

A PERVASIVE GAME FOR FRESHMEN TO EXPLORE THEIR CAMPUS: REQUIREMENTS AND DESIGN ISSUES

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ABSTRACT

Usually, students starting their studies at the University for the first time are clearly overstrained regarding what they shall do, where and how to do this, who to ask, and so on. That's why we decided to support freshmen's orientation on the campus by means of a pervasive game, that helps them to learn about important facts, places, and procedures related to their new environment – and to get in contact with other students. We started with a survey among current freshmen in four programs of study, in order to align our game design at the personal attitudes, habits, devices, and practical problems of our students. The intention of this paper is threefold: (a) to present and to discuss the idea of a pervasive game for freshmen, (b) to present a methodology to develop such a game based on students' experiences, and (c) to present the results of our initial survey resulting in design requirements for such a game. We believe that all three points will be of certain interest for the reader who thinks about supporting freshmen and/or designing a pervasive campus game.

KEYWORDS

pervasive game, campus, freshmen, survey, design requirements

1. INTRODUCTION

Orientation in a new environment – like a new job, a new home, and so on – is sometimes jokingly referred to as “100 days idiot's period”. Though this sounds funny, it can be a very hard time, leading to severe personal problems, decrease of performance, and a significant drop-out rate. Besides individual difficulties, the economical loss should not be under-estimated.

This is also true for students beginning their studies at the University. Typically, they are in an unstable period of life right between adolescence and maturity. Academic studies are often related with a new home, a first car, a new form of living, a new responsibility for their own life, and a totally different style of learning and organizing their day. While in school they have always been told and shown what to do, they now have to explore their new environment and tasks on their very own. This may overstrain them (Romeike & Schwill 2006). The results are a significant number of drop-outs (25% to 35% in technical disciplines at German Universities according to Becker C. et al., 2010), and a delay in being productive within their studies.

Surely, one could say that this belongs to the process of growing up. Our challenges define how powerful we become. Nevertheless, a little help with orientation on the campus should not eliminate this situation, but rather support students in dealing better with that and learn more from this challenging period in their life. At least, this can be ideas like: “If I don't feel able to do something, I have to *do* something in order to learn it” or: “If I don't know something, I have to *ask* someone”. Since there are always personal restraints against such actions, especially in a new environment, and especially for introverted people, we believe that a game-based approach might be relaxing and helpful in this situation. Moreover, students can be brought together by means of the game in order to stimulate their social relationships throughout the whole studies.

The idea to combine online computer games with real-life settings became popular within the last decade. Players are equipped with mobile devices and move around a given area. Locations and moves of the players are even relevant if no positioning mechanism is used. Moreover, augmented reality can be used to tightly interweave the virtual game story with physical artifacts (Magerkurth et al. 2005). Thus, the field of

pervasive gaming brings together the perspectives of technology (Benford et al., 2006), game design (Crawford 2003), psychology and culture (Salen & Zimmerman 2004) – and, if used for educational purposes, pedagogies (Thomas 2005). A special challenge for the game designer is that the borders between the game and the physical environment are not as apparent as in traditional play settings (Huizinga 1938), but build the so-called magic circle as a special place in time and space (Montola 2005). That's why the game design has to ensure that players don't lose touch with reality, or sustain an accident on the street. From the multitude of pervasive games that have been developed, we'd like to draw special attention to the following:

- Chawton House (Weal et al. 2007) is an English manor related to the writer Jane Austen. It was equipped with an infrastructure for extending literacy field trips with location-sensitive devices. A learning game was designed that puts children into the place of historic writers, transforming what they see and what they explore to a story that is transferred back to classroom.
- REXplorer (Ballagas et al. 2008) is a game for tourists in the old German city of Regensburg forcing them to learn about its history and attractions. The story is around supernatural phenomena and a scientist who is asked to analyze this. Players are equipped with a mobile device that allows them to interact with historical and legendary figures. The goal is to find as much magical energy as possible.
- REWARD (Triebel et al. 2010) has a similar approach of exploring an unknown area. There is not an actual game story, but players have to collect photographs of visual tags from hidden places they shall find.
- CollecTic (Hielscher 2006) is a Playstation game. Users are requested to find public hotspots with WiFi access. Depending on parameters like signal strength and MAC address, the hotspots are coded with different symbols and arranged in a 3x3 grid. Players have to collect rows with all equal symbols.
- There are a large number of shooters deployed as a pervasive game, like BotFighters or Shoot Me If You Can. Players have to locate their opponents by moving through the real world, and to catch or destroy them by taking photographs or in a virtual fight. There are also augmented reality versions of traditional games like Pacman and Quake.

