The Components of Enjoyable Game Design for Motor Impaired Users: Expert Evaluation

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Abstract
Facilitating enjoyable user experiences are significant in the design of computer games. To achieve this, we need to understand the composition of these components and how to evaluate it. However, studies which evaluate on the components of the enjoyable game design are limited, specifically in relation to motor-impaired users. The Motor-Impaired Users – GameFlow Model (MIU-GameFlow Model) rating scale in this study was developed based on GameFlow Model, EGame Flow Model, user experience literatures and an interview with motor-impaired users. MIU-GameFlow Model was developed to measure enjoyable game design for motor impaired users. Expert evaluation approach was implemented to refine the MIU-GameFlow Model’s content, wordings and gaps in the rating scale. The data were analyzed using descriptive analysis.

Keywords: Expert Review, Enjoyable, Game Design, Motor-Impaired User

1. Introduction
In order to understand the user’s experience in computer games, researchers are using a variety of theories and methods¹. However, evaluating the enjoyable game design for special needs remains an open challenge. The main issue making it difficult to create a good evaluation method is the need of a framework that specifically for special needs such as motor impaired users². The measures should be brief, clear, and easy to administer³.

Author in³ described validation becomes 36 s an important stage especially when a new measure is being developed where there is no existing measure that operationalizes the concept as the researcher intended. For instance, there are instrument measuring player enjoyment in games, however, an instrument that defines and measure enjoyable game design for motor impaired users is new and need to be validated. Validity looks at how well the items of an instrument represent a concept or domain of content⁴–⁵.

A panel expert was invited during content validation will offer valuable feedback about the quality of a newly developed measure. A research will use an untested measurement when conducting studies without validation process. The instrument needs revisions and the process would need to be redone with another pilot study for the revised instrument if the data from an untested measurement. If the components were validated early on, an instrument developed based on the framework would require less revision and need not be evaluated repeatedly.

The aim of this research is to analyze expert’s evaluation of the contents of MIU-GameFlow Model rating scale. We define motor-impaired users as a user who have symptoms of wrist/hand, such as hand discomfort, numbness, tingling, pain or burning sensations while a computer game playing.

2. Theoretical Framework
A variety of ideas, techniques and different approaches were used to assess game experience and enjoyment⁶. Author in⁷ introduced a Flow Theory in 1960s as a description of the enojyment derived from daily actions.
He defines flow as an emotional state of optimum pleasure which arises when people are engaged in activities. People in this state perceive their activity to be enjoyable, even if no goal is reached. The Flow Theory involves eight components: Completion of tasks, concentrating on tasks, clear goals of tasks, immediate feedback on tasks, control over actions, effortlessness that removes awareness of frustrations, self-conscientiousness disappears and a stronger sense of self-awareness arises and sense of time is distorted. Flow Theory is the main concept used to explain the experience of users while playing computer games.

The tripartite media enjoyment model was introduced by 68 r’s to conceptualize enjoyment as an attitude with affective, cognitive, and behavioral antecedents and consequences. The affective element focuses on empathy, positive and negative moods; cognitive aspect focuses on judgments of game characters’ actions and the behavioral aspect connected to selective exposure in terms of the player’s viewing intent as well as behaviors during viewing.

Author in was proposed the GameFlow Model. The GameFlow Model is based on Flow Theory integrated with appropriate criteria from computer game usability and user experience literature. The GameFlow model consists of eight core elements. The core elements are concentration, challenge, player skills, control, clear goals, feedback, immersion, and social engagement. The elements are summarized in Table 1.

EGameFlow Model was introduced by based on authors in framework. The study is to develop a more precise scale that measure learners’ enjoyment of e-learning games. The scale developed in this study consists of eight dimensions: Immersion, social interaction, challenge, goal clarity, feedback, concentration, control, and knowledge improvement. Four learning games employed in a university’s online learning course were used as the instruments of scale verification.

Author in was presented Pervasive GameFlow Model, which is described and discussed in terms of additions and elaborations to the general GameFlow Model. This model proposed to serve as an argument for further empirical studies on player enjoyment in the pervasive game environment.

Some unique features of game design for motor-impaired users were emphasized. Author in proposed features that can adapt to different users’ requirements, support a wide range of input devices, offer simple design that easy to understand and encourage further exploration. Additionally, the interface should be able to analyze the extraordinary user’s interest and behavior and can adapt according to their need; improve adaptive personalization mechanism with reduce the amount of navigation required to reach items and offer scanning mechanism to reduce repetitive and forceful hand movements.

3. Proposed Conceptual Framework

Designing computer games that are given an enjoyable experience for ordinary user is a challenging task. The methodology becomes even more complex when we design motor impaired users inclusive game. One of the main processes is to identify the user’s abilities and limitation.

Table 1. The GameFlow model elements by

| Elements         | Definition                                                                 |
|------------------|---------------------------------------------------------------------------|
| Concentration    | Games should require concentration and the player should be able to concentrate on the game |
| Challenge        | Games should be sufficiently challenging and match the player’s skill level |
| Player Skills    | Games must support the player skill development and mastery                |
| Control          | Players should feel a sense of control over their actions in the game      |
| Clear Goals      | Games should provide the player with clear goals at appropriate times     |
| Feedback         | Players must receive appropriate feedback at appropriate times            |
| Immersion        | Players should experience deep, but effortless immersion in the game      |
| Social Interaction| Games should support and create opportunities for social interaction     |
Few studies have developed the rating scale pertinent to the enjoyment of computer games. Therefore, the objectives of MIU-GameFlow Model rating scale are to measure enjoyable game design for motor impaired users. At first phase, scale items were generated based on GameFlow Model\(^2\), Game Flow Model\(^1\), user experience literatures and on interview with motor-impaired users. The instrument consists of the seven constructs specifically, concentration, challenge, player control, clear goal, feedback, immersion and flexibility. The operational definition for each construct was presented in Table 2.

### Table 2. Operational definition of MTU-GameFlow’s construct

| Elements       | Definition                                                                 |
|----------------|---------------------------------------------------------------------------|
| Concentration  | Games should require concentration and the motor-impaired player should be able to concentrate on the game. |
| Challenge      | Games should be sufficiently challenging and match the motor-impaired player’s skill level. |
| Player Control | Motor-impaired players should be able to control interaction in the game.     |
| Clear Goals    | Games should provide the motor-impaired players with clear goals at appropriate times. |
| Feedback       | Motor-impaired players must receive appropriate feedback from the computer game at appropriate times. |
| Immersion      | Motor-impaired players should experience deep, but effortless involvement in the game. |
| Flexibility    | Games should accommodate a wide range of individual preferences and abilities. |

4. **Methodology**

4.1 Develop Motor-Impaired Users GameFlow Model (MIU-GameFlow Model) Rating Scale

The Motor-Impaired Users Flow Experience rating scale was developed to measure enjoyable game design for motor-impaired users. MUI-GameFlow Model have seven potentials construct including concentration, challenge, player control, clear goal, feedback, immersion and flexibility. Figure 1 showed each construct used in the instrument.

**Figure 1.** MIU-GameFlow constructs.

4.2 Develop Response Items

Experts were asked to rate how important each item to enjoyable game design for motor impaired users. The response option uses a five point scale format. Table 3 shows the condition to rate each of the items. If as the item is deemed as “1 = Extremely unimportant” then the exclusion of that item does not affect enjoyable game design for motor impaired users in the games. On the contrary, if an item was rated as a “5 = Extremely Important” then the exclusion of that item would be detrimental to enjoyable game design for motor impaired users. An item with a rating of “2 = Unimportant”, “3 = Less Important” and “4
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4.3 Identify Potential Expert
Author in\textsuperscript{21} proposes that the choice of experts depends on the expertise related to the conceptual framework. Moreover, an expert publication, presentations and research experience in the area of interest can be used as the criteria for selection\textsuperscript{22}. For example, the purpose of this study was to evaluate a framework for enjoyable game design for motor impaired users; expert members should be familiar with the construct of enjoyable game design, have experience in game development and at least one expert from psychology department. Experts will evaluate every single of the item as well as the whole framework. The total number of experts involved in a content validity study range from three to twenty experts.

In this study, six experts, three academic game researchers, two professional game designers and one physiotherapist were selected. There were five female and one male experts ranging from 34 to 54 years of age. These experts were recruited on the basis of their experience and publications in game design.

4.4 Create Invitation Email for Expert Involvement
An invitation email was submitted after potential experts were identified. An email was sent to expert at least two weeks before the study start. The email invitation contained the purpose of study, a brief description of the instrument, how to contribute to a study and contact information to the researchers. The detailed sample text that used for the invitation is shown in Table 4.

| Paragraph | Sample text |
|-----------|-------------|
| State purpose of study | You are invited to serve as a content expert because of your knowledge and contribute in (area of study). Your participation in the review process is valuable as a preliminary step to future studies that investigate strategies to (study objective). |
| Briefly describe the instrument | The survey should take about (time to complete study) to complete by (response type e.g. ticking response boxes). It consists of items related to the construct of (study concept). The items will be assessed with a five-point rating scale, with 1 = 'Extremely unimportant', 2 = 'Unimportant', 3 = 'Less Important', 4 = 'Important' and 5 = 'Extremely Important'. |
| Describe how to contribute to a study | All responses are treated as anonymous, and in no case will responses from individual participants be identified. If you decide to participate, please refer email's attachment. |
| Contact information and thank you | If you have any further questions about this study or your role, or if you wish to lodge a complaint or concern, you may contact the researcher (Researcher Name) by email (www@email). I hope you will participate in the survey as the data will be very helpful in my studies. |

4.5 Develop Item Evaluation
In this study, three doctorate (Ph.D) in game design, two professional game developer and designer, and one from physiotherapist were contacted to review the initial pools of items. These experts were asked to rate the level of importance of each item for the constructs involved and provide feedback on the first version of the instrument. They were presented all the constructs, items and asked to make a choice out of five options (Extremely unimportant, Unimportant, Less Important, Important, Extremely Important) for each item. An exemplar question as seen in Figure 3 showed an item for concentration construct.
Table 5. Demographic data of experts

| Range                   | Frequency (N) |
|-------------------------|---------------|
| Gender                  |               |
| Male                    | 1             |
| Female                  | 5             |
| Experience in industry  |               |
| 5 – 9 years             | -             |
| 10 – 14 years           | 4             |
| 15 – 19 years           | 2             |
| 20 – 24 years           | -             |
| Software development experience | Yes | 5 |
| No                      | 1             |
| Software evaluation experience | Yes | 5 |
| No                      | 1             |

Table 6. Descriptive analysis for each item

| Items                                                                 | Mean | SD  |
|-----------------------------------------------------------------------|------|-----|
| The game grabs my attention                                           | 4.83 | .18 |
| The game activities are adequate for me                               | 4.87 | .16 |
| The game workload is adequate for me                                  | 4.17 | .93 |
| The game provides content that stimulates my attention                | 4.67 | .10 |
| The game makes me remain concentrated on the game                     | 4.33 | .16 |
| The game challenges are adequate for me                               | 5.00 | .00 |
| The game levels of difficulty are adequate for me                     | 5.00 | .00 |
| The game challenges are balanced with my skill levels                 | 4.50 | .54 |
| The game offers “hunts” to help me overcome the challenges           | 4.67 | .31 |
| The game offers different levels of challenges to cater my needs      | 4.07 | .10 |
| The game is easy to play                                             | 4.67 | .16 |
| The game has simple interaction                                       | 4.67 | .16 |
| Part of the game’s interaction is automated                           | 4.67 | .16 |
| The game offers interaction based on users’ preferences               | 4.50 | .48 |
| The game has a tutorial that is easy to follow                        | 4.67 | .16 |
| The game offers similar game’s goals                                  | 4.67 | .16 |
| The main game’s goals present clearly                                | 4.83 | .10 |
| The intermediate game’s goals present clearly                         | 4.83 | .40 |
| The main game’s goals present at the beginning of the game           | 4.67 | .96 |
| The intermediate game’s goals present at the beginning of each scene  | 4.33 | 1.03 |
| I receive feedback on my progress in the game                         | 4.67 | .16 |
| I receive feedback on my progress in the game (or failure)            | 4.67 | .16 |
| I receive immediate feedback on my actions                           | 4.50 | 1.25 |
| I am notified of new activity immediately                             | 4.33 | 1.03 |
| I am alerted by break reminder at the appropriate time                | 4.67 | .16 |
| I feel imaginative                                                    | 4.33 | .16 |
| I love a story that relates to my motor skills                        | 4.50 | .37 |
| I forget about time passing while playing the game                    | 4.33 | 1.03 |
| I become unaware of my surroundings while playing the game           | 4.50 | .37 |
| I feel emotionally involved in the game                               | 4.33 | 1.03 |
| I love game offers user’s preferences                                 | 4.83 | .10 |
| I love game offers switch keyboard                                    | 4.00 | .48 |
| I love game offers ‘defeating’ mechanism                              | 4.33 | 1.03 |
| I love game offers voice recognition                                  | 4.83 | .40 |
| I love game enlarges the active area of the cursor                    | 4.50 | .37 |
| I love game features that can adapt according to my needs             | 4.00 | 1.03 |

