



Evaluating Wick Editor as Open-Source Alternative for Developing Educational Games using Heuristics

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ABSTRACT

Wick Editor is a free and open-source web-based tool for creating games. Unlike Flash, which is widely discussed in literature as a tool to produce educational multimedia titles and educational games, Wick Editor is not widely known. This study proposes Wick Editor as a more accessible and viable alternative to Flash. There are two main approaches employed in this study, namely examining process: 1) developing a software artefact as evidence as well as comparative features analysis of authoring tools; and examining the end product 2) selecting relevant heuristics and getting experts to evaluate. A selected cohort of students were trained to use Wick Editor. At the end of the training, they were required to develop educational games. In the process, Wick Editor was assessed in terms of functionalities. A heuristics protocol engaging 18 educators was used to assess the educational games developed by students. The findings reveal that Wick Editor is indeed a viable alternative but with certain limitations and opportunities for improvements in game design. In order for educational games to be used extensively and democratization of educational games development, a free and accessible authoring tool must be made available for educators.

1. Introduction

1.1 Background

Wick Editor is used by the first author as a free software alternative (of which Basir and Rasam [1] did the same and even naming Wick Editor as Flash animation software) to the proprietary Adobe Flash, which is now part of Adobe Creative Cloud under the name Animate CC [2]. At its inception, the Flash animation software is intended to be visual and interactive multimedia authoring tools [3] with contemporaries like Authorware, Director and ToolBook and widely used in developing educational multimedia titles like an interactive multimedia title to learn science [4]. However, Flash runs into problems with its security issues and web browser like Chrome starts to block Flash content.

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The security vulnerability lies in the need for the web browser to install Adobe Flash Player plugin, which becomes a target for malware infection [5]. Wick Editor, though not widely discussed in literature, from our direct experience, does not require any additional plugin, uses Java Script, as evidenced in its public acknowledgement of libraries used as an open-source initiative [6], and more importantly an open-source tool. Basir and Rasam [1] in fact posited Wix and Weebly as free potential alternatives to proprietary Adobe Flash in developing multimedia cartography at UiTM. In the context of this study, Wick Editor would be evaluated using Adobe Flash a benchmark proprietary authoring software in developing educational games.

The interest in educational games originates from research like Zokhi [7] in which a game play is introduced to enliven classroom teaching, which in its most traditional form may resort to mere memorization of concepts. The use of non-computer-based game like Q-Track Kit [7], which is actually an adapted board game, is found to be effective in learning theoretical modules and with other reported benefits like cognitive development, communication skills and positive self-development. Educational games can also be in digital form like computer games developed specifically to address training or teaching needs and, in this case, they are known as serious games. There are many studies [8] that report favourable effects of such software games, instead of manual board games, with a difference: the use of devices like desktop computers and mobile devices are now inevitable. As more studies establish the effectiveness of educational games, more researchers now turn to the design aspects of such games. In a review of educational games done by Zeng, Parks and Shang [9], they found that researchers were primarily interested in primarily two issues:

- i. design and development
- ii. application in teaching.

By design and development, in the foregoing study, the issues examined seems to focus on game play and usability aspects in exclusion to choose of game engine or tools to develop the educational games. Therefore, this study seeks to fill that gap by focusing on viability of a particular tool for developing educational games and also to do so by considering its capabilities in producing educational games with good design and application, the two dimensions considered to be important by researchers globally [9].

An example of a study of game development tool is Chover *et al.*, [10] in which a 2D game engine was specifically developed to enable developers to design video games without in depth programming skills. In fact, the empirical study established that children, without programming knowledge, successfully develop 2D arcade video game using the specially built game engine for the study. Of interest was the remarks made by the researchers that the choice of 2D game in their study: in the introduction section they mentioned that it was easier to achieve “democratization of game development” [10] for 2D games. This is significant because Wick Editor is a 2D game development tool. To put the democratization theme in context, it must first be understood that the adoption of certain prevailing multimedia authoring software like Photoshop, Blender, Garage Band, Final Cut Pro and Unity, from image editing, 3D modelling to a robust 3D and AR enabled game engine, would impose certain limitations in workflow, methodology and standards [11]. Nicoll & Keogh [11] in their book wrote that commercial third-party game engine is preferred by developers and with reference to Unity game engine, remarked that although policy wise, Unity is for democratization of game development, it imposed a certain “politics” [11] to the contrary. The developers interviewed in the book expressed the usage of Unity in no way influence their creative work yet at the same time they showed preference for certain tools and consequently certain workflow as well as standards within the circuit or ecology of Unity. The cost of being tightly invested