Though there are a large variety of pervasive games for entertainment, the number of educational approaches is limited. To the best of our knowledge, existing game-based approaches to alleviate students' start at the University are limited to traditional mobile games for single players, for instance:

- C-Shock (Maniar & Maniar 2010) was designed at the University of Portsmouth in order to prevent students from foreign countries from being irritated by cultural differences, like drinking alcohol or kissing in public spaces. The game was designed for mobile phones and should be played by students prior to entering the country.
- A Campus Navigation System developed at Dublin City University (Hatt & Muntean 2007) guides students through some activities they have to perform during their first days on campus. Students are requested to enter specific buildings associated with these tasks. When the correct position is detected the game engine lets them perform a virtual task. This comes along with collecting happiness, education, energy, and money; with the final goal of virtual graduation.

We believe that a truly pervasive game, which closely interweaves real-life settings and artifacts with a digital game, may activate students to a much larger extent and may create a deeper knowledge compared to the isolated experience of a digital or mobile game. This paper presents our thoughts on how such a game should be designed, and why. We based this concept on an initial survey among freshmen in order to derive requirements regarding technology, organizational issues, game story, and necessity at all. The paper is organized as follows: Section 2 presents our survey and its results. Section 3 contains the design requirements derived from the survey. Section 4 proposes an idea for such a game. Finally, section 5 draws a conclusion and outlines further work.

2. THE SITUATION OF FRESHMEN ON THE CAMPUS

Preparing our development of such a game for freshmen we designed a simple 15 items questionnaire and sent it to participants during weeks 4 to 7 of their studies. We selected three introductory courses of the main Bachelor programs on our local campus. We asked for the following issues:

- personal data (age, gender, type of studies)
- equipment and attitudes (devices and how they use them)
- experiences (how well they did as freshmen)
- preferences and ideas for a freshmen game

This was a web-based survey. We received a total of 146 submitted questionnaires, which is approximately 40% of the overall freshmen in the involved courses. Students are mainly in the age of 19 to 21 years (88%). About 44% are female and 56% male. They assigned themselves to computer science (14%), business informatics (28%), business economics (54%), and political economics (4%). While a majority of business economics students is female, in the other disciplines a majority is male. Considering the overall number and distribution of students, we feel that this is a good sample of students in these disciplines. In the following, we're going to present selected answers in more detail.

Most of our students own mobile devices that could be facilitated for the game. The types of available devices and network connections (multiple selections were possible) are given in Figure 1. We see that students are well-equipped with mobile devices, mostly in terms of notebooks (74%) and smart phones (39%). Additionally, some MP3 players and tablet PCs were mentioned. We believe that traditional phones without seamless web access are not suitable for our intention. Almost all students (99%) have internet access. Surprisingly, there are no inter-dependencies of technical equipment with gender or discipline; this is in contrast to what we experienced in previous developments.

