Interdisciplinary Course on Urban Health Games

Concept and first results of an interdisciplinary course on location-based games for health

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Abstract

This article presents the concept and implementation of a new interdisciplinary course on Urban Health Games at Technische Universität Darmstadt, which aims to facilitate interdisciplinary collaboration to critically investigate and improve the quality of life in cities. The authors present for the first time the course format, in which students of architecture, psychology, and computer science develop and evaluate location-based games for health. Specifically, they discuss the potentials of this approach for informal learning about one's health and wellbeing with a prototype for a context-sensitive exergame, in which users learn to balance their heart rate in response to the game's storytelling and their movement in real world locations. Preliminary tests underline the potential benefits of integrating contextual information on users' psychophysiological state and the urban environment.Participants have observed increased sensibility towards environmental stressors and health outcomes. Reflecting on the first research outcomes and students' evaluation, this article identifies challenges of the format in optimizing interdisciplinary exchange among students and researchers. It concludes with an outline of how to further develop the course format.

Keywords

Games for health, learning, education, urban health, urban design

1 Objectives

A growing body of research seems to underline the importance of contextual information to improve user experience, learning and health outcomes of serious games. Unusual locations such as *moving spaces* add to storytelling (Toprak, 2013), new user interfaces enable innovative training methods (Dutz, Hardy, Knöll, Göbel, & Steinmetz, 2014) while considering *formal and informal* cultural settings raises user acceptance (Lieberman, 2009). In order to organise the different sets of knowledge and methodologies, health game researchers discuss *interdisciplinary* and *transdisciplinary collaboration* (RMIT University Melbourne, 2014), and emphasise contributions from disciplines including psychology (Health Game Research, 2014) and urban design (Knöll, Dutz, Hardy, & Göbel, 2014). A thorough scholarly investigation into the various forms of academic and industrial collaborations seems long overdue. To the best of our knowledge there is no article that critically reflects interdisciplinary education formats on health games. Here, we observe that there is no interdisciplinary teaching format on health games that addresses students on graduate and undergraduate levels.[1]

The new research course *Developing Urban Health Games* at TU Darmstadt seeks to foster further interdisciplinary exchange among students and researchers, who have investigated urban design, serious gaming, as well as cognitive and health psychology technologies separately from each other.[2] The concept has evolved

[1] An outstanding exception to this rule seems Floyd Müller's course on "radical games", http://gameslecture.blogspot.de
[2] An overview of the format, briefings and current activities can be accessed at http://www.urbanhealthgames.de.
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from Knöll's model of digital games that stimulate healthy behaviours, specifically by making use of the urban environments they are played in. In this view, playing health games is a distinctive *urban practice*, through which users reflect and discuss matters relevant to wellbeing and potentially collaborate on health promoting activities (Knöll, 2012). The course aims to develop an environment in which researchers *and* students can gain deeper understanding of topics relevant to their shared interest in health and wellbeing through exergames. The new format has set distinctive success criteria including positive feedback about cross-faculty cooperation of students[3], co-authored articles, research proposals and resulting demonstrator projects. However, there are challenges in the organization of the course due to diverging study objectives and coordination across faculties, which will be discussed in the following.

2 Course Format

The course addresses students of computer science, electrical engineering and information technology, as well as students of architecture and psychology, enrolled in bachelor and master programs. The participating lecturers and organizers have designed an integrated course program that combines lectures, block courses, student team projects and advisory boards from each discipline (see Figure 1).

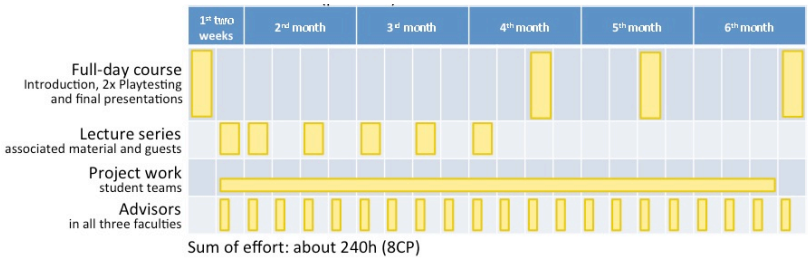

Figure 1: Course structure for one term (schematic), sum of all efforts is about 240h (8 CP).

Participants engage into problem solving competencies and the practical development of a functioning prototype within a real use case. Each term, a unique scenario and topic with outcome requirements are given. Students build equally sized teams of 3-9 members with all disciplines represented. The topic is then explored in an open mode and a unique solution is drafted including design decisions, requirements and restrictions of each discipline. The course period is six months with three fixed milestones set, when participants travel on site to present and *playtest* their alpha, beta and pre-final prototypes. Question and answer sessions with lectures and fellow students contribute to the quality improvement. Finally, student teams need to evaluate their prototypes and provide first results and reflection on discovered limitations in their final project report.

Throughout the process, students are being supported by lecturers and invited guests, who introduce to project management skills, provide an overview into basic knowledge and recent research outcomes. Topics span from *active design* strategies (Knöll, Dutz, Hardy, & Göbel, 2013) over evaluation methods to mobile game and sensor technologies. The given design briefs aim at preventive health measures, specifically to promote medium intense physical activity. Usually, the target group consisted of female and male users of age between 18 and 30 without motoric or cognitive restrictions, specified by analyzing the usage of the public space in question. Requirements are to design for a specific location e.g. a public park, and to include physiological data in response to changing activities. In the following, we will present one of the results, discuss outcomes of the course format with respect to learning in cities, and outline further directions.

3 Prototype for a context-sensitive health game

This section introduces a students' project from the winter term 2013-14 (Johé, et al., 2014) with the help of describing parameters for *a new health game* (Baranowski, 2014).

3.1 Health topic, target group and game idea

fRUNkfurt addresses office workers of the nearby new headquarter premises for the European Central Bank (ECB) in Frankfurt, Germany. It invites commuters for a run to get to know the new area while experiencing an audio and on-screen story that responds to changing heart rate measures and locations (see Figure 2).

[3] Standardized evaluation, conducted by the computer science student association at TU Darmstadt

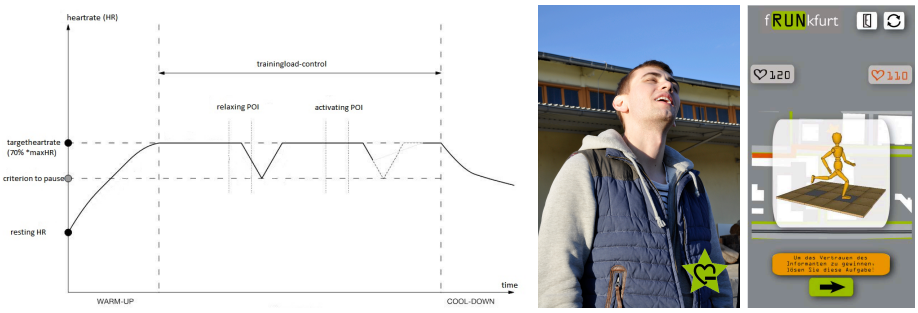

Figure 2: left: showing concept of how Points of Interest (POIs), heart rate and game interact, center: participant, right: screen of fRUNkfurt.

3.2 Conceptual Framework

The student team used training models from sports science proposing ideal heart rate frequencies and corresponding warm up and cooling phases (Harre, Krug, & Schnabel, 2011). They also used urban design guidelines to analyze the built environment according to its potential to be activating and relaxing (City of New York, 2013). The team aimed to support already existing motivation patterns such as going for a run on the way from or to work, which they observed in office workers taking their gear to the office. One of the projects' main intentions is to make users more aware of how environmental aspects such as green space, noise, crowding, and traffic contribute to one's wellbeing and experience in a certain place. fRUNkfurt is a context-sensitive mobile game, that includes heart rate (HR) and GPS coordinates of the player in the tradition of (Boyd Davis, et al., 2007). On this basis, fRUNkfurt also includes urban design characteristics and sports science.

3.3 Game design

The game proposes a detective story, in which the player is following a drug dealer in Frankfurt. The components consist of a map showing one's location and providing directions, one's current heart rate, and various tasks that were designed to either activate or relax. The player aims to proceed in the story by staying close to the ideal HR and fulfilling assigned tasks to assist the detective. He chooses start and end destination within a walkable distance and is then being guided for about 30 minutes along the points of interests (POIs) in response to HR. The POIs and activities have been chosen according to their potential to raise or decrease HR. The player's aim within the game is identical with their outside goal – optimizing their work out. The progress in game is getting easier while one learns to balance one's HR in response to new places and activities. fRUNkfurt is being developed for Android smartphones using Zephir HR straps.

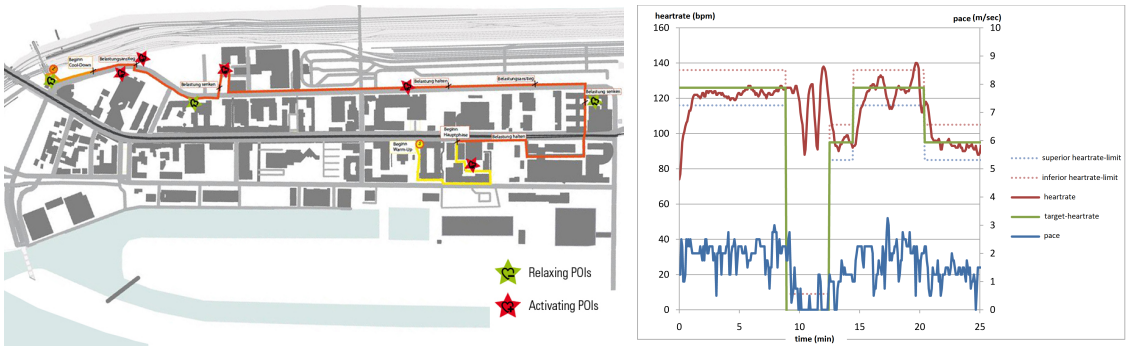

Figure 3: Exemplary routes of relaxing and activating POIs (left) and results of heart rates (right).

3.4 Results of preliminary tests

Results of stress perception using salivary immunoglobulin A test and HR are currently analyzed and will be subject to further investigations and publications. Here, the authors will focus on potentials for learning about environmental contributors to physical activity and wellbeing. The graph in Figure 3 shows a typical heart rate trend (red line) during interval training. Green-lined is the ideal target-heart-rate, varying from 127 bpm during warm-up (minutes 0-10) to 95 bpm during relaxation (minute 20-25). Lower heart-rates coincide with relaxing "story POIs" as indicated by lower paces in Figure 3. The student team also observed that users showed raised

awareness of changing environmental qualities. In response to *relaxing* activities such as breathing exercises, players would receive a grade of detail of the POI (such as brightness, noise pollution, materials, wideness), whereas in *active* phases, users would be mostly concerned with available space, pedestrian and traffic volumes. The team mentions that many dynamic factors of urban life (peaks in traffic, accidents, changing weather, etc.) may interact with the measured HR at a given POI that has been analyzed as relaxing or activating. However, the student team mentions the potential of the game concept to learn from game play and individual preferences, and include this information in further game sessions (Johé, et.al., 2014).

4 Discussion

4.1 Preliminary tests with fRUNkfurt

We see large potential of such game design, which may lie in the set of data (bio feedback in combination with GPS and environmental data such as noise pollution, pedestrian flow, and green places) that is gathered and can be experienced while playing urban health games. The concept can be adapted to increase learning outcomes for specific users, or to contribute to planning processes. This will be subject to further research. Based on the results, a further demonstrator project will be developed with the aim to bring actors in Frankfurt Ost together in order to further develop the project as a tool to guide future urban development. The site is being marketed as die "Automeile", giving courtesy to its high density of car retail shops along the strip leading out of Frankfurt city centre. The insights gained through fRUNkfurt will be used to make aware of the hidden urban qualities to foster walkability and physical activity on site.[4]

4.2 Course format and evaluation

The authors have observed how students worked together as a team in most of the projects so far. In fRUNkurt, architecture students have contributed with their analysis of noise pollution and pedestrian movement and have constructed a model to estimate the relaxing or activating effect of a POI in collaboration with the psychology students. IT students used this model for the routing and the game mechanic. Psychology students did organize evaluation and gathering of physiological data. Next to setting discipline-specific foci, all participants in a student team are responsible for developing the game concept and contributing to its implementation. For the fist two design briefs, the authors choose a site,in Darmstadt and a second one in nearby Frankfurt, ca 20 km away from the University campus in Darmstadt. The site in Frankfurt Ost has shown many interesting stimuli of environmental and socio-economic factors. However, the authors found that to be able to work on site on a weekly basis is crucial in developing a location-based game, which has led to changes in the following term (see below).

Students have highlighted in the evaluation that the interdisciplinary approach has an overall positive effect on motivation and learning. They have pointed to challenges in developing such a new format; adjustments are needed in terms of timing of theoretical inputs during the design process and lecturers providing coherent feedback despite coming from different academic backgrounds. Students have stated an extra benefit from the broader angle on urban health and serious gaming and some have continued the work on other prototypes in research projects, bachelor studies and theses.

4.3 Further steps to improve the course format

We have implemented the following steps in response to students' evaluation in order to *optimise feedback and input structure.* We are also planning to invite guest lecturers from professional design studios and stake holders interested in health promotion and city developing to involve potential collaborators early in the process.

Using emerging concepts and models, more attentions will be laid on psychological models to explain and evaluate learning and behaviour change in games for health. The experience from the two first semesters taught us that architecture and serious gaming technology are highly dependent on psychological input to structure and guide their contribution to health game design. In addition, future design briefs will be developed together with potential partners, which will specify requirements on the health games context and goals, but also give orientation about potential users.

In the first two semesters, the design briefs for the students included various interests of researchers involved in the project. The discussions that have been evolving around the course format have been helpful to develop

[4] The research group Urban Health Games will show the demonstrator *Stadtflucht* as part of the art project "First evacuation plan for the Rhein-Main area" by Japanese artist Akira Takayama in September 2014. See www.evakuieren.de

shared research language, interests and projects. In the future, the format will include *ground truth* studies, e.g. on psychophysiological effects in urban environments in regular use. In a second step, health game prototypes developed in the course will be compared within experimental set ups. In this way, the authors plan to unfold further synergies between scientific and educational interest in health games.

5 Conclusion

Developing Urban Health Games has shown a successful format to involve students in interdisciplinary approach to promoting health and learning with strategies from serious gaming, urban design and psychology. This article has pointed to challenges in setting up a new interdisciplinary collaboration in terms of developing a shared base of knowledge and interests. First outcomes have indicated potentials for learning and health outcomes when prototypes include information on physiological data and environmental design characteristics.

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