Figure 2. An exemplar question rating for concentration construct.
4.6 Procedure of Expert Evaluation

Two weeks prior to the study, an email was sent to each expert, inviting them to participate in the study. If they agreed to participate, a second email containing an attachment of the instrument was sent. They were also advised that their participation was voluntary and that all data gathered would remain confidential. The study lasted about two weeks, and the procedure was as follows:

- Email invitations were sent to invite the experts involved in the evaluation process.
- Experts have agreed to be involved in the evaluation process.
- Instruments sent to experts.
- Experts evaluate the instrument:
  - Rate the importance of each item for the constructs involved.
  - Refine the content, wordings and gaps in the instrument.
  - Experts and researchers will communicate if there is a misunderstanding in the instrument. In this study, there are experts who have been communicating by phone, email and face to face with researchers.
  - After completing the questions, the expert will email an attachment of the instrument to researchers.

5. Result and Discussion

5.1 Descriptive Analysis

This section discusses on expert view based on constructing needed. There are seven constructs to evaluate in determining enjoyable game design for motor impaired users. These seven constructs are: Concentration (CO), Challenge (CH), Player Control (PC), Clear Goal (CG), Feedback (FB), Immersion (IM) and Flexibility.

### Table 7: Summarization feedback from each expert

| Construct | E1 | E2 | E3 | E4 | E5 | E6 |
|-----------|----|----|----|----|----|----|
| CO        |    |    |    |    |    |    |
| CH        |    |    |    |    |    |    |
| PC        |    |    |    |    |    |    |
| CG        |    |    |    |    |    |    |
| FB        |    |    |    |    |    |    |
| IM        |    |    |    |    |    |    |
| FL        |    |    |    |    |    |    |

| Comments |
|----------|
| Inadequate language and English |
| Adapt the level of wording according to expected level |
| Add word “gaame that” |
| “The user must slowly understand” |

| Table 7: Summarization feedback from each expert |
|-----------------------------------------------|
| **Construct** | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| CO            |        |        |        |        |        |        |
| CH            |        |        |        |        |        |        |
| PC            |        |        |        |        |        |        |
| CG            |        |        |        |        |        |        |
| FB            |        |        |        |        |        |        |
| IM            |        |        |        |        |        |        |
| FL            |        |        |        |        |        |        |
| Comments      |        |        |        |        |        |        |

| Issue language and English |
| Adapt the level of wording according to expected level |
| Add word “game that” |
| “The user most slowly understand” |

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In this study, expert will evaluate the importance of each item in every construct. The detailed demographic data are shown in Table 5. In total, six experts involved in this study and all of them were experienced in teaching or industry area. As shown in Table 5, all experts from academic game researchers and professional game designers are experienced in software development and software evaluation. The only one which is expert from psychotherapy area do not involve in software development and software evaluation.

The lowest value = 1, shows the item is extremely unimportant to enjoyable game design for motor impaired users and can be excluded and the highest value = 5, shows the item is extremely important and essential to enjoyable game design in games. It must be included and its absence would significantly hamper enjoyable game design for motor impaired users in the games.

The results of the descriptive analysis for each item based on a Likert Scale. Table 6 shows mean value and Standard Deviation (SD) that achieved as a result of the evaluation. For the overall finding, all items have mean value more than 3.00 which means experts agreed all 41 items were important to the components of enjoyable game design for motor impaired users.

### 5.2 Feedback from Expert

Experts’ feedback is very important at this stage to ensure that the quality of a newly developed measurement and validate at how well the items of an instrument represent a concept or the domain of the content. Table 6 and Table 7 shows feedback from experts during evaluation process.

### 6. Conclusion

This paper discussed the expert’s evaluation of the components of enjoyable game design for motor impaired users. The evaluation of this instrument shows that its use appropriate in gaining understanding of enjoyable game design for motor impaired users. A total of 36 items were generated and experts were asked to rate the importance of each item towards enjoyable game design for motor impaired users. Generally, experts agreed all 36 items were important to the components of enjoyable game design for motor impaired users. Some additions, changes, comments and explanations are suggested that result in an outline for a new model of enjoyable game design for motor impaired users, that is, MIU-GameFlow Model. This model needs to be empirically validated. Future work may include applications that have features of motor impaired users’ interactions using the MIU-GameFlow Model to verify the model and identify further elaborations and extensions that may be needed.

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