in a particular standard can be seen in considering the news of the recent pricing controversy by Unity game engine that rippled across the industry [12]. This perhaps underscores the need for democratization.

Hence it is justified to undertake a study on alternative and more accessible 2D game development tool like Wick editor in the interest of democratizing game development. There is little or no existing study on the tool. With reference to Chover *et al.*, [10], this is also a study on simple to use 2D game development tool, but the focus is on Wick Editor's potential to produce educational games. A study like this will promote greater visibility for the tool as an alternative to commercial or proprietary software.

1.2 Literature Review

To qualify as a benchmark, the literature must be gleaned for evidence that the Flash software is being used to develop educational games. Below is a survey of educational games created using Flash:

Table 1
 Survey of educational games created using Flash

Ref	Year	Edu Game for	Game Play	Features
Ljungkvist & Mozelius [13]	2012	Programming languages	Simulate software industry jobs as game play	Action Script Integration with Moodle Database Text input Vector
Pushkareva & Rybalko [14]	2016	Didactic mathematics	'Sports mathematics': arrow shoots with correct answer to math question, colouring games, creating image using geomatic shapes etc.	Vector Action Script Buttons
Herdiansyah, Cholily & Cahyono [15]	2019	Geometry lesson	Geometry lesson game on cube and cuboid. No visual data on the game.	Not enough details on the game.
Mustafidah & Imani [16]	2018	Natural science	Part module and game: user being asked to choose plant eating animals, failing which will be directed to material page.	Vector Raster Buttons Scripting
Syafruddin <i>et al.</i> , [17]	2021	Biology	The entire module is presented as a quiz game with attractive audio-visual material and with scores.	Vector Video Raster Buttons Scripting

The Flash software can be used to build an interactive multimedia title that supports self-exploration, more engaging mix of visual, audio and textual presentation and may come with some form of assessment as typified in Fani & Sukoco [18] in making volleyball learning more effective. This can be improved by turning the engagement of learning material into a game play with scores and a sense of interesting or fun challenge as in Syafruddin *et al.*, [17]. Other approaches include separating the learning module and the games. The latter would be used to assess understanding of the learning material in a fun way using games [14,16]. At times the games may have added value of simulating real life scenarios for the users [13]. For example, a user may be tasked with tweaking a

Python code to fix an automated railway system so that all the trains can reach their destination. Thus, the users would have a sense of fixing a serious problem affecting a city and not a mere lab assignment. Upon completion of more programming jobs like this, new cities would be “unlocked” and players would get more exciting new jobs. Thus, the study attempts to establish whether Wick Editor may support the features and game play in Table 1.

When game play is designed deliberately for educational impact rather than entertainment, then it is Serious Games [19], which may be best evaluated using heuristics: a set of usability criteria based on which a small number of evaluators identify violations and suggest improvements [20]. In fact, Mohamed & Jaafar [20] argued for the use of qualitative heuristics versus quantitative analysis. The latter deals with finding an efficient way to finalize, validate and using statistical model to explain a narrowly defined phenomenon. This may result in missing the overall big picture and for Mohamed & Jaafar [20] who are studying evaluation for educational game, they view the complex issue of user satisfaction cannot be reduced to few quantitative variables to be analysed in a statistical model. In fact, this can be observed in Table 1 in which Herdiansyah *et al.*, [15] used statistical method to prove validity but were found lacking in details like screenshots, game play and other details were not made evident for the benefit of researchers. Instead, they propose the use of heuristics for interface, educational, content, playability and multimedia with a mathematical function that assigns weightage to the categories as well as providing an objective score on usability. Table 2 shows a survey how heuristics may be used:

Table 2
 Survey of heuristics usage

Ref	Purpose	How heuristics are used
Suha <i>et al.</i> , [21]	Assessing usability of mobile applications developed for autistic users	Identify number of heuristic violations for each app evaluated. Findings used for future improvements
Ouherrou <i>et al.</i> , [22]	Evaluate educational game for children with dyslexia	Identify the number of violations using heuristics customized from Nielsen Usability Heuristics. The findings used to indicate whether educational name “is a supportive tool”.
Paliokas <i>et al.</i> , [23]	Proof-of-concept for AR application for museums	Using four experts. There are 9 heuristics. Record violations (with maximum 4) and with comments /mitigation actions by experts. Heuristics evaluation protocol used to validate proof-of-concept as well as identifying improvements.

Where Basir and Rasam [1] attempts to create a similar end product using a free software as proof-of-concept that the free alternative is viable, using a heuristics protocol can do the same [23]. And so, both approaches would be used in this study.

A study [24] was conducted using a group of students, who were taught to use two platforms: Adobe Flash and CSS/HTML to develop interactive multimedia applications. The study concluded by stating Adobe Flash being the preferred platform in regards to performance, easier to learn, more attractive and usable, to name a few. The drawbacks for Adobe Flash (when compared to HTML/CSS) as gleaned from the study include: not free and available due to licensing, installation required and also additional plug in for web browser. Developers interested to develop educational games should be able to have access to the right kind of authoring tool that is free, reasonable learning curve and even ubiquitous. Wick Editor may fit that bill. This fact is further verified based on the current authors’ experience in teaching elective multimedia course using Wick Editor and evidenced by the students’ projects.

2. Methodology

There are two main approaches employed in this study, namely examining the process:

- i. developing a software artefact as evidence as well as comparative features analysis of authoring tools; and examining the end product
- ii. selecting relevant heuristics and getting experts to evaluate. The figure below will show the overview of the research methodology and was adapted from Basir and Rasam [1] and the use of students as developers to test Wick Editor is inspired by Chover *et al.*, [10]