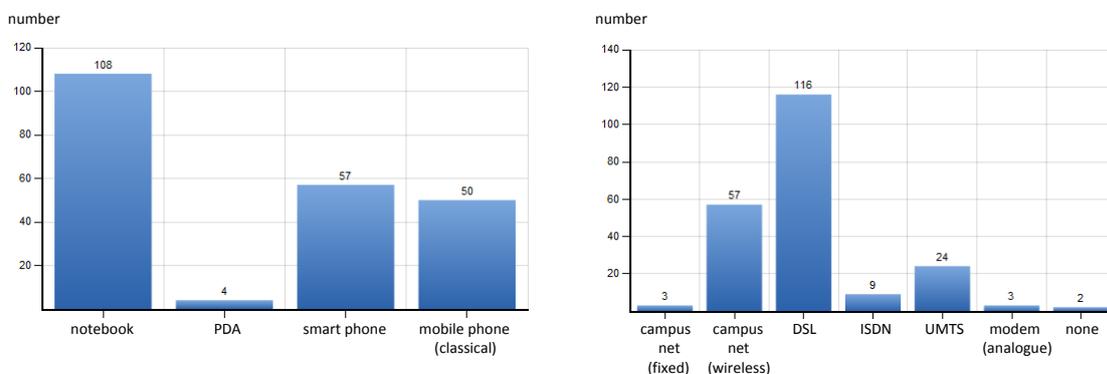


Figure 1: Different types of mobile devices (left) and network connections (right) at the students' disposal

The students are familiar with using the internet for different activities both in private life and in their studies (80 to 90% for browsing the web and communicating online). So, the technical preconditions for our game are given. Many students play computer games in their private life (47%), but only few in relation to their studies (3%).

Another block of questions tried to find out how well the students did on the campus during their first weeks. For designing our survey, we identified some points in the daily life of a student that might be crucial. We asked the students if they had problems with this places and actions, or not. Figure 2 presents the results.

There were almost no problems with attending relevant lectures (82%). Some students mentioned the systematical numbering of rooms within building as a reason for this.

A second group of items did not cause considerable problems, but did also not make the students feel very competent. Students did more or less well with orientation in the own institute (69%), on the campus (68%), and in the city (40%) as well as in the cafeteria (76%), in the library (48%), and public transport (53%).

Finally, we've seen that a number of students had little or severe problems with course registration (18%), course guidance (16%), academic help (15%), and social help (12%). These columns are marked with a solid triangle in the figure; we're going to focus our game on these points.

It shall be mentioned that a large number of students claimed not to need or make use of orientation in the city (35%), working in the library (22%), course guidance (29%), social help (57%), and public transport (26%). This may be a misjudgment and is thus also a toehold or goal, respectively, for our game. These issues are marked with an empty triangle in the figure.

There were no remarkable gender differences in this block, except two points: Regarding library and course guidance, female students tend to feel more comfortable, while male students tend to say that they don't need or don't use it.

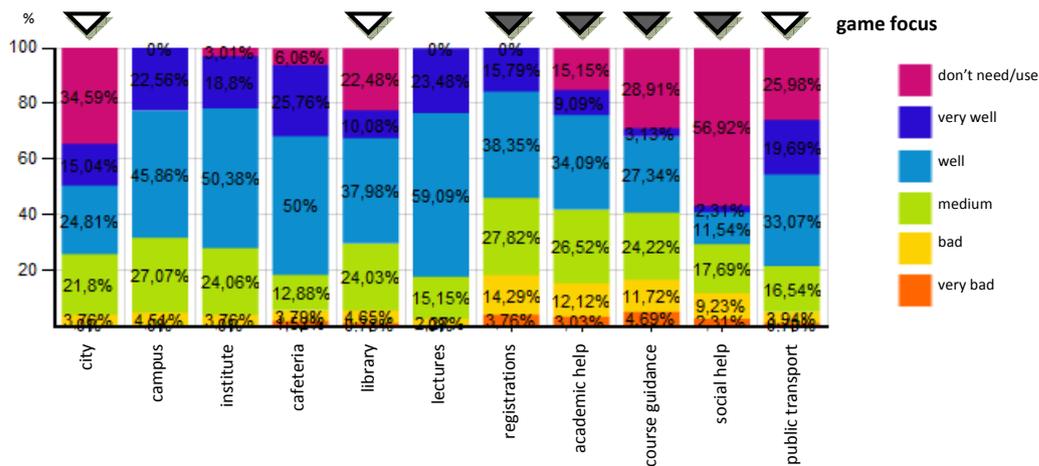


Figure 2: Self-assessment of students' capabilities regarding typical activities on the campus / during their studies

In the last block of our questionnaire we tried to find out how the students like our idea of a pervasive game, how they could imagine the organization of such a game, and which types of games they prefer. Fortunately, students appreciate our idea (97%) and share our vision of a mobile, online approach (64%) across the whole campus and city (90%). Surprisingly, students prefer a team-based approach (83%); we appreciate this but did not expect it because we experienced most students in technical disciplines to be a loner. Most of the students are willing to bring their own devices (93%, including 13% who do not want to use foreign devices). The majority prefers small-sized mobile devices (like smart phone 49%), but also bigger and more stationary devices (notebooks 64%, PCs 45%).

Moreover, we did not imagine that 55% prefer a funny game against a sportive (33%) or serious (32%) approach. Male students clearly tend towards a funny game, while female students slightly preferred a serious approach. Regarding the game story, we asked the students to rate the suitability of traditional designs (multiple selections possible). Figure 3 presents the results. In general, students preferred adventures (48%), rallyes (49%), and cards (50%), while the latter one did not find friends among the sportive group of students (only 25%). In general, students who liked funny games did agree with all offers (mean of 62%), while students with a serious preference were more or less undecided and observant (mean of 55%). The group who agreed with a shooter mainly consists of male students (86%), while dice are selected mostly by female students (71%). Additional suggestions provided by the students included chess and singing.

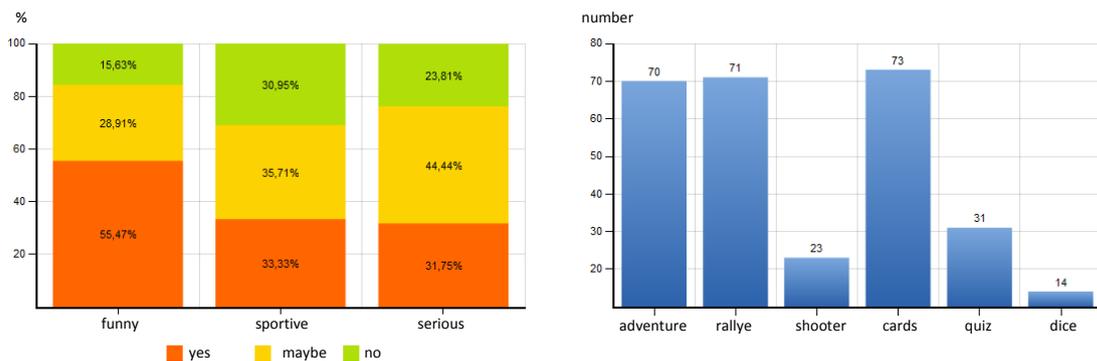


Figure 3: Students' preferences for different game designs

3. DESIGN REQUIREMENTS FOR SUPPORTING FRESHMEN

Derived from the results of the survey presented above, we identified a number of design requirements for the planned game. This process was straight-forward and shall not be commented here.

- There is no need for a compromise of medium-sized devices. But we have to guarantee distinction between large and small screens (notebooks/PCs and smart phone) including different interaction concepts.
- The overwhelming willingness of students to use own devices comes along with a variety of platforms we have to support. Thus, there are strong requirements for platform independence of the developed game.
- Students declared far less wireless network connections than mobile devices. Especially, access via UMTS is in their private responsibility and associated with costs (even in case of a flat rate). So, a mixed strategy is necessary. First, students can be supported by the game to establish WiFi connection on campus. Second, we have to provide alternatives like a targeted integration of stationary devices.
- We can presume that students are well familiar with the use of mobile devices and the internet. Thus, the game design has to follow only general rules of usability and does not need to take care of novice computer users. Since many (but clearly not all) students are experienced game players, we'll need to have different levels of difficulty in order to attract all students. The same is with the focus on funny, serious, or sportive tasks.
- We need a high degree of freedom within game play in order to support variety of disciplines with specific personal and scientific habits, including different ratio of male/female students.
- The game shall be in online team-play modus and mobile across all three campuses of our University as well as the whole city.
- The topics covered by the game should have a main focus on course registration, course guidance, academic help, and social help. Additional focus can be necessary on orientation in the city, working in the library, and public transport. Other topics are negligible.
- Rallye and adventure are the most promising game types, but also hard to implement. Alternatively, cards can be a sufficient approach, if there is a sportive element in order to attract all groups of students.

These requirements directly led to the concept of our freshmen game, presented in the following section.

