

The effectiveness of the m-learning application was tested by a final performance test. We wanted to know if the use of the application influenced grades obtained on the test. Only two questions on the test were supported by our application. On the first question covered by our application, a student could get a maximum of 12 points, and on the second question, a student could get a maximum of 8 points. Scores from these two questions show that there were no statistically significant differences between groups (users of the application vs. others) for the first question ($t = 10.083$, $P = 0.323$) (users of the application have an average of 11.82 points, and others have an average of 11.44 points). In the second question, we can confirm the tendency ($t = 10.199$, $P = 0.054$). Even though the users of the application received a much higher average score (7.55 out of 8) on the second questions vs others (6 out of 8), the Mann-Whitney U-test did not show any statistically significant differences between groups ($U = 29.000$, $P = 0.131$). The results, on the other hand, show that the EILC course is well structured and didactically suitable for all participants. Nevertheless, we did discover a tendency for those who have greater ICT knowledge to achieve better scores on the second question (test2 by Q7) ($t = -2.182$, $P = 0.057$).

It is evident that the sample for analysis was small but also that circumstances dictated this limitation. Therefore, the results may change in the future with a larger research sample.

# 13 Conclusion

The experimental pilot study we performed yielded valuable insight into the functioning of m-learning. Mobile devices do not have the full functionality of computers and are mostly suited to predefined, well considered scenarios. From previous experience, we knew that the preferred topic in e-learning was the student assignment [30] [45], which encourages student creativity. There is sufficient evidence (also supported by other researchers) that m-learning is not just e-learning with mobile devices [21]. The constraints involved in using mobile devices require careful design of learning materials, and these also need to be prepared with the least possible distractions to maximize efficiency. Our example – language learning-- proved the concept and verified the design recommendations. Therefore, we have provided a good starting point for any author and developer who wants to create m-learning materials. The distinct concept – the haptic user interface--means that such learning materials are suitable for younger learners who also demand clean design, eschewing the "bloatware" style. We expect that in the near future tablets will enter the education arena, and m-learning will increase its presence in our education.

# References


[1] Abbott, S. E., Guisbond, L., Levy, J. and Sommerfeld, M. (2013). The Glossary of Education Reform. Accessed 9. 11 2014 at Blended Learning: http://edglossary.org/blended-learning/

[2] Adda-Decker, M., Lamel, L. (2005). Do speech recognizers prefer female speakers? Interspeech 2005 (pp. 2205–2208). Orsay cedex: Spoken Language Processing Group.Brodnik, A., Dobrin, A., Matija, D., Gams, M., Mohar, B. and Petkovšek, M. (1991). Računalništvo (Leksikoni Cankarjeve založbe). Ljubljana: Cankarjeva založba.

[3] Ambrožič-Dolinšek, Jana, Duh, Matjaž, Fošnarič, Samo, Golob, Nika, Grubelnik, Vladimir, Hus, Vlasta, Krašna, Marjan, Marhl, Marko, Nekrep, Andreja, Rajšp, Martina, Repnik, Robert, Šorgo, Andrej, Marhl, Marko (editor), Nekrep, Andreja (editor), Repnik, Robert (editor). E-učna gradiva za predmet Spoznavanje okolja v 3. razredu : projekti : e-okolje. Maribor: Pedagoška fakulteta, 2008. http://distance.pfmb.uni-mb.si/course/view.php?id=39. [COBISS.SI-ID 16500744]

[4] ANSYS. (2009). ANSYS Fluent 12.0. Pittsburgh, PA: ANSYS, Inc.

[5] Anthony, T. (2012). Finger-Friendly Design: Ideal Mobile Touchscreen Target Sizes. Accessed 27. 4. 2014 at Smashing Magazine: http://www.smashingmagazine.com/2012/02/21/finger-friendly-design-ideal-mobile-touchscreen-target-sizes/

[6] Ballman, C. (2014), mLearning vs. eLearning: Key Differences, Meeting and Conventions, March 28, 2014, Accessed 3. 8. 2015, http://www.meetings-conventions.com//Blogs/Guest-Stars/post/2014/03/28/mLearning-vs-eLearning-Key-Differences

[7] Bates, L. (2012), The Different Uses of E-learning and M-learning, Fractus Learning, September 12, 2012, Accessed 3. 8. 2015, http://www.fractuslearning.com/2012/09/12/e-learning-and-m-learning/

[8] Beaudouin-Lafon, M. (2004). Designing interaction, not interfaces. AVI '04 Proceedings of the working conference on Advanced visual interfaces (15–22). New York: ACM New York.

[9] Bedell, C. (2014). Mobile Apps Development: Defining Requirements Is a Whole New Ballgame. Accessed 7. 5. 2014 at http://searchsoftwarequality.techtarget.com/feature/Mobile-apps-development-Defining-requirements-is-a-whole-new-ballgame

[10] Behera, S., K. (2013), E- and M-learning: A Comparative Study, International Journal on New Trends in Education and Their Implications, July 2013 Volume: 4 Issue: 3 Article: 08 ISSN 1309-6249

[11] Chandler, P., Sweller, J. (1991). Cognitive Load Theory and the Format of Instruction. Cognition and Instruction, 8 (4), 293–332.

[12] Charness, N., Holley, P., Feddon, J., Jastrzembski, T. (2004). Light pen use and practice minimize age and hand performance differences in pointing tasks. Human Factors, 46, 373–384.

[13] Clayton-Staker, H., Horn, M. B. (2012). Classifying K-12 Blended Learning. Mountain View, CA: Innosight Institute, Inc.

[14] Collins McLaughlin, A., Rogers, W., A., Fisk, A. D. (April 2009). Using Direct and Indirect Input Devices: Attention Demands and. ACM Trans Comput Hum Interact, 16 (1), 1–15.

[15] Crompton, H. (2013a). A historical overview of mobile learning: Toward learner-centered education. In Z. L. Berge L. Y. Muilenburg (ed.), Handbook of mobile learning (3–14). Florence, NY: Routledge.

[16] Crompton, H. (2013b). Mobile Learning: New Approach, New Theory. V Z. L. Berge in L. Muilenburg (ed.), Handbook of Mobile Learning (47–57). New York: Routledge.

[17] Dastidar, D. G. (2014). Top 10 Principles Of Mobile Interface Layout. Accessed 7. 5. 2014 at http://designyoutrust.com/2013/09/top-10-principles-of-mobile-interface-layout/

[18] Driscoll, M. (2003). IBM Global Services. Accessed 11. 10. 2014 at Blended learning: Let's Get Beyond the Hype: http://www-07.ibm.com/services/pdf/blended_learning.pdf

[19] Duh, M., Krašna, M. (2010) Interactive e-learning materials: How to prepare and use it properly? In: Čičin-Šain, Marina (ed.). MIPRO 2010: 33rd International Convention, May 24-28, 2010, Opatija, Croatia: proceedings = 33. međunarodni skup : zbornik radova. [Vol. 4], Computers in education, = Računala u obrazovanju. Rijeka: MIPRO, cop. 2010, pp. 77-80, ilustr. [COBISS.SI-ID 17826568]

[20] EI Lab. (2015). Touch Screen Gestures. Accessed 18. 1. 2015 at Embedded Interaction Lab: http://www.embeddedinteractions.com/touch%20screen%20gestures.html

[21] Feser, J. (2010). mLearning is Not eLearning on A Mobile Device, float mobile learning, April 2010 Newsletter, Accessed 3. 8. 2015, http://floatlearning.com/2010/04/mlearning-is-not-elearning-on-a-mobile-device/

[22] Gong, J., Tarasewich, P. (2004). Guidelines for handheld mobile device interface design. Proceedings of the 2004 DSI Annual Meeting (3751–3756). Boston, MA: Decision Sciences Institute.

[23] Grady, J., O. (2006). System Requirements Analysis. San Diego, London: Academic Press.

[24] Hashim, A., S. (2010). A Study of Design Principles and Requirements for the M-Learning Application Development. User Science and Engineering (i-USEr), 2010 International Conference (226–231). Shah Alam: IEEE.

[25] Hatter, D. (2014). Mobile Apps Development. (C. Bedell, Interviewer)

[26] Henley, E. (2012). Designing Finger-Friendly Mobile Touch Interfaces. Accessed 13. 5. 2014 at Spartan Internet Consulting Corporation: http://www.spartaninternet.com/designing-finger-friendly-mobile-touch-interfaces/

[27] Jacob, R., J. (March 1996). Human-computer interaction: input devices. ACM Computing Surveys (CSUR), pp. 177–179.

[28] Jahandar, S., Khodabandehlou, M., Seyedi, G., Abadi, R. M. (2012). A Gender-based Approach to Pronunciation Accuracy of Advanced EFL Learners. International Journal of Scientific & Engineering Research, 3 (5), 1–9.

[29] Knewton. (2014). Blended Learning Infographic: Blended learning is a disruptive innovation in education that can take many forms. Accessed 15. 9. 2014 at Knewton – Personalized Learning for All: http://www.knewton.com/blended-learning/

[30] Kokot, M., Vovk Korže, A., Vrhovšek, D., Krašna, M., Sajovic, A., Globovnik, N., Amon, T. (2010). E-gradiva za okolje in trajnostni razvoj. Maribor: Filozofska fakulteta; [Ljubljana]: Ministrstvo za šolstvo, [2010]. 1 optični disk (CD-ROM), barve. http://distance.pfmb.uni-mb.si/. [COBISS.SI-ID 18011656]

[31] Krashen, S., D., Terrell, T. D. (1995). The Natural Approach: Language Acquisition in the Classroom. Hemel Hempstead: Prentice Hall Europe.

[32] Krašna, M. (2015) Izobraževanje v digitalnem svetu. Maribor: Zora.

[33] Krašna, M., Bratina, T. (2009). Multimedia E-learning material production for primary school. In: First Computer Science and Mobility Workshop 2009 (CSMW'09), AAU Klagenfurt, Austria, 9th-10th April, 2009. BOLLIN, Andreas (ed.), BOUCHACHIA,

Abdelhamid (ed.). Proceedings CSMW'09. Klagenfurt: Alpen-Adria Universität, 2009, pp. 21-27, ilustr. [COBISS.SI-ID 17010440]

[34] Kristoffersen, S., Ljunberg, F. (1999). Making Place to Make IT Work: Empirical Explorations of HCI for Mobile CSCW. Proceedings of the International Conference on Supporting Group Work (276–285). Phoenix: ACM Press.

[35] Long, H., M. (1985). Input and second language acquisition theory. V S. M. Gass, & C. G. Madden, Input in second language acquisition (pp. 377–393). Rowley, MA: Newbury House Publishers. Adda-Decker, M. and Lamel, L. (2005). Do speech recognizers prefer female speakers? Interspeech 2005 (2205–2208). Orsay cedex: Spoken Language Processing Group.

[36] Mayer, R., E. (2009). Multimedia Learning: Second Edition. Cambridge: Cambridge University Press.

[37] Moore, J., L., Dickson-Deane, C., Galyen, K. (2011). E-Learning, online learning, and distance learning environments: Are they the same? Internet and Higher Education, (14), 129–135.

[38] Ozuorcun, N., C. (2012). Is M-learning Versus E-learning or are They Supporting Each Other? Procedia - Social and Behavioral Sciences, 46, 299–305.

[39] Pardede, P. (2012). Blended learning for ELT. Journal of English Teaching, 2 (3), 65–178.

[40] Pegrum, M. (2014). Mobile Learning: Languages, literacies and cultures. Basingstoke, Hampshire: Palgrave Macmillan.

[41] Pirih Svetina, N. (2005). Slovenščina kot tuji jezik. Domžale: Založba Izolit.

[42] Plass, J., Jones, L. (2005). Multimedia learning in second language acquisition. V R. Mayer (ed.), The Cambridge handbook of multimedia learning (467–488). New York: Cambridge University Press.

[43] Pukšič, D. (2013). Spontaneous learning event. TwinTide AUtumn Training SchOol 2013. Bled, Slovenia: University of Leicester.

[44] Rao, R. (2013). Challenges and Potential in Requirement Gathering for Mobile Apps. Accessed 8. 5. 2014 at http://mlabs.boston-technology.com/blog/requirement-gathering-for-mobile-apps-same-process-new-challenges

[45] Repnik, R., Krašna, M. (2010) Application of e-Learning Materials: Environmental Studies for 3rd Grade of Primary School, CECISS 2010, Varaždin, Croatia.

[46] Richards, J., C., & Rodgers, T., S. (2003). Approaches and Methods in Language Teaching. Cambridge: Cambridge University Press.

[47] Shneiderman, B. (1998). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Menlo Park: Addison Wesley Longman.

[48] Stopper, R., Sieber, R. (2012). Graphical User Interface – Layout and Design. Accessed 8. 11. 2014 at CartouCHe: http://www.e-cartouche.ch/content_reg/cartouche/ui_access/en/text/ui_access.pdf

[49] Swain, M. and Lapkin, S. (1995). Problems in output and the cognitive processes they generate: A step towards second language learning. Applied Linguistics, 16 (3), 371–391.

[50] Sweller, J., van Merrienboer, J., J., Paas, F. G. (1998). Cognitive Architecture and Instructional Design. Educational Psychology Review, 10 (3), 251–296.

[51] Štiglic, G., Nemec, A., Heine, M., Vovk Korže, A., Korže, D., Pajk, T., Krašna, M. (2009) E-študij okolja: študijska gradiva za projekt E-študij okolja za srednje šole. Maribor: Filozofska fakulteta, [2009]. http://distance.pfmb.uni-mb.si/course/category.php?id=7. [COBISS.SI-ID 19346440]

[52] TechTerms. (2014b). User Interface. Accessed 5. 5. 2014 at TechTerms: http://www.techterms.com/definition/user_interface

[53] Toporišič, J. (2000). Slovenska slovnica. Maribor: Založba Obzorja.

[54] Traxler, J. (2009). The evolution of mobile learning. In R. Guy, The evolution of mobile teaching and learning (pp. 1–14). Santa Rosa, CA: Informing Science Press.

[55] Trubetzkoy, N., S. (1969). Principles of Phonology. Berkley, Los Angeles: University of California Press.

[56] Unesco. (2013).What is mobile learning? Accessed 13. 2. 2015 at ICT in Education: http://unesdoc.unesco.org/images/0021/002196/219641E.pdf

[57] Vukovic, P. (2014). 7 user interface design trends you need to know about. Accessed 19. 1. 2015 at 99 designs: http://99designs.com/designer-blog/2012/06/20/7-user-interface-design-trends-you-need-to-know-about/

[58] Wang, S., Iwata, J., Jarrell, D. (2014). Creating and Delivering Learning Materials for Mobile Phones - Our Findings in Japan. V S. K. Cheung, J. Fong, J. Zhang, & R. Kwan, Hybrid Learning: Theory and Practice (7th International Conference ICHL) (pp. 243–253). Cham: Springer International Publishing Switzerland.

[59] Zaikina, O. (2011). The significance of the Russian language in Finland (diploma thesis). Vantaa: Laurea University of Applied Sciences.