Designing for Virtual Mobility: Potentials and Caveats

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Abstract. This paper reflects on the joint pilot development and implementation of an international master level online course in Educational Design by three universities from different European countries. The pilot targeted curriculum internationalization and provision of international learning experiences to students with less mobility opportunities through online learning and use of technology. The key focus was on connecting students from different countries by collaborative learning and working on an authentic task in the professional domain of their study - educational media design - via a joint platform and digital media. In small international groups, students collaboratively developed mobile game apps for educational settings. Students enjoyed full freedom in design choices, starting from theories in which they anchored their designs to subject matter and the way they implemented designs in mobile applications.

In the eight weeks of online learning and collaboration, students demonstrated their collaborative and digital learning skills and made extensive use of tools and technologies. The pilot provided designers with insights on co-designing and co-teaching international technology-enhanced online courses. It demonstrated the potentials and the caveats of designing for virtual mobility.

Keywords: Virtual mobility, Curriculum design, Mobile learning, Collaborative learning

1 Introduction

Instructional designers need to know, apply and use diverse educational methodologies, approaches and tools in their professional work and need to keep track of innovations. However, within formal curricula in higher education, the space for experimentation and innovation-based development is often limited. Moreover, learning and teaching in international contexts is not standardly part of curricula in the educational domains.

Due to the contemporary globalization trends, ubiquitous character of social media and on-going technological developments, education is changing more rapidly than ever before. Education needs to attain and retain students' interests, and for one, become more technologically appealing and fitting [1]. In part, universities are under pressure to meet the new challenges: to prepare future experts from more heterogeneous and demanding student groups and cohorts for a work life, labor market and a quickly changing society, and at the same time, prepare them for collaboration in diverse (or multicultural in broad sense) work contexts [2].

Three European universities - FernUniversität in Hagen, Germany (FeU), University of Jyväskylä (JYU), Finland, and Open Universiteit in the Netherlands (OUNL) - joined forces to tackle these challenges by piloting a technology-enhanced approach to innovate their master level curricula in the educational domain. This pilot addressed three major objectives:

- to offer rich international learning experiences to students who have fewer opportunities for global learning, like distance learning or adult students who combine study and work or cannot afford to study abroad;
- to design, implement and evaluate a joint master level course in the domain of education combining pedagogical and technological expertise of the three participating universities and state-of-art tools;
- to build common ground and exchange ideas, understanding and know-how on co-designing and implementing innovative technology enhanced approaches for opening closed curriculum-based academic education between the three participating universities.

The paper frames the pilot as an attempt to open up academic education through learning from an authentic collaborative online learning experience. It presents the designed course, tools and technology used and elaborates on the pilot outcomes addressing each of the three objectives. Furthermore, it positions the presented pilot in a broader context of virtual mobility and authentic learning. Since the student group was diverse, building a supportive and immersive technology enhanced learning experience was the main challenge of the pilot. To that end, evaluation questions targeted the design and pilot outcomes as well as students' perceptions of the implementation.

2 Design principles and implementation guidelines

The key focus of the pilot was to connect cross-border students for whom it would be very difficult to collaborate face-to-face in order to get to know each other, work and learn together [1] by developing and offering a jointly produced course on instructional design. Moreover, with this course, the three universities aspired to improve and innovate their own study programs as well as to find synergies between universities. Traditionally, these synergies and benefits are sought through different forms of physical mobility and exchange. In the pilot, the objectives were realized through virtual connections, using existing learning platforms and tools.

To bridge the physical separation of the students from universities in three different countries, an online learning platform and online tools have been used. The course design followed the principles of computer supported collaborative learning (CSCL) [3] to promote synchronous and asynchronous collaboration and exchange.

To promote engagement, concepts of task authenticity, context and interaction [4] have been applied in course design. Learning takes place through the interaction between the learners with given problems and the environment itself. It needs to be an authentic context that reflects the way knowledge is used in real life (concerning purpose and motivation). Therefore, the psychological closeness (cognitive realism) of the problems with real live problems is important [5]. In addition, students should have access to expert thinking, e.g. by social media where students can directly interact with experts. To sum up, an authentic learning environment:

- offers the students multiple roles and perspectives;
- makes use of authentic tasks. These are ill-defined problems, allow competing solutions and diversity of outcomes;
- provides coaching and scaffolding, e.g., via communication with teachers and other students;
- offers articulation and collaboration, which deepens the understanding and reasoning and identifies the gaps in lines of thought;
- contains authentic assessment to give students the opportunity to demonstrate their solutions.

3 Pilot design and implementation

The course aims at master level students studying educational science. The authentic learning task chosen in the course had to be of relevance for the students for their future profession in education. For this purpose, an authentic educational design task was formulated: to design, develop and evaluate a mobile game application, to ground game design decisions in established educational theories and to integrate the end product (mobile game) in an educational setting. Students were free to choose the topic for their mobile game project to address the authenticity of the task. During the eight-week duration of the course, students were expected to work on the task in small international groups, interacting with each other, teachers and relevant course resources in the learning environment developed to support collaborative learning.

The course was structured as a series of subtasks. Each week learning activities were introduced with milestones for task completion and feedback opportunities communicated in advance to provide optimal support for students in their collaborative learning and work. The introductory task contained activities focused on socialization and exchange of personal information to facilitate group forming and collaboration. In the following weeks, students received introductions in learning and instructional design theory, the educational design process and evaluation, and tools for design of mobile learning. In parallel, after the introduction of educational theories and the game platform, students made a start with designing and implementing the educational product, building on each of the theoretical aspects that were presented every week.

Table 1. Outline of the course and topics covered

	Topic covered
Week 1	Introduction
Week 2	Media and instructional theories
Week 3	Introduction on evaluation Development of mobile game/app
Week 4	Writing a concept Development of mobile game/app
Week 5	Summative assessment Development of mobile game/app
Week 6 - 8	Development of mobile game/app
	Showcase of mobile game/app and group presentation

The design of the course activities and tasks has been based on the principles of Salmon's 'e-tivities' [6]. These were chosen in order to help students in structuring their group work as well as to clarify expectations, ways of feedback and deliverables. Suggestions on how to collaborate were given in the e-tivities as well. Course resources included video materials, e-books, articles and hyperlinks to other websites and resources. Regular supervision and teacher support were provided by the supervising tutors from the three participating universities on several levels: as task support (instructional videos, course materials and synchronous virtual classes), as learning support (feedback on provisional products, monitoring of group exchanges) and as resource support (weekly instruction, guidelines for communication and collaboration with peers) [4].

The three universities jointly designed and implemented the course. Each university provided its particular expertise for content, tasks and activities and realized the design of the weekly tasks accordingly.

A mix of tools was used for synchronous and asynchronous communication to enable immersive experiences within groups as well as with teachers and facilitators. In addition, students were encouraged to introduce and use their own preferred solutions for group communication and collaboration.

3.1 Applied technology and its usage

Partners decided to make use of the learning environment[1] provided by the FeU for their open courses to bypass restrictions imposed by the formal learning environments in use by the universities. This learning environment is based on Moodle (version 3.2.8), a commonly used open source learning platform that provides a variety of tools and resources to design and implement courses. In addition, students had access to tools and resources outside the platform. For example, students could use Mindmeister to create the mind maps they had to produce in order to structure ideas on the topic of the

[1] Moodle LMS: https://offene.fernuni-hagen.de/

group work. In addition, Blackboard Collaborate virtual classroom sessions were set up by the course designers for use by individual groups as well as for teacher-student interaction.

The learning environment provided discussion forums. Besides general shared discussion forums that were used to allow participants to introduce themselves and to discuss general issues, specific discussion forums were set up for each group. As part of the assessment, individual groups had to maintain a wiki - provided in the learning environment - in which they were to document their progress and reflect on process and events.

Students also made extensive use of social media and communication and collaboration tools outside the platform. To mention a few, they used Skype, Slack, OneDrive, Google drive and Google docs, Padlet, WhatsApp, and various other default applications such as Word and PowerPoint.

Students had to use the augmented reality platform ARLearn, provided by OUNL, to develop their mobile game. This open source platform supports creating and playing mobile serious games. The ARLearn implementation follows augmented reality design principles [7]. It consists of:

- an authoring environment[2]
- a player, available through the Google play store[3].

