






Enhancing Game Usability: A Framework for Small-to-Medium-Sized Game Development Businesses

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Abstract: The field of Human-Computer Interaction (HCI) research has developed numerous procedures and techniques to ensure high usability when developing software. Usability in video games is also considered to be important, so it is crucial to ensure that game systems comply with usability standards. However, research has overlooked software development, specifically the stage of game development. Additionally, large gaming firms and game developers tend to keep their procedures and techniques secret. Professional reports have revealed the "ugly face" of the gaming industry. Bangladesh's slowly expanding game development sector comprises a significant number of small-to-medium-sized businesses and start-ups. These businesses require practical, developer-centric solutions to guarantee usability as they may lack the funds to engage usability specialists to oversee it. This article discusses the concept of game usability, including current research on usability techniques for game production. The study involved conducting polls, heuristic scoring studies, and speaking with several game developers. Twelve usability heuristics were created based on the Nielsen usability technique and the stages of game software development, which help in preventing typical usability problems in games. A preliminary analysis of the heuristics indicates that they can assist in identifying game-specific usability problems that may otherwise go unnoticed.


1 INTRODUCTION


Video games are electronic games that require user input devices to generate visual feedback displayed on video display devices such as TVs, monitors, or virtual reality headsets. The industry has expanded to include mobile gaming, virtual reality, and remote cloud gaming.


The video game industry is rapidly growing, with revenues projected to reach \$197 billion in 2022. The global video game market was valued at \$195.65 billion in 2021 and is expected to increase to \$220.79 billion in 2022. During the COVID-19 pandemic, major gaming companies saw an increase in their stock values despite criticism of game releases for


bugs and lack of originality. Steam's active user base also increased by over 20%. (Şener, Yalcin & Gulseven, 2021). Bangladesh's gaming market is currently worth \$0.37 billion, but it is predicted to quadruple by 2026 (Islam, 2020). Despite the industry's potential for growth, there is a lack of official statistics on game development companies in Bangladesh, and research on game development processes has been limited.


A small game developer studio contains as few as a few staff members or as many as 50, and a medium-sized studio may have several hundred. The size of a studio can be influenced by elements like the size of the projects it accepts, the number of games it produces annually, and its level of success in the

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market. A company's size might also change over time because of expansion, contraction, or mergers with other businesses.

This study examines the utilization of usability evaluation heuristics by game developers in Bangladesh. Game design involves several elements, including storyline, pacing, and gameplay mechanics, with usability being a crucial factor due to the frequent interaction required from players. Poorly designed game interfaces can hinder player engagement, leading to reduced game quality and success. (Fabricatore, 2007).

The goal of this study is to review the concept of game usability and provide practical, developer-centric solutions to ensure high usability in game development, particularly for small-to-medium-sized businesses and start-ups in the slowly expanding game development sector in Bangladesh.

This study aims to review current research on usability techniques for game production, create usability heuristics based on the Nielsen usability technique and the stages of game software development, and evaluate their effectiveness in identifying game-specific usability problems.

The primary contributions of this paper are:

1. Identify real world usability problems that provide breadth and depth coverage of the game design space
2. To make the heuristics simple enough for individuals with familiarity with usability principles and some game development experience to implement.
3. Game developers can use the heuristics to identify real problems that will affect the usability of games.

2 LITERATURE REVIEW

An extensive literature review was conducted on related publications in the field, and an analysis of the most relevant papers have been included. Mylly et al. designed a new set of usable usability heuristics for game development based on user satisfaction and convenience (Mylly, Rajanen, & Iivari, 2020). Politowski et al. presented insights and considerations gathered from developers and literature studies (Politowski, Vargas, Fontoura, & Foletto, 2016), while Zaidi et al. designed a usability framework for VR casual game development for non-gamers (Zaidi, Duthie, Carr & Maksoud, 2018). Simor et al. proposed usability evaluation methods for gesture-based games, particularly for older adults (Simor, Brum, Schmidt & Rieder, 2016). Fatta et al.