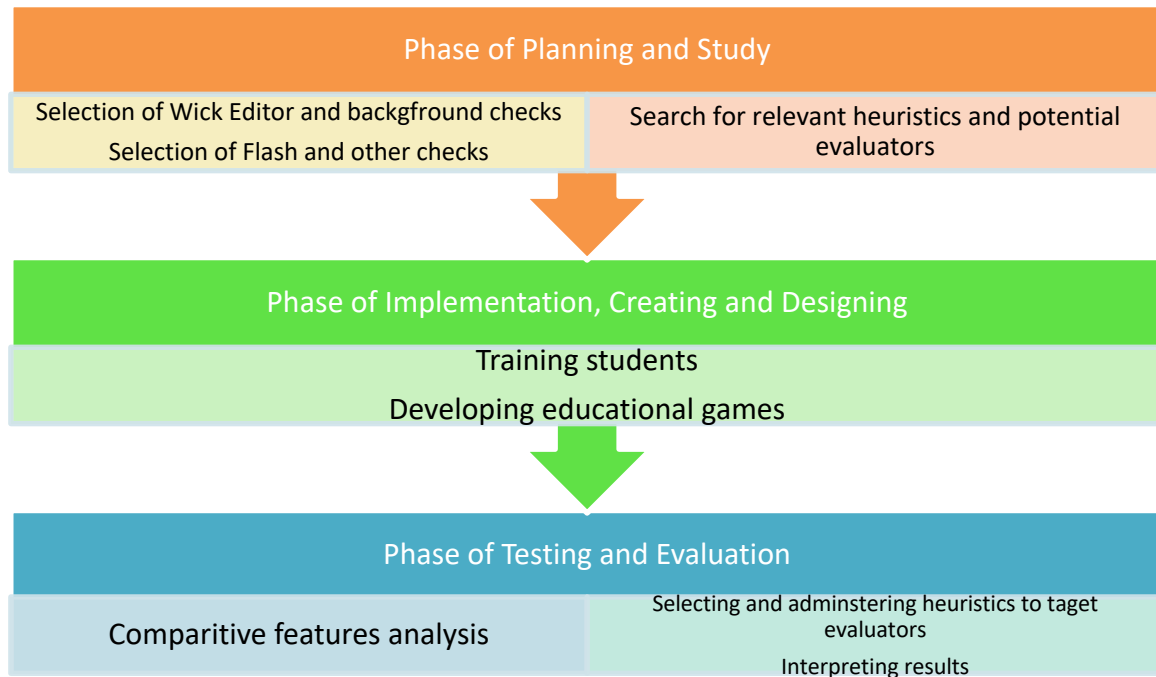


Fig. 1. Overview of the research methodology

2.1 Phase of Planning and Study

For this study, Wick Editor is used and it is confirmed that there is little discussion in literature. Wick Editor can be deployed on the cloud and developers just need to use the standard web browser without the need for any installation. The files can be saved locally and the previous work can be automatically loaded. Completed animation works can be published as single HTML file without any other attached supporting files. This single HTML file would contain all the scripts and multimedia elements. Thus, it is very neat and clean. There are options for export as bitmaps and MP4 (but with limitations).

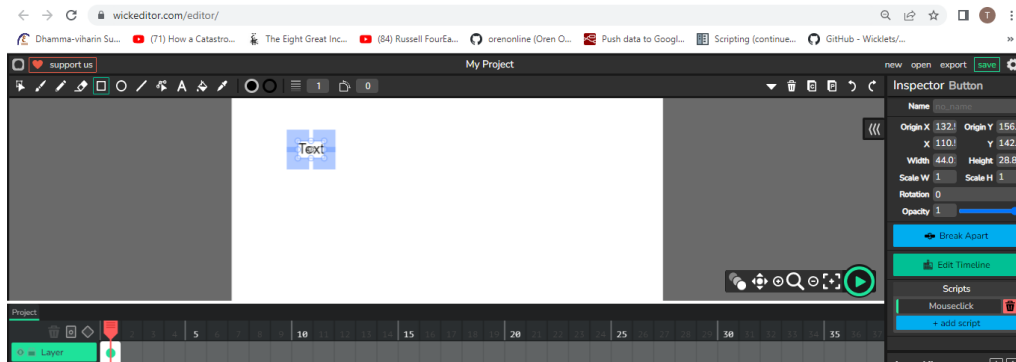


Fig. 2. The Wick Editor can be accessed just using the web browser without installation at <https://www.wickeditor.com/editor/>

2.2 Phase of Implementation, Creating and Designing

The authors have been using Wick Editor to teach a multimedia course. The course would have about 6-7 weeks of instructions to familiarize with Wick Editor and as part of summative assessment, students would require to do a final group project using Wick Editor. Two projects would be chosen namely:

- i. a web based educational game on suicide awareness (<http://foit.click/game1/mainmenu.html>)
- ii. a web-based multimedia title that combines storytelling for instruction and game on COVID-19 awareness (<http://foit.click/game2/Menu.html>).

2.3 Phase of Testing and Evaluation

Firstly, the software aspects would be evaluated on the following aspects: application type, license, graphics, animation, scripting, database capability, multimedia elements and elements of web-based system.

Secondly, the heuristics are selected from literature and incorporated in Google Forms to be disseminated to evaluators, who in our study would be educators. Evaluators can access the games directly (see previous URLs) or watch project demonstrations (<https://youtu.be/fgidJouGLD8> and <https://youtu.be/FgK3ojaO7fM>) They would be our academic colleagues in the university and other educators in community college and secondary schools. On the selection of heuristics, care must be taken to choose heuristics befitting the context. Pinelle *et al.*, [20] in their development of heuristