Playability heuristics for mobile games

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Hannu Korhonen
Nokia Research Center
Visiokatu 1
33720 Tampere, Finland
hannu.j.korhonen@nokia.com

Elina M.I. Koivisto
Nokia Research Center
Visiokatu 1
33720 Tampere, Finland
elina.m.koivisto@nokia.com

ABSTRACT
Expert evaluation is a widely used method for evaluating the usability of software products. When evaluating games, traditional usability heuristics lack comprehension and cannot be directly applied. In this paper, we introduce playability heuristics that are specifically designed for evaluating mobile games. Heuristics form a core model that can be used in any mobile game evaluation. The model consists of three modules: *Game Usability, Mobility,* and *Gameplay*. The mobile context has some unique characteristics, which require special attention during the evaluation. These characteristics are described in mobility heuristics. Mobile devices also set some of their own requirements for general usability and these issues are described along with game usability heuristics. These heuristics have been developed by using an iterative design process of a mobile game. In addition, we have validated the heuristics and evaluated five mobile games by using them with the expert evaluation method. The results indicate that playability problems, which violate game usability or mobility heuristics, are quite easy to identify. Gameplay problems are harder to find, but gameplay heuristics help in evaluation and focus on different aspects of the gameplay.

Categories and Subject Descriptors
H5.2. Information interfaces and presentation (e.g., HCI): User Interfaces

General Terms
Design, Human Factors

Keywords
Mobile Games, Playability, Heuristics, Evaluation, Usability.

1. INTRODUCTION
The usability of a software product is often defined as effectiveness, efficiency, and user satisfaction in a specified context of use [7]. Games, however, are most enjoyable and fun when they provide sufficient challenge for a player. The challenge can be, for instance, in learning the game, solving problems or discovering new things.

A good gaming experience requires a lot from the user interface. It should be convenient, reliable, and usable so that the player can concentrate on playing the game and enjoying it instead of struggling with the user interface. In addition, the game design itself has a huge impact on the gaming experience. If the rules or game world contains implausible features, the players can be easily offended or frustrated and quit playing the game.

Playing games with mobile devices in a mobile context is quite a new research area and the heuristics for evaluating these aspects has not been discussed in previous playability heuristics. We have developed playability heuristics to cover the mobile context aspects. The playability heuristics can be used with an expert evaluation method to identify possible playability problems in the user interface and game design in early phase of a game project. These heuristics cover general usability, mobility, and gameplay issues of the game. This method is mainly targeted at pre-production and production phases of a game project, but it can also be utilized in post-production phase.

Mobile games (see for example, Figure 1) have become more and more complex over the years and currently they resemble console and PC games. We have used these heuristics to evaluate different game titles that are designed for smartphones[1] and mobile gaming devices, such as Nokia N-Gage[2]. These heuristics, however, are suitable for evaluating games in other platforms as well since gameplay and game usability are common for all games.

Figure 1 An example of a mobile game on smartphones

MobileHCI'06, September 12–15, 2006, Helsinki, Finland.

[1] Smartphones combine telephone and PDA functions, and enable the user to install additional applications on the device. In addition, the device uses particular operating system such as Symbian, Windows Mobile or Linux.

[2] http://web.n-gage.com/en-US/gamedeck/ngage_qd/

2. RELATED WORK

Usability heuristics are designed for evaluating the user interface of the application. Users typically have their own goals that they try to accomplish with the application and the evaluations try to find out how easily and efficiently the user can achieve these goals. Probably the most commonly used usability heuristics are those originally developed by Nielsen and Molich [15]. Nielsen has then refined these heuristics [13], resulting in the current list of usability heuristics [14]. Additions have also been made to Nielsen's heuristics when evaluating utility software. For example, Muller *et al.* have added three new heuristics that they have considered to be useful [11].

Games differ from utility software in some key characteristics. In games, the purpose is to have fun and enjoy playing the game. Learning to play the game, solving problems, or discovering new things is part of that experience. Moreover, in a game, the players do not know in advance what to expect. Game designers have created the game content and defined goals that the players must achieve. Playing a game is not straightforward either, but it is challenging, and the player needs to work towards goals. Therefore, applying general usability heuristics in game evaluations is not sufficient and using only them would leave many important aspects of the game unprocessed [5].

There are other playability heuristics already available. Malone created the first heuristics for evaluating educational games [10]. More recently, Federoff has created a list of heuristics as a result of a case study at a game development company [5]. Desurvire *et al* have created heuristics that are best suited for evaluating general issues in early development phase with a prototype or mock-up [3]. Järvinen *et al* have developed a theoretical tool for evaluating playability of games trough studying such notions and concepts as 'optimal experience', 'playability', and 'gameplay' [9]. We considered using these heuristics or tools in our evaluations, but they were not feasible. First, the existing heuristics did not deal with mobility issues, which is one of our main targets. Second, all heuristics were not described in detail so that they could have been directly adapted to our process. Third, some of the heuristics were overlapping, which made them ambiguous. Therefore, we decided to start developing our own set of heuristics, which would overcome these shortcomings.

3. DEVELOPMENT OF PLAYABILITY HEURISTICS FOR MOBILE GAMES

We started the development of the playability heuristics for mobile games by defining what kinds of aspects should be evaluated. Even if our original purpose was to concentrate on the gameplay issues, we quickly noticed that game usability is so closely related to the gameplay that in game evaluation general usability aspects cannot be ignored. General usability of the mobile games is a very important aspect and players do not want to struggle with it, because players are not interested in the user interface. The user interface of the game and control keys that are used for controlling the game characters should be very natural and intuitive to use. Since we are evaluating mobile games, another aspect is to evaluate how well a game fits into the mobile context. The third aspect is to evaluate the actual content of the game. This is also the characteristic that differentiates games from other software. Unlike utility software, game developers have created game content and all tasks that players need to achieve in the game. Normally with utility software, users define they own goals and content that they will manage. The software is a tool and its responsibility is to help the users to achieve their goals as fast and efficiently as possible.

Our evaluation model for mobile games is modular and consists of three core modules: *Gameplay*, *Mobility*, and *Game Usability* (Figure 2). They are common for any mobile game. In addition, *Game Usability* and *Gameplay* modules are generic and they can be used for evaluating any mobile game regardless of the platform. The number of modules is smaller than what Federoff and Desurvire *et al* have proposed [5],[3]. The reason for doing this is that we have consolidated some of their modules. For example, the *Gameplay* module incorporates game mechanics because they belong together inextricably. Depending on the point of view many heuristics in these two groups can belong to either group. Gameplay tells about the structures of the player interaction with the game system and with other players in the game [1]. Game mechanics, on the other hand, consists of rules that define the operation of the game world and make up the core mechanics, the foundations of gameplay [16]. Gameplay occurs when the player interacts with the game mechanics and possibly other players. In our model the *Gameplay* module contains also game story, which is separate in Desurvire's list.

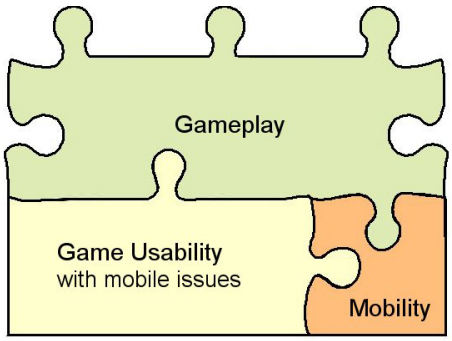

Figure 2 Modules in the core playability model

The structure of the model defines relations of these modules. Gameplay is "the heart of the game" and in order to evaluate it properly there should not be any major playability problems in game usability nor mobility. Game usability and mobility have also correlation in mobile games. Even though *Mobility* is a separate module in the model, there are also mobile issues in game usability heuristics that need to be taken into account when evaluating game usability in mobile games.

A modular structure suggests that it is possible to use each of these modules separately and evaluate the game against one module at a time. This is very useful when evaluating early versions of the game. Gameplay should be evaluated already in an early design phase when there are design documents available. Game usability and mobility will increase their importance when there is interaction design or prototypes available. The structure also suggests that it is possible to add new modules if needed. Especially the gameplay module may need some supplements with different game styles because current gameplay heuristics are very general and applicable for any game. This also helps maintaining the number of heuristics reasonable.

3.1 Defining Mobility Heuristics

We started the development of the mobility heuristics by analyzing mobile phones and their context of use. We analyzed how the context, in which the mobile phones are used, affects the tasks that the user does and in what kind of context the mobile phones are normally used. Since mobile games are also mobile applications, it is presumable that similar requirements would also apply for them. In addition, physical characteristics of the mobile phones probably have some influence to mobile gaming as well.

The mobile context can be very different from the office context. Users will use their mobile phones outdoors where lighting conditions and noise can change frequently. Occasionally users may need to observe their surroundings while doing something with their phones. In addition, when using a mobile phone in public places, there can be other persons in the vicinity, who must be taken into consideration.

A mobile phone is an excellent companion for killing time or just doing something during short breaks because it is always with the user. Taking a photo, sending a message, checking the calendar, or browsing a web site are typical tasks that should be initiated without delay. Therefore, the application and the phone should be in operating mode instantly.

A mobile phone is a multi-purpose device, which is, however, used first and foremost for communication. Incoming calls or messages will inevitably cause interruptions for other use of the device. From our experience phone calls are still in high priority and users will answer an incoming call. Messages are not ranked as high and reading a received message can wait until the other task is completed, unless the user is expecting the message.

In the mobile context, interruptions can be triggered by an external event. These events require the user's attention and the task that the user was doing with the mobile phone must be suspended. Examples of such interruptions may be an encounter of a friend or arrival of the bus. The device itself has no means to prepare or act on such situations, but it can let the user decide what to do.

Characteristics of mobile devices will also set some requirements for mobile applications. Users interact with applications by using a standard 12-key keypad and few navigation keys. In some cases they can use a miniature-size joystick, which is operated with the thumb. The small screen size, insufficient audio capabilities, limited processing power, and battery limitations will cause additional requirements that need to be taken into account when designing mobile applications.

3.2 Initial Playability Heuristics

Next we will present heuristics derived from the analysis and discuss the observations. Results of the mobile context analysis, a review of Nielsen's heuristics and game design guidelines helped us create the first version of playability heuristics for mobile games. This version contained the following heuristics:

H1: Don't waste the player's time

H2: Prepare for interruptions

H3: Take other persons into account

H4: Follow standard conventions

H5: Provide gameplay help

H6: Differentiation between device UI and the game UI should be evident

H7: Use terms that are familiar to the player

H8: Status of the characters and the game should be clearly visible

H9: The Player should have clear goals

H10: Support a wide range of players and playing styles

H11: Don't encourage repetitive and boring tasks

We tried to keep the number of heuristics minimal because a smaller number would be easier to use and remember during evaluation. The other objective was to get the heuristics generic enough so they would cover as many problems as possible.

Heuristics H1, H2, and H3 are derived from the analysis of mobile phone and mobile context. *"Don't waste the player's time*" comes from the observation that mobile phones are used for short periods for killing time or doing something useful and there is not much time for waiting. "*Prepare for interruptions*" heuristic combines characteristics of the multi-purpose device and its use in the mobile context. This heuristic could actually be used when evaluating any mobile application because interruptions can happen when the user is using non-game applications as well. "*Take other persons into account*" applies for all mobile devices because they are used in public places and other people are almost always in the vicinity. The player should not end up in an embarrassing situation where disturbance is inappropriate.

Although mobile phones are quite new devices as a gaming platform, certain conventions can already be drawn from current games. For instance, number five on the mobile phone's keypad works in many cases as a selection key. The device's standard input methods should be used for controlling the game [6]. Another interesting point is the form factor of the device. If the device is meant to be operated one-handed, the game should be playable with one hand. "*Follow standard conventions*" states that a game should follow these conventions because it makes using the device and learning the game controls easier.

Heuristics H5, H7, and H8 are modified versions of general principles for user interface design that Nielsen and Molich have developed [14]. "*Provide gameplay help*" is based on the fact that players rarely read manuals before they start playing the game and carrying a paper manual around would be very inconvenient. "*Use terms that are familiar to the player*" means that the game should avoid terminology that is unfamiliar to a player. The player may not be aware or even interested in knowing differences of network connections nor their associated settings. Also, if the game uses some abbreviations or terms, they should be introduced to the player when they are first encountered. "*Status of the characters and the game should be clearly visible*" is another modified principle from general usability heuristics. The player should always know the current state of the game, for example, whose turn it is to make the next move or what is the current condition of the character. Nothing is more frustrating than unexpected game ending without knowing why it happened.

Games rely much on the immersion during a play session. The game world is a place where the player wants to concentrate on

events that are happening over there. Using phone UI widgets to display some information will break this immersion. "*Differentiation between device UI and the game UI should be evident*" states that game developers should not use device UI, but create a new UI for the game. Preferably the game should use full screen mode and not to use any device's user interface widgets in the game interface in order to maintain the immersion.

Heuristics H9, H10 and H11 are purely gameplay oriented heuristics. "*The Player should have clear goals*" is a fundamental issue in all games. In order to play the game, a player should understand the goals that exist in the game [4]. According to the Flow theory, having a clear goal in mind is a core of an enjoyable experience [2]. Within a non-gaming context, users create their own goals and use applications to achieve these goals. When playing games, however, a player does not know in advance what to expect. A game designer has created the game content and defined goals that the player must achieve. Even though this heuristic does not mean that the game must tell how to achieve goals, it should tell what the goal is and how to begin. In some games players can also create their own goals or select a goal from the pre-defined list of goals. "*Support a wide range of players and playing styles*" means that the game should provide at least a possibility to adjust the game challenge according to the player's experience. The players can vary a lot in terms of both experience and preferred play styles. Usually this can be done with difficulty levels that change gameplay. "*Don't encourage repetitive and boring tasks*" deals with the issues that sometimes make games boring or frustrating. The game should not require repetition of tasks without changing any conditions. Repeating the same tasks over and over again is often called tread milling or grinding, and is usually a guaranteed way of killing the fun in the game. However, it should be noted that a training phase in the game is not grinding because the player needs to practice basic actions, for instance, how the character is controlled in the game. During the training phase, it is useful to repeat certain tasks so that the player learns them.

3.3 Expert Evaluation of Games

In the expert evaluation of utility software, 1-6 evaluators explore the application and write a report about findings that violate heuristics. In addition, the report should contain design solutions that are successful in the application. This should prevent designers to change features, which are working well. Usually the evaluators are usability experts, but it is recommended that they have some kind of domain expertise as well because it helps with the evaluation [14]. In game evaluations, the domain expertise is mandatory. At least the evaluators should be interested in games and preferably be familiar with the game genre of the tested game. The reason for requiring knowledge about the game genre is well grounded because each genre has its own characteristics and conventions that should be followed in order to create a successful game. Also some our gameplay heuristics are not relevant for all game styles.

An expert evaluation of the application can take a couple of hours at minimum. The evaluators go through the application a couple of times and write a report about their findings. When we have conducted evaluations with mobile games, we have noticed that the time required to do a game evaluation is much longer. First, the evaluators have to learn to play the game until all of its aspects can be studied. In addition, due to the nature of games as entertaining products, the whole game is not usually revealed to the player in the beginning. Instead, the player discovers new things in the game little by little by playing the game.

Games are often designed so that there is about to 20-40 hours of playing time in a game. This applies mainly to games which have a storyline. For games without a strict storyline, it can be considerably longer. Of course, the evaluators can examine common things, such as the user interface and general usability of the game, in a shorter time, but evaluating the gameplay requires that the evaluators have really played the game.

3.4 Validation of the Heuristics

After formulating this initial set of heuristics, we evaluated a mobile game (Game A_1) using these heuristics as a guideline. The game was in production phase and the first (alpha) version was soon to be finished. The game was playable on smartphones. The evaluation was done by four experts. One evaluator had game design experience and the other evaluators had done normal utility software evaluations. Two of them were eager game players during their spare-time.

During the evaluation, it came apparent that the list is not sufficient, and many playability problems would have left unidentified with only these heuristics. We found 61 playability problems, but for 16 playability problems we did not have a proper heuristic. The list did not cover all user interface and general usability problems, but more specifically was missing gameplay heuristics. In addition, we found four playability problems that were related to the multiplayer features of the game.

The number of playability problems that violated each heuristic is illustrated in Figure 3. The game design succeeded quite well in the mobility aspects and there were only six playability problems that violated the first three heuristics. Unfortunately, all of them were critical problems that required immediate correction.

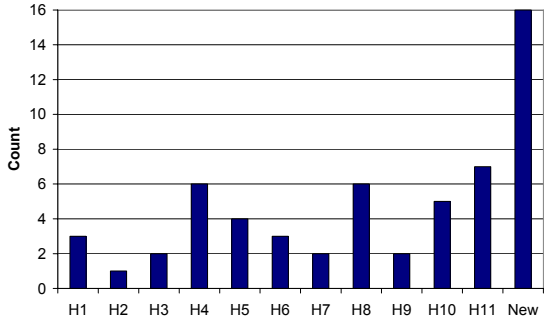

Figure 3 Evaluation results from the first evaluation

The game had many problems in screen layout design and basic navigation. The game UI design tried to follow device UI structure even though there were more commands available than what was possible with device's UI style. This caused confusing moments and players did not know how the control keys worked. In addition, some of the commands were scattered around the screen and the player should have followed certain navigation paths to reach all commands. These playability problems violated heuristics H4 and H6 constantly.

Another severe playability problem in the game was that is was not easy to notice the current status of the game and the player's

characters (Heuristic H8). This was a really severe problem because the pace of the game was fast and the player was forced to make quick decisions for the next move. Furthermore, the player needed to repeat same commands to the characters over and over again, which made the combat system cumbersome.

3.5 Re-evaluating the Heuristics

During the game evaluation we found 16 playability problems for which we did not have a proper playability heuristic. We started to analyze these problems and noticed that most of them were related to gameplay issues, but there were also issues related to the user interface and general usability. Moreover, we had identified four playability problems that were related to multi-player features of the game.

Gameplay is a very complicated part in game evaluation and our initial list did not cover it thoroughly. Although players should have clear goals in the game, they should be able to see progress towards a goal and be rewarded when reaching the goal. In addition, players should be able to compare the achievements. During the first evaluation round we noticed that it is also very important for the player to be in control. It is, after all, the player's responsibility to decide what to do or how to do it, even though game designers have created those events. In addition, if the game contains a story, it should support the gameplay and be meaningful to the player.

All players are novice players in the beginning. During the first play sessions, the player will create a first impression of the game, which is very difficult to change. After that the player gains experience with the game and the game should be able to adjust the challenge for experienced players as well. Balancing the challenge, strategies and pace for various players is a key point for all games. Gaming experience will also create different playing styles, which game designers may not have even thought about.

During the play session it is important that the game world is consistent and every item has purpose. Players are particularly smart in trying different approaches when they are solving problems or discovering new things. Sometimes combining different strategies in the game may result unexpected situations even for game developers[3]. In these situations the game should not stagnate, but the players should be able to continue playing or conclude the play session. Unexpected situations can also lead to exploiting [12].

Game usability issues are also more extensive than we assumed at first. Designing an efficient screen layout, which contains all necessary data, is not an easy task especially on small screens. In addition, due to rapid development of graphics cards, games look visually appealing and players expect that too. However, the game graphics should always support the gameplay and story. Audio is another feature that is left unnoticed in many designs. In mobile games the importance of music and sound effects increases because they create sound environment for the game, but it can also disturb other persons in the vicinity.

In order to provide a satisfying gaming experience, the game should use game controls that are convenient and flexible and provide feedback on player's actions. Moreover, the game should not require the player to remember things unnecessarily or allow the player to make irreversible errors with the user interface. These may seem like irrelevant issues, but during the play session the player does not want to struggle with the user interface, but instead concentrate on playing the game.

As a result, we defined 18 new heuristics to be included in our original heuristics list ending up total of 29 heuristics. Before the next validation round, we arranged a review of the playability heuristics with experienced game designers. Based on their comments we made some modifications to the heuristics.

3.6 Revised Playability Heuristics

Our current list of playability heuristics contains following heuristics categorized into three groups. Detailed descriptions of each heuristic are provided in an article discussing mobile game playability heuristics [8].

3.6.1 Game Usability

The game usability heuristics (Table 1) cover the game controls and interface through which the player interacts with the game. As a general rule, the game interface should allow the player to control the game fluently and display all necessary information about the game status and possible actions. The game interface is usually the first thing that a player encounters when starting to play a new game. Good game usability ensures that the player will have another enjoyable play session.

Game usability heuristics can be grouped to several subgroups. Heuristics GU1-GU5 are related to visual design and how information is presented. This includes also terminology that is used in the game. Heuristics GU6-GU8 will deal with how navigation is arranged and what controls are used for navigation and controlling the game character. The rest of the heuristics are related to other important aspects like getting feedback and how the game can help or guide the player to concentrate on playing the game.

Table 1 Heuristics for evaluating game usability

No.	Game Usability Heuristics
GU1	Audio-visual representation supports the game
GU2	Screen layout is efficient and visually pleasing
GU3	Device UI and game UI are used for their own purposes
GU4	Indicators are visible
GU5	The player understands the terminology
GU6	Navigation is consistent, logical, and minimalist
GU7	Control keys are consistent and follow standard conventions
GU8	Game controls are convenient and flexible
GU9	The game gives feedback on the player's actions
GU10	The player cannot make irreversible errors
GU11	The player does not have to memorize things unnecessarily
GU12	The game contains help

[3] This is also called "emergent gameplay".

3.6.2 Mobility

While the game usability heuristics deal with the user interface issues, the mobility heuristics (Table 2) concern issues that affect mobility of the game. Since mobile devices do not dictate where and when games are played, the game design should assimilate this freedom into the game experience. Mobility is defined by how easily the game allows a player to enter to the game world and how it behaves in diverse and unexpected environments.

Table 2 Heuristics for evaluating mobility

No.	Mobility Heuristics
MO1	The game and play sessions can be started quickly
MO2	The game accommodates with the surroundings
MO3	Interruptions are handled reasonably

3.6.3 Gameplay

Gameplay heuristics (Table 3) are valid regardless of the platform on which the game is played. When evaluating gameplay, it is recommended that evaluators have at least some game design expertise. They should also understand the design goals and know the target players. The evaluators need not belong to the target group themselves, but it is imperative to get more familiar with it.

Table 3 Heuristics for evaluating gameplay

No.	Gameplay Heuristics
GP1	The game provides clear goals or supports player-created goals
GP2	The player sees the progress in the game and can compare the results
GP3	The players are rewarded and rewards are meaningful
GP4	The player is in control
GP5	Challenge, strategy, and pace are in balance
GP6	The first-time experience is encouraging
GP7	The game story supports the gameplay and is meaningful
GP8	There are no repetitive or boring tasks
GP9	The players can express themselves
GP10	The game supports different playing styles
GP11	The game does not stagnate
GP12	The game is consistent
GP13	The game uses orthogonal unit differentiation[4]
GP 14	The player does not lose any hard-won possessions

[4] Units in the game should be designed so that they are functionally different

4. VALIDATING THE HEURISTICS

In order to validate these heuristics we have evaluated several mobile games during last months. Each game was evaluated by two to four evaluators. One evaluator was always a usability expert. Other evaluators were game designers with basic knowledge on usability issues and the evaluation method.

4.1 Games

We selected five games for the evaluations. Game styles and target players were different in order to see how well the heuristics can identify playability problems. Characteristics of games are listed in Table 4. All games were developed by different game companies, and they have not been published yet. Usually we evaluated the first alpha version of the game, which means that most of the features were implemented and the game was running on a mobile device. For one game we evaluated single features because the evaluation happened before the alpha milestone.

Table 4 Game Characteristics

	Game Style	Player mode	Target Player	Device	Evaluators
A_1	Combat	Multi-player	20+, Male	Smart phone	4
A_2	Combat	Multi-player	20+, Male	Mobile Gaming Device	2
B	Adventure	Multi-player	18+, Male	Smart phone	3
C	Simulation	Single Player	12+, Female	Mobile Gaming Device	2
D	Puzzle	Single Player	10+, Neutral	Mobile Gaming Device	3

In game A_1 two players fight duels and collect game characters. Game A_2 is the second version of the game A_1 after corrections based on the first evaluation round. The game felt like a new game after these corrections. In game B a player controls ships and battles on the sea. Game C is a typical simulation game where a player observes and controls game characters indirectly. In game D a player solves puzzles in the game world, which consists of different levels.

4.2 Game Usability and Mobility Heuristics

Game usability issues were the easiest playability problems to be identified in the games. Unfortunately, they seem to be the easiest heuristics to be violated too. At least four games violated each heuristic in the *Game Usability* module. The only exception was preventing a player to make irreversible errors (GU10). Games A_1, B, and C violated this heuristic, but only in a certain situation. During the evaluations we identified 151 playability problems related to game usability (Figure 4). It is noticeable that quite often playability problems in a game were concentrated in certain heuristic. For example game A_1 suffered from navigation problems (GU6), whereas games C and D had many terminology related problems (GU5). Memorizing different things (GU11) in the user interface was a problem in games A_2 and B.

Designing an efficient and visually pleasing user interface is not an easy task in mobile devices. Displaying sufficient amount of data and required commands on the screen is challenging. A game user interface tends to keep everything visible and arranging them reasonably is difficult. Game A_2 in particular suffered these kinds of problems, but the visual design was probably not yet finished.

A small number of mobility problems were expected to be found because the games were designed to be mobile. However, all games, except game C had some playability problems in this area. We identified 10 playability problems related to mobility (Figure 4). These heuristics are quite easy to test since an evaluator needs a Subscriber Identity Module (SIM) card for a device and test how interruptions are handled (MO3). Accommodation to the surroundings (MO2) and launching the game (MO1) are easily tested.

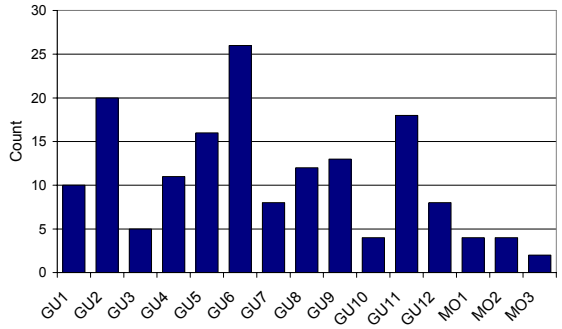

Figure 4 Playability problems violating game usability and mobility heuristics

4.3 Gameplay Heuristics

Gameplay is the most difficult aspect to evaluate because it requires that evaluators explore all aspects in the game. Evaluating gameplay issues may take considerable amount of time. The game complexity will also affect the time needed greatly. We found 64 gameplay problems from the games (Figure 5). The most common violations of gameplay heuristics focused on heuristics GP1, GP3, GP4, and GP5. All evaluated games violated these heuristics. Surprisingly, games had problems in defining understandable goals. This should be the core design concern in game development projects since otherwise players do not know what to do in the game. These kinds of problems in a game may be an indication of design flaws. Other difficult aspects to design were letting the player be in control and balancing challenge, strategy and pace in the game.

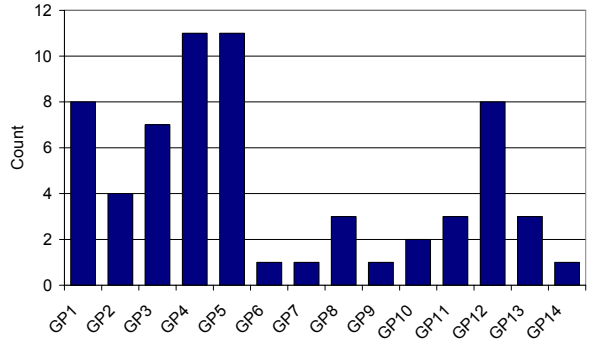

Figure 5 Playability problems violating gameplay heuristics

Another heuristic that was violated by all games except game C was GP12 (The game is consistent). Risk of having these kinds of problems increases when the game becomes more complex.

Gameplay problems related to heuristics GP8, GP9, GP10, and GP11 were found only in Game A_1. The reason for this is that the evaluation time for game A_1 was substantially longer than for other games and the evaluators were able to explore the game thoroughly. Especially, finding these kinds of gameplay problems in the game requires that the evaluators are really familiar with the game and are able to try unique things during the gameplay.

5. DISCUSSION AND FUTURE WORK

Playability heuristics proved to be very efficient in game evaluations and games had playability problems associated to each heuristic. We found 235 playability problems from five mobile games. Some of the problems were more severe than others, but all of them still have some influence on the overall gaming experience. Playability heuristics helped evaluators focus on specific aspects in the game. Even though the evaluators were not able to find that many playability problems from gameplay that violated specific heuristic, it does not necessary imply that the heuristic is useless. On the contrary, this is usually a positive result, because game designers have then succeeded in the design phase and evaluators remembered to acknowledge that aspect as well.

During the evaluation, the most easily identifiable playability problems were related to game usability and mobility. Especially, information visualization and navigational problems were easy to spot. On the other hand, evaluating these aspects from the game resembles normal usability evaluations of utility software. Evaluating the gameplay is much harder. In order to evaluate the gameplay properly requires that game usability issues are checked beforehand. In the future, we should start looking for guidelines that would help finding gameplay problems and thus, making the evaluation more efficient.

Another task for future work is to define playability heuristics for multi-player features. During these evaluations we had three games that are multi-player games. Evaluation revealed some playability problems that do not fit into any existing module. This is the main reason why we designed our heuristics modular. Gameplay heuristics are meant to be general for all game styles and for example multi-player heuristics are applicable to multi-player games only. Therefore, they cannot be included in the gameplay heuristics. However, our model allows other game style specific heuristics to be included in the core heuristics and to be used in game evaluation.

We will continue validating heuristics and evaluate more mobile games using these heuristics. By doing this we will get enough data as to whether these heuristic are applicable for all mobile games and how much there is need for game style specific heuristics. Comparing results from playability testing and expert evaluation would also help in validating these heuristics. In playability testing, players from the target group play the game. Results from these methods should show whether similar problems are found and which method should be used to test different versions of the game.

We will provide these heuristics with descriptions to the public. Any game evaluator or game designer can use them in their evaluations. It is important to know whether these heuristics are

understandable for evaluators that do not have previous experience with them. Another interesting aspect is to see how these heuristics can help during the game design phase because every major change is easier to do when a feature is only written in the design documents.

6. CONCLUSION

We have introduced playability heuristics for mobile games. These heuristics form a core model, which can be used for evaluating any mobile game. The model consists of three modules: *Game Usability, Mobility*, and *Gameplay*. The *Game Usability* module covers the game controls and interface through which the player interacts with the game. Also, it contains common usability aspects that help the player to get into the game and interact with it. *Mobility* module concerns issues that make the game mobile. The *Gameplay* module deals with issues that arise when the player interacts with the game mechanics and story.

We have developed the first version of heuristics in parallel with a game project and used them to evaluate the game. In addition, we have conducted the first validation of heuristics and evaluated five mobile games. The results indicated that these heuristics are useful in identifying playability problems in mobile games. Game usability and mobility problems are quite easy to identify since the procedure is very similar to evaluation of utility software. Playability problems related to gameplay are more difficult to identify, but gameplay heuristics helped evaluators to focus on important aspects in the gameplay.

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