developed a model for measuring usability evaluation specifically for mobile game-based learning applications (Fatta, Maksom & Zakaria, 2018). Soomro et al. designed a playability heuristic evaluation system for application software and games (Soomro, Ahmad & Sulaiman, 2014), and Desurvire et al. adapted heuristics from productivity software to games (Desurvire & Wiberg, 2009). Fernandez et al. proposed a usability inspection method for model-driven video game development (Fernandez, Insfran, Abrahão, Carsi & Montero, 2012), while Smith et al. proposed a domain-specific heuristic list for virtual-reality game development (Smith, Granados & Suss, 2019). Parker et al. explored how indie game developers perceive the benefits and risks of game streaming (Parker & Perks, 2021). Xenos et al. found that the perceived usability of a game significantly impacts learning during gameplay (Xenos, Papaloukas & Kostaras, 2019), while Hussain et al. conducted a systematic review of mobile game usability evaluations (Hussain, Abbas, Abdulwaheed, Mohammed & Abdulhussein, 2015). Muhanna et al. developed a list of adapted usability heuristics for Arabic mobile games (Muhanna, Masoud & Qusef, 2022), Şener et al. investigated the impact of the Covid-19 pandemic on the game industry (Şener & Yalçın), Senap et al. proposed a set of evaluation components for assessing the usability of mobile educational games (Senap & Ibrahim, 2019), Vieira et al. proposed a methodology to identify heuristics applicable for evaluating the usability of educational games (Vieira, Silveira & Martins, 2019), Halonen et al. proposed a set of heuristics to evaluate the usability of games that employ speech recognition (Halonen, Hyrnsalmi, Kimppa, Knuutila, Smed & Hakonen, 2012), and Pyae et al. evaluated the usability and user-friendliness of a Finnish skiing video game among elderly Japanese participants (Pyae et al., 2020).

3 METHODOLOGIES

Three research questions were raised to specify this research.

- 1.RQ1. What is the nature of specific usability recommendations for Game Development?
- 2.RQ2. What Heuristic Method developers follow to develop a game?
- 3.RQ3. What are the most common problems faced by game developers in each process type?

The above questions influenced the key literature search criteria. Relevant papers were identified by searching in papers' metadata (title, abstract,

keywords), using keyword search queries. The keywords identified from the research questions were as follows: usability specialists, game developers, usability heuristics, Nielsen usability technique, stages of game development, usability problems, game-specific usability problems.

Renowned works related to game development and video game heuristic evaluations were prioritised from researchers of various countries. Research works related to the same topic from Bangladesh were also searched but nothing remarkable was found. There is not enough research done in Bangladesh about game development. Many other countries have done intense research on this topic. As an alternative measure, articles released by local news media and interviews or data provided by Bangladesh ICT Ministry were studied.

This research is done based on the heuristics provided by Sami Mylly et al. In their research paper *The Quest for Usable Usability Heuristics for Game Developers in 2020*. Also, theoretical concept was drawn from Kristina Magyilaite et al's "Towards High Usability in Gamified Systems: A Systematic" in 2022 which is based on Nielsen's 10 heuristics. Review of Key Concepts and Approaches.

Game developers prefer to devise their own usability heuristic lists tailored to each game rather than using pre-existing lists since they consider them to be too intricate to use (Mylly, Rajanen, & Iivari, 2020). While Nielsen's usability evaluation heuristics are widely used for assessing software systems, they are not always suitable for video games. Therefore, the authors aimed to develop a set of heuristics that could be applied throughout all stages of video game development.

Questionnaires were designed based on the heuristics proposed by Mylly et al. The game development process was divided into eight stages, including Concept, Pre-production, Prototype, Production, Alpha, Beta, Gold, and Post-release, and a total of 30 questions were asked across all stages. The participants were selected randomly from game developers in Bangladesh, including both employees and freelancers. Participation in the survey was voluntary, and anonymity was maintained. The survey questions were distributed among the participants through a Google survey form link.

Additionally, interviews were conducted with the participants to gain further understanding of the game developing situation of Bangladesh.

4 DATA ANALYSIS & RESULT

In October 2022, a small-scale survey was conducted among game creators, testers, consumers, and freelancers in Bangladesh to gauge their views on game usability, the use of heuristic evaluation in businesses, and the usefulness of usability heuristics described in the literature. The survey received responses from 19 individuals. In addition, interviews were conducted with a few game testers and developers who were both employees and independent contractors. Despite the relatively small number of game firms in Bangladesh, only 36% of the developers responded to the survey.

The research on game development in Bangladesh is inadequate compared to numerous other countries that have conducted extensive research on the subject. The results indicate that the chosen papers were published within the past five years, but the number of papers was small. Most of the articles were conference proceedings.

4.1 Usability Testing Method Employed

The papers that were chosen used a variety of usability assessment techniques. The Quantitative and Qualitative approaches used in this paper are (1) Questionnaires (n=20); (2) "Think Aloud procedure"; (3) Interviews (n=10); and (4) Heuristic Testing (n=8).

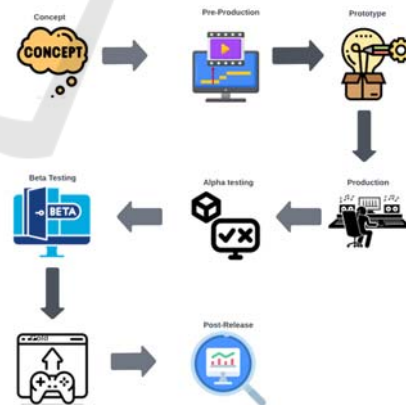


Figure 1: Development Phases. It shows Phases list & Details about the development phases. (Mylly, Rajanen, & Iivari, 2020).

The response from the respondents to an inquiry about what usability meant to them is quite like how people think of (game) usability: "One of the design objectives that should be followed during development is usability, which will help to ensure

that the product's target market has as much access to, and understanding of, it as possible." This encourages the inclusion of usability activities in the development cycle.

There are several ways for the game development process to resemble the traditional software development process. (Mylly, Rajanen, & Iivari, 2020)'s paper "The Quest for Usable Usability Heuristics for Game Developers" said the basic game development process can be divided into phases in Table 1.

Table 1: Phases of game development with description.

Development Phases	Description
Concept	The main idea of the game is decided and described
Pre-Production	To define what the game is, how long it will take, how many people are needed and how much it will cost to make it
Prototype	To test the non-functional requirements of the game which is difficult to evaluate (gameplay).
Production	It's when the most action happens, most people work at the same time and most time is consumed.
Alpha	To define when the game is mostly playable from start to finish and where a particular build of the game is the first playable version.
Beta	In this phase, the goal is to have the game stabilized and remove most of the errors and problems
Gold	The climax of the process where the game is ready and waiting to be delivered for the distributors.
Post-Release	Patching the bugs and issues that were not found or fixed before the initial release, without forgetting the upgrades,

4.2 Design of Questionnaires

Based on Eight development phases which are discussed above, the study is designed with some Questionnaires to proceed in this research. Some of the most important questions are given in the list below as sample:

- During the concept development stage do you gather all the necessary information and set them on board?
- When designing the game, do you consider the target audience?
- Do you make the basic controls and tutorials easy to learn for new players?

- At beta phase of the development do you ensure the players receive enough feedback from their surroundings while progressing through the
- Do you ensure the game interface/HUD (skill bar, health indicator, mini-map, compasses, currency) is informative?
- Do you provide manuals, tutorials so the player doesn't have to rely on outside sources for information?
- Does the new content remain consistent with the old content/base game?