4. THE CONCEPT OF A PERVASIVE CAMPUS GAME

Based on our user survey and the requirements we derived from it, we'd like to propose the following concept to implement the idea for a pervasive game to support freshmen on campus. We kindly appreciate any comments of scientific reviewers and conference participants that may help us to improve the concept before starting implementation.

For reasons of platform independence we decided to implement a *browser-based game*, since this is the common denominator of all devices. Accordingly, extensions like Flash or JavaScript must not be used. This comes along with omitting specific device capabilities like sensors for position estimation. (Depending on the variety of device types among students, there is a future option of client-side plug-ins for specific extensions.) We're going to create awareness of user's position using existing infrastructure like WiFi access on selected points. Moreover, the current position of a player can be estimated by integrating physical artifacts (like books, posters, trees, houses, ...) into the game play – not into the IT infrastructure itself.

Our second design decision is towards a cards-based game (in particular, a *quartet* or *foursome*) in order to limit the amount of information to be displayed on the screen. This is both to address the variety of client devices and to ease the play of the game (Weal et al. 2007). The goal shall be to collect four cards of a type; these types are the topics of interest identified in our survey. Every card stands for a question to be answered, a task to be done, or a place to be visited. These can be online activities (like creating their personal info page in the learning platform) or physical activities (like finding an artifact hidden somewhere on the campus). We have to find a balanced mix of funny, sportive, and serious tasks. This refers to the relevance of topic; important points should require more personal involvement, while marginal issues can be treated casually. Some tasks will have a rallye character in order to keep players attentive and interested.

Regarding the subjects of these tasks we decided to directly implement a model from cognitive sciences, applied to the required *knowledge types* for freshmen. This can be classified into four levels (Jarz 1997), based on each other:

- Factual knowledge is declarative, static information on an issue. We can simply test that by letting the students answer a question.
- Orientational knowledge is a schematic model of a topic. For theoretical fields, this requires targeted questions. For physical issues, the student can be asked to visit a place or select an object.
- Actionable knowledge is procedural and dynamic information on an activity. Questions are needed to verify if the student knows how to do something.
- Practical knowledge is an actual skill to perform an activity. We can test that by letting the students do something.

These four levels result in the four cards of each type. The following table gives some examples for selected topics of the game or types of cards, respectively. The challenge is not only to create a task, but rather to find ways to bring back the result of the task into the gaming engine.

	factual knowledge	orientational knowledge	actionable knowledge	practical knowledge
course registration	Where does course registration take place? students' office, online system, tutor, or professor.	Select the categories of courses you are forced to attend this semester! [depends on discipline]	What do you need to log into the course management system? matriculation number, account, password, or email address.	Register yourself for the project on pervasive gaming!
cafeteria	Who is owner of the cafeteria? university, student union, city, or state.	Select the building on the map where the cafeteria is located in!	Finished your meal, where do you leave your dishes? table, rack, conveyor, or cashier.	Go to the cafeteria and take your meal. Then, enter the code the cashier gave to you into this interface.
library	Why do you need a signature in the library? to sign a ticket, or to identify a book.	Entering the library, in which direction is the desk? straight forward, to the left, or to the right.	When lending a book, do you first take the book from the rack, or present your id at the desk?	Go to the library and lend the book [randomly generated for each team]!
public transport	Select the types of public transport that are available in our city! bus, tram, railway, or subway.	Which river do you cross on the trip from the eastern campus to the city centre?	Use the route planner of the transportation company to find out how long the next connection from eastern campus to the biosphere will take.	Take a train to central station. Go to the bus terminal and find out at which platform bus 695 takes off.
other topic ...	answer a question	select or visit something	proof know-how	do something

Table 1: Examples for different tasks of the game relating to knowledge types and game topics

The *organization* of the game is simple. Students can request their tasks from the web server of the game. When a task is fulfilled correctly, the respective card will be added to the personal deck of the player. This requires just a central record with web-based interface. Though collecting cards is an individual job, we need a support for team-play. Cooperation among students can be forced not only by helping each other in collecting cards. Furthermore, we're going to divide the organization of the game into three phases. In an initial face-to-face meeting, teams are built that compete with each other. The second phase is made of personal mobility and collecting cards. The central game server will keep track of all tasks fulfilled resp. cards collected by each team. Third, there shall be a phase for exchanging cards in order to complete a block of the quartet. This can be both another face-to-face meeting and/or a web-based market place.