Course designers and/or teachers use the authoring environment to design and implement games. It defines a game as a blueprint for mobile activity. ARLearn allows the game designer or author (i.e. course designer or teacher) to script learning activities to be performed. These activities are shown to the learner as messages that appear either in a message list or on a street map. The game author can create a variety of messages and use several kinds of tools (such as video, audio, QR-scanners, questions, text, instructions, etc.) to base the activities on. For example, the game author can create an assignment and ask the learner to record a video and upload the video, or scan a QR to receive further instructions, answer a question. Of course, the game author can use textual instructions as well. The game author uses conditions to define when a message appears or disappears from the message list or map. Once the game is designed, the game author has to deploy it to a mobile device. Learners can download the game onto an Android device and can play the game once the author has made a game run available. A game run is an instantiation of the game that links a set of learners to the game.

The example in Fig. 1 shows the two modes of listing messages or activities: displaying messages on a street map (on the left), or in a simple list (in the middle). The right hand image shows the instruction (in Dutch) to explain in fifty words the masonry structure of the building and upload an audio recording. It also shows a previously uploaded recording and allows the learner to listen to recorded sessions.

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[2] ARLearn authoring environment: https://streetlearn.appspot.com

[3] Google play store: https://play.google.com/store/apps/details?id=org.celstec.arlearn2.android

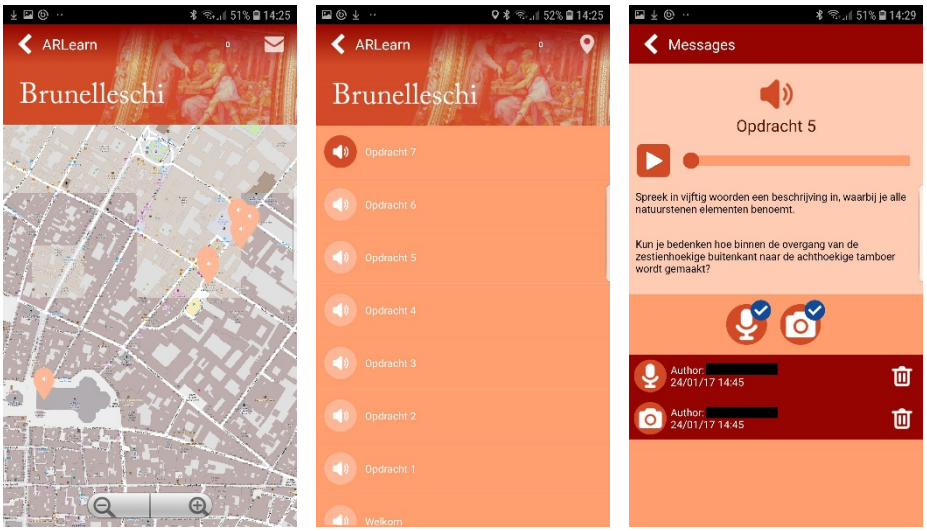

Fig. 1. Messages of a game are displayed on a map or as a list. Once selected, the content of the message details the activity to be performed (e.g., recording the answer using audio).

4 An overview of pilot outcomes

This section details course outcomes based on realized mobile game designs, formal assessments and course evaluations that the students completed in week three and upon course completion. The focus of the first evaluation questionnaire was on student expectations and personal learning objectives, their first experiences with the course, the tools and the group forming. In the final evaluation, students provided estimations of what they had learned in the course, gave extensive feedback on the course content, platform, teacher support and group work and shared insights in their perceptions of the overall learning experience.

4.1 An international collaborative learning experience

Basic prerequisites for participation on voluntary basis in all three universities included motivation, affinity with educational science at (pre-)master level, fluency in English and basic ICT skills. FeU addressed students from a Master of Arts program ‘eEducation’ of the Institute of Educational Science and Media Research. OUNL invited all master and pre-master students of its distance-learning program in Educational Science as well as alumni to participate. However, only master students could embed the course in their curriculum by enrolling in an existing elective course and completing an additional assignment. JYU invited international students from a Master program in Educational Sciences of the Faculty of Education and Psychology.

At the start of week 1, 24 students were allocated to eight groups, mixing students from the three universities. Groups were expected to collaborate throughout the course.