4.3 Participants in the Usability Testing

Most of the studies (64%, n = 10) had only one type of user as a participant in usability evaluations, e.g., Ten were Freelancer, 4 to 5 were Tester or users, and 5 of them were Game Developer means professionals only. By categorising the data according to the number of participants according to type of usability evaluation method.

4.4 Data Analysis

Data extracted from each article were recorded on a computer worksheet (Excel) to categorise and compare characteristics. Descriptive statistics, mostly frequency tables for the categorical variables, were constructed for the dataset using Excel Sheets for quantitative analysis. To respond to the research questions that formed the basis of this study, the study summarized the results from the chosen papers. Filtering the survey questionnaire results was done using cross tabulations.

In table 2, it shows the percentage (%) data collected from game developers based on their experience using different parameters of their development phases.

The research is to ensure if any of the answers depends on or correlated with each other because of the usability testing, as the correlation approach is cited as an important component of game development.

To have a clearer understanding of this study, if a developer failed to build a clear concept or prototype of the game, the game development can be stuck and further failed to proceed.

Table 2: This Crossed tabulation shows calculations of survey questionnaires using development phases maintaining heuristics in percentage (%).

Development Phases (%)	Never	Often	Sometimes	Mostly	Always
Concept	8.3	5.5	33.3	27.8	24.9
Pre-Production	2.8	9.7	32.0	37.5	18.0
Prototype	4.2	9.7	31.9	37.5	18.0
Production	8.3	25.0	16.7	25.1	34.6
Alpha	4.2	8.3	22.9	24.4	26.4
Beta	0.0	13.3	31.7	28.3	26.7
Gold	11.6	20.0	23.2	25.0	24.9
Post-Release	0.0	5.5	27.6	33.3	25.0

4.5 Comparison of Two Heuristic Models

In 2022 Magylaité et al., introduced another set of Heuristics for game development. To gain a better understanding of the nature of the recommendations proposed in the selected papers, the generalised recommendations namely: Nielsen’s heuristics for user interface design. Heuristics serve as the most general usability principles available. There are several similarities between in this reviewed heuristics and Nielsen’s heuristics; N1, N4, N5, and N9 are kind of similar with the concepts so far. The discussions were with the developers but there are some variations with their version of heuristic methods. Each recommendation had to be assigned to one or more of the following heuristics:

- N1. Visibility of system status.
- N2. Match between system and the real world.
- N3. User control and freedom.
- N4. Consistency and standards.
- N5. Error prevention.
- N6. Recognition rather than recall.
- N7. Flexibility and efficiency of use.
- N8. Aesthetic and minimalist design.
- N9. Help users recognize, diagnose, and recover from errors.
- N10. Help and documentation.

Nielsen’s error detection (N9) (N5) is like alpha and beta phase as Alpha and Beta testing is the user end’s acceptance testing. This can help to detect bug from the final product and fix it if needed. The data is

shown here Table 3, here the similarities between two methods are denoted by ✓.

Table 3: Similarities between Two Methods.

	Concept	Preproduction	Prototype	Production	Alpha	Beta	Gold	Post Release
N1	✓	✓	✓	✓		✓		✓
N2								
N3								
N4	✓	✓	✓	✓				
N5					✓	✓	✓	✓
N6								
N7								
N8								
N9		✓		✓	✓		✓	✓
N10								

This also addresses control design, artificial intelligence, and information on game status. However, the content and focus of the heuristics are significantly different. Their heuristics focus on engagement issues, but ours are strongly oriented around usability and are augmented by detailed information on common usability problems.

4.6 Proposed Heuristics

To fulfil two key functions in the game design process, this study put together a set of game heuristics. First, heuristics can be utilised as a set of design guidelines early in the game design and development process. They can also be used to conduct usability inspections, where evaluators utilise them to iteratively critique the design.

This paper's approach is more closely aligned with that described by Sami Mylly et al., who suggest that heuristics can be developed using specific software development phases, as well as by developing principles that describe the usability problems that seem to be present in games. Nielsen's method for defining a new set of general-purpose heuristics served as the initial motivation for this method for defining game usability heuristics.

After studying both methods, a set of heuristics was designed to help game developers in Bangladesh. Here are the key findings of the analysis:

1. Making long-term goals (end game objectives) visible and short-term goals (early game objectives) obvious from the start.
2. Allowing players to customize controls to suit their preferences and physical limitations.
3. Using consistent and clear visual cues, such as coloration and words, to convey information.
4. Avoiding lag or delays in the system's response to user input.

5. Using visual representations, such as maps and symbols, that are easy to understand and avoiding jargon.
6. Adding a fictional plot to engage users emotionally.
7. Providing feedback on progress and how to move forward.
8. Offering challenges that are rewarding to overcome, with a ranking or incentive system.
9. Ensuring that user activities are consistent and relevant, with no distracting or irrelevant options.
10. Giving users badges for achievements or accomplishments.
11. Allowing users to control the system's speed and avoiding arbitrary time limits.
12. Providing comprehensive game documentation to help users understand game features and visual cues.

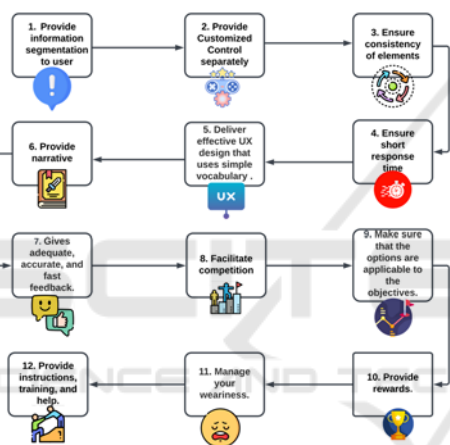


Figure 2: Twelve Proposed Heuristics.

By following these heuristics, game developers can create games that are engaging, intuitive, and enjoyable for a wide range of players. Users should have access to comprehensive game documentation that explains how to interact with game features and understand visual cues.

Each assessor filled out an open-ended questionnaire at the end of the trial. Questions were asked participants to describe the advantages and disadvantages of using heuristics to evaluate games. Also, Interviews were taken about any heuristics that they found particularly helpful and whether they were challenging to use. Finally, it is learned if they discovered problems using the heuristics that they would have ignored in any scenario. The problem description was examined. Some deleted problems that by the same evaluator brought up frequently as well as problems that did not adequately depict actual usability problems (such as comments regarding

game play, preferred features, etc.). The research confirmed that the evaluators referred to heuristics that were pertinent to the noted problems.

5 DISCUSSIONS

The results of the review presented above served as the input answering the research question RQ1-RQ3. The key observation is presented below:

QR1. What Is the Nature of Specific Usability Recommendations for Game Development?

The authors of the chosen papers presented their findings not just as advice for usability but also as suggestions for enhancing user experience, increasing motivation, and improving compliance with humans. Many of the suggestions fell under the category of being widely accepted, such as using common jargon, giving helpful comments, preventing errors, segmenting information, assuring quick response times, etc. As an alternative, the writers frequently suggested employing modality and signalling principles, making sure that all necessary information was provided prior to the activity, and including features for managing fatigue (adaptable time limitations and speed of work). (Magylaitė, Kapočius, Butleris & Čeponienė, 2022).

QR2. What Heuristic Method Developers Follow to Develop a Game?

Most game developers attempt to create games using Nielsen's heuristics method. The survey asked if it would be simple or difficult to implement a particular heuristic in a current project. However, some recent studies have alarmingly shown that heuristic evaluation is not a typical usability evaluation method in the video game industry and that game developers would prefer to create their own usability heuristic lists for each of their games rather than use existing lists, which they believe to be too cumbersome to use.