This brings up the question of gaming *interfaces*. Each gaming interface offers different functionality within the game play (Lindt et al. 2006). In general, there is an administrative and a player interface required. Administration includes management of players and external components as well as supervising the game progress. Here, a comparatively large amount of data has to be handled, which can be done better using a conventional PC. Players' interface allows to request and fulfill tasks, and to manage cards. This interface will be designed for a smart phone, but works also on a PC/notebook. Moreover, some activities are carried out using external platforms, like registering for a course or lending a book. A notification on success of the player is sent to the gaming server, automatically.

The *interoperability* between these components will be realized by means of a service-oriented architecture. We made excellent experiences with such an approach for the dynamic interconnection of different gaming scenarios and systems in an educational setting (Zender et al. 2009). A learning platform, the 3D virtual world Second Life, a lecture recording system, a map server, and several own components were integrated by Web Services. This shall now be transferred to the pervasive gaming scenario. External platforms can be equipped with a service wrapper; either directly as a plug-in or code modification, or indirectly by introducing a so called surrogate that mediates between service-based and conventional communication paradigms. Our game engine itself will be provided as a service, too, and is thus re-usable for other purposes.

Starting from this concept, we scheduled *implementation* of the game to the upcoming summer semester. Further preparations include selection and purchase of selected mobile devices for implementing the prototype, collecting further ideas for activities and places the game may integrate, as well as formal modeling of game logics. We are confident that the game will be available for the next generation of freshmen in winter semester 2011/2012. This will require coordination with the official students' office and teachers of selected introductory courses. For a first prototype, we're going to restrict ourselves to students in the disciplines covered by our survey. Anyhow, the designed game should be of interest for other departments, too.

5. CONCLUSION AND FURTHER WORK

This article presented the results of a user study analyzing how well freshmen did on the campus in their first weeks and how they could be supported by use of a pervasive game during an introductory course. Based on the results of this study, general requirements for such a game were stated from a technical, social, and organizational point of view. Finally, we described a concept for a pervasive game to support freshmen, which we're currently implementing. We plan to provide our game to students throughout 2011. Considering the feedback ratio of 40% to our survey, which is usual for surveys in general, we assume that a similar (or even higher) percentage of freshmen will participate in the game. The key point for acceptance (and thus, for the impact) of the game will be to cleverly embed it into the organizational procedure during welcome days on the campus.

Though we can neither present a completed system nor its evaluation, we strongly believe that the results of our survey, the requirements we derived from that, and our design of the game will be of certain benefit for other institutions dealing with the idea to welcome freshmen on their campus with innovative methods for integration. Our findings are applicable to other scenarios, too. The survey provides valuable information for the design of any IT systems for students. And the design issues presented can be transferred to other games at the University, like for learning of subject matters, as well as for games in other environments, e. g. for tourist information.

Beyond implementation of the game, we intend to thoroughly evaluate the system and its usage. This includes questions like: Did we draw correct conclusions from the survey, leading to valid design requirements? How do the students rate our design decisions? Are there activities they prefer or don't like, and do the activities have a suitable level of difficulty? Is the mix of funny, sportive, and serious elements well-balanced? And last but not least, does the game improve the situation of freshmen on campus, compared to the current results of our survey?

From a technical perspective, we'll have to further analyze which types of smart phones are popular among the students (like Apple, Android, or Windows Mobile) in order to align the programming and characteristics of the game with the capabilities of students' devices. Accessing system functions like sensors for GPS, orientation, and velocity will allow us to realize an enhanced version of the game with positioning information, gesture integration or the like, and finally a game design that has more the character of a rallye or adventure. Of course, we'll have to collect this technical data automatically without hampering players.

Regarding survey among freshmen, we plan to resend our questionnaire to students of arts and humanities. Moreover, we're going to further refine our analysis of the survey in terms of a factor analysis, e.g. if there are any distinguishing elements between students. A service-based architecture and a dynamic composition of different elements in the gaming scenario provide the flexibility we need to address individual needs and preferences in such a system.

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