Students (n=16) described personal learning objectives in two main categories:

- acquisition or further development of media design skills
  - learn about mobile learning
  - make a serious game
  - learn to work with the mobile games platform
  - develop an app
- international online collaboration
  - talk English with other students
  - learn from each other
  - experience working together online
  - collaborate with students from other educational cultures.

In the questionnaire issued upon course completion, students (n=11) confirmed knowledge and skills gain in both areas and expressed their particular appreciation of intercultural communication and collaboration skills they had developed during course activities. As documented in student reflections and the group wiki in which at least one student from each group systematically reflected on the progress, collaboration and the synergy of new domain knowledge and understandings and learning from others constituted a most prominent gain from participation in this pilot. That is how students reflected on the experience of learning through international collaboration:

'Being "forced" into a new group and organizing the workflow in this group with all its positive and negative aspects... It was great to see an actual result.'

'*In previous courses I have learned elaborately about learning theories and concepts but through discussion with my peers these theories and concepts really came to life.*'

'*Through interaction with peers and tutors from other countries your view on education as a whole broadens.*'

4.2 Mobile game designs for educational practice

Table 1 provides an overview of realized game designs. As this overview demonstrates, topics chosen by groups varied considerably and targeted different audiences. All solutions were explicitly grounded in learning and instructional theories and connected to the educational practice, in most cases to that of several group members. In each case, students aimed at resolving a pedagogical problem by using technology and embedding the solution in practice. In this context, a student emphasizes:

'*You learn to consider situations for which an app is a suitable choice, rather than just build an app for the sake of using modern technology*'.

Table 2. An overview of mobile app/game designs produced in the course

AR(e) you English?	
Group characteristics	3 members (an alumnus, a master and a pre-master student from OUNL)
Topic	Learning words and use of everyday vocabulary
Instructional problem	The need to improve learning English as foreign language in primary education
Instructional solution	A mobile app for learning to pronounce words and short sentences in English by non-native speakers. Audio and text with rhymes and listening exercises to activate the learning of pronouncing words and short sentences. The game is played with QR-codes that can be printed out.
Theoretical underpinning	Gagne's principles of learning; Augmented reality design principles
Target group	12-year-old students, non-native speakers, starters
The Xylophones	
Group characteristics	4 members (an alumnus and 2 master students from OUNL; a master student from JYU)
Topic	An educational app for a music school open day
Instructional problem	The need for an attractive and engaging way for a quick introduction to a variety of music instruments
Instructional solution	Active and interactive game elements: taking a photo, making a recording, doing a quiz with a chosen instrument. Use of QR codes to choose one of four pre-set paths per instrument type
Theoretical underpinning	Mayer's multimedia design theory
Target group	Young children
Learning Democracy	
Group characteristics	5 members (a master student from FeU; a pre-master, a master student and an alumnus from OUNL; a master student from JYU)
Topic	Critical thinking about democracy in Europe and in your own environment
Instructional problem	The need to develop and improve awareness of what democracy is, how this concept and institutions developed in Europe over time
Instructional solution	The mobile game is integrated in a school lesson series about democracy designed as problem-based learning. The game provides information, video recordings from historic sites (i.e., Greece, the birthplace of democracy), activity scripts and quizzes
Theoretical underpinning	Social constructivism; Laurillard's conversational framework; Self-determination theory; Problem-based learning; Bloom taxonomy of learning objectives
Target group	English speaking learners, age 12-14

Table 2. (*continued)*

Division of Germany: the Berlin Tour	
Group characteristics	4 members (2 master students from FeU; an alumnus and a master student from OUNL)
Topic	Understanding the implications of the political system at that time (German Division) on a more personal scale: what impact did the Wall have on people‘s lives back then?
Instructional problem	The need to achieve deeper understanding of own history and relate it to personal history
Instructional solution	The game is integrated in a lesson series in classroom and at locations (Berlin tour). The game is a part of the preparation to a real-life tour and part of the tour as it includes location-based assignments. Game “solutions” were discussed back in classroom
Theoretical underpinning	Laurillard's conversational framework; First principles of instruction by Merrill; Cognitive load theory; Mayer's cognitive theory of multimedia learning; Socio-constructivism.
Target group	Students in 9th grade secondary education (Gymnasium) in Berlin-Brandenburg (Germany)
First aid at the workplace	
Group characteristics	2 members (a master student from FeU; a master student from OUNL)
Topic	E-learning for employees to train and repeat relevant content on resuscitation after a first aid presence course
Instructional problem	The need to enrich and improve an existing e-learning training on first aid provision
Instructional solution	The game script is a preparation for the e-learning course and is used during the life training through assignments, quizzes and text fragments, photos and video recordings in the mobile app
Theoretical underpinning	Gagne’s events of instruction; Keller’s ARSC model
Target group	Adult learners: employees in the company that organizes the training

Table 2. (*continued*)

Math word problems	
Group characteristics	3 members (a master and a pre-master student from FeU; a master student from JYU)
Topic	Math word problems for young learners
Instructional problem	The need to provide scaffolding for understanding and solving math word problems
Instructional solution	A script that supports learning an 8-step strategy to solve a word math problem with the help of modelling video-based examples, just-in-time feedback and overviews of steps, self-checks (quizzes) and realistic tasks
Theoretical underpinning	Cognitivist learning; Cognitive load theory; Augmented reality design principles
Target group	9-year olds (primary school) with difficulties understanding the mathematical problem structure of word math problems
E-scape the classroom: a virtual escape room to prepare for internship	
Group characteristics	3 members (a master and a pre-master student from OUNL; a master student from FeU)
Topic	Preparing for internship
Instructional problem	The need for low threshold, "safe" environment to train for real life work tasks of first aid provision
Instructional solution	A mobile game with three scenarios of real life health care service cases as a mini-training for (future) interns prior to or during a work placement, integrating text and video-recordings and quizzes
Theoretical underpinning	Van Merriënboer's 4C/ID (4 components instructional design) model
Target group	Students in health care domain prior to the first internship/work placement

To illustrate game design, one of the group products is presented below in some detail.

Division of Germany – the Berlin tour game was designed as a part of a school-based history lesson series aimed at stimulating secondary school students to think about the causes and the consequences of separation of Germany into two parts after World War II through a personal perspective. After an introduction to the topic and the mobile app in the classroom, students were offered a two-day location-based game scenario in AR-Learn to be activated in different places in Berlin. For example, at the former border crossing Checkpoint Charlie, students were offered to listen to an audio describing the place and then were asked to compare what they saw with the place the audio described. At another location, a video of the beginning of the Berlin wall fall was shown and the students were requested to reflect on the video and compare reflections. Other tasks requested making an audio or a video recording, writing answers or doing a quiz. Figure 2 presents three screenshots of the game: a quiz and two active assignments, which the learner can complete by recording the answer on a video or an audio or writing it down.

Having played the game, the students were expected to share experiences and discuss lessons learned in the classroom again.

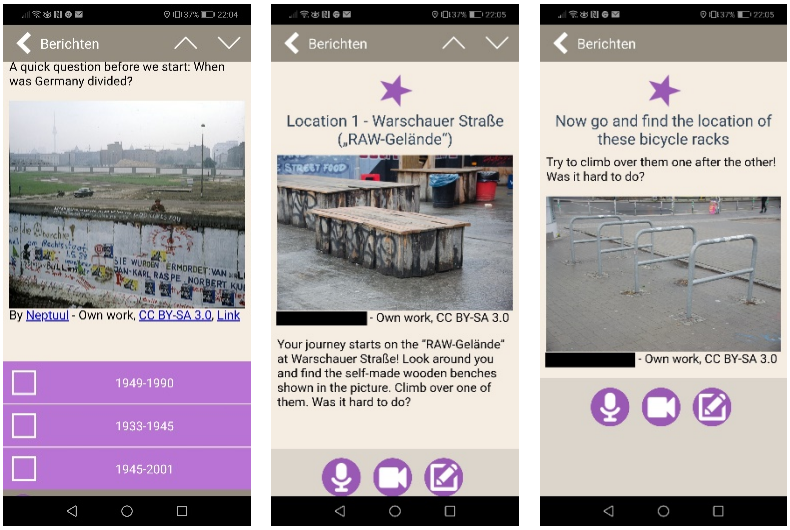

Fig. 2. Exemplary screenshots of the game Division of Germany – Berlin Tour: a quiz and two location based assignments.