Together with "Greater knowledge," it is believed there is a need for a broader set of heuristics that covers the entire spectrum of game creation, from concept to live operations and serving the user base, as well as a set that explains what and why the heuristics are. These questions are being addressed by the heuristics suggested in this study, which also serves as a foundation for a more in-depth and comprehensive treatment of game creation. (Mylly, Rajanen, & Iivari, 2020)

RQ3. What are the Most Common Problems Faced by Game Developers in Each Process Type?

Age is a crucial consideration when deciding how to create or enhance games, as shown by most of the papers that were chosen, which (30% and 30%, respectively), discussed the usability of games especially geared at either children or adults. Half of the six publications that offered suggestions for adults were targeted exclusively at gamers over the age of sixty. The authors of the remaining 40% of the chosen publications didn't mention any details about the target population that their recommendations were intended for. According to the poll, it appears that game designers struggle with the choice of whether to make the game simple for children with few key actions necessary, or complex for adults with a variety of activities. Other user qualities, such as user goals, degree of motivation, education, or IT abilities, were also cited as factors that frequently have an impact on usability-related system development decisions (Magylaitė, Kapočius, Butleris & Čeponienė, 2022).

After evaluating the pertinent suggestions and guidelines for gamified systems included in the selected publications, it was discovered that the recommendation lists provided by the different writers substantially overlapped. The terminology used to express the same concept or piece of advice by the many authors was the only thing that changed. Consequently, a preliminary categorization was carried out to make it simpler to analyze the recommendations. Moving forward, game makers will no longer solely rely on the conventional heuristic technique and will instead set their own usability tests. To speed up the process, game developers make their own usability tests as opposed to constantly employing heuristics. This study concluded that each game developer adheres to the industry standard for game creation in their own distinctive way through interviews with or surveys of game developers.

The evaluation does not include a thorough analysis of the heuristics because it is not expected for any game to necessarily have problems in every area of coverage. But it does show that the Bangladeshi Developers were able to understand the heuristics, and a check at the problem descriptions shows that they did match the range of coverage specified by the selected heuristic. This shows that Developers or testers could apply the heuristics to recognize real problems, and that they weren't too challenging to utilise. Bangladeshi game creators tried to concentrate on engrossing and entertaining the player,

which includes a variety of design factors like plot, tempo, level of difficulty, and gameplay mechanics. However, as most games necessitate frequent player contact, usability issues must be carefully considered by game designers. They tried to adhere to the guidelines based on the game's needs. This paper first reveals the degree of success of the heuristics in achieving these objectives. With only a handful of the heuristics, Testers or Developers were able to track down countless problems and discover numerous problems.

6 LIMITATIONS

Bangladesh has a limited presence in game development, resulting in a scarcity of game production companies and developers. Formal education and research on this topic are also lacking. As a result, most developers are self-taught and passionate individuals who start their careers as independent game creators. However, due to corporate policies and privacy concerns, both independent and company developers are hesitant to share information or participate in interviews. This is a pattern that was also observed in other papers (Mylly, Rajanen, & Iivari, 2020).

7 CONCLUSIONS

In this study essay, the usability of game development is the main topic. Bangladesh has gradually entered the gaming industry. The game development process should find it easier to follow accepted software development procedures if heuristics are maintained. Games may be created using these process models. Nielsen's heuristics aid consumers' cognitive load, especially their memory power. Because it's easier for them, it's essential to think about how to emphasise opportunities and useful attributes.

With the use of heuristics, there are some sets proposed in this research, which present a fresh method to modifying usability inspections for games, allowing developers to assess both mock-ups and functioning prototypes. In this study, usability problems in software were found and a set of design principles for game creation were presented. This broad methodology, which is a novel approach, can be used by researchers to understand design problems in different kinds of speciality software. This study points that this method can be applied to further development studies and that it can be used to create

new heuristics on involvement and for multiplayer games in Bangladesh.

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