4.3 Course evaluation: in need of (more) structure and feedback

In their reflections on the course progress and outcomes, students pointed to the lack of teacher presence and feedback on the progress, e.g., on the initial mind maps and posts in the wiki. They experienced the multitude of sources and media as a lack of focus and structure. Moreover, they considered the differences in the organization of weekly subtasks and content presented by each separate university team as a lack of clarity. The learning environment was found to be complex and even confusing, and the tool for game design not intuitive enough to learn without a manual and systematic instruction.

4.4 Co-designing education for virtual mobility: a novel experience

A joint experience of course design and delivery proved to be a most important outcome of this pilot for the three universities and their design teams. Combining expertise in the field of educational design, the field which all the three teams know professionally and from their teaching experience in combination with good will seemed a sufficient point of departure. Student evaluations clearly indicated that course design missed clarity and consistency, and that teacher teams from the three universities differed in the way they realized design in the electronic environment, in the way they interpreted the feedback and monitoring task, and to the extent they supported their allocated groups throughout the design. The way of scaffolding students' learning needed more alignment as well, as students indicated to perceive a lack of student-teacher interaction. It

became clear that alignment at the programmatic level and at the level of schedules is only one of the many prerequisites for co-designing a course. Alignment within the course at the level of study tasks and subtasks was required just as much, if not more.

5 Lessons learned from applying the solution: points for discussion

Overall, the underlying assumption of the usefulness of authentic collaboration combined with a genuine professional challenge resulted in a fruitful experience for students (and teaching staff). Students' enthusiasm about collaborating in an international group to design, develop and evaluate an educational media product became the best ‘evidence’ of the pilots' success.

The authentic and profession related educational design task enabled students to enact their previously attained expertise in an international collaboration project. Students worked in groups composed of different educational home institutions, study programs and level of study to distribute somewhat evenly theoretical and practical experience. In this setting, the multimodal facilitation of the theoretical background, practical framework, working with a mobile design platform, and group interactions proved as reasonably functional.

Tools that are needed for online learning and virtual mobility have become ubiquitous and equally accessible for institutions and individuals [1]. While ICT, platform and digital media solutions can be regarded universal, there is a multitude of differences in versions and in practices of use. In this pilot, differences in platform versions, lack of familiarity with particular versions and with the corresponding practices of use were manifested. These differences do not necessarily relate to technical aspects only but also to pedagogical and work-skill aspects. Higher education graduates can rarely have full autonomy and self-direction with the tools they end up using. Therefore providing varied experiences and platforms as well as developing generic skills can be considered an important learning objective. Instead of learning to apply specific skills to resolve overcoming problems, students need a higher level of computer literacy and transferable skills generalizable through various learning platforms.

However, critical tones, especially in the light of such a diverse student body, were expected. They can be in part attributed to unfamiliarity with the platform, both for students and for course designers. This resulted in a less than optimal first implementation of the course, which gives room for improvement.

A procedural scaffolding students to find orientation in the learning environment and participate at learning activities should be more in focus at the beginning of the course [8]. In future, students should be allowed more time to familiarize themselves with the platform and each other and detailed instructions on group formation and conduct should be provided, together with improvements in the structure and course navigation.

Another challenge lay in the heavy workload, combining overhead of international collaboration with the educational design task, to be finished under a strict deadline as well as fitting it into an on-going curriculum. Course design and learning objectives

could have been more focused and better aligned with estimated study load and available time, taking into account holidays.

Although in the planning phase course designers agreed on responsibilities, practices and templates, in hindsight more resources (time and personnel) should have been in place to produce a balanced pedagogical experience and proactive presence [8] as well as learning supports [4].

To answer to the issues rising from the fast-paced and vastly varied digital realities, challenges posed to teaching staff are highly demanding [2]. An implicit demand to be 'quick on one's feet' posed to educational practitioners, creates a need to transit from a fixed and predetermined course construction and structure towards something that has tones from fluid and liquid existence, both claimed to be evident in the contemporary times of uncertainty and change [9]. However, these demand of fluidity the pilot shows that offers have to be planned diligently, in particular regarding a diverse and distributed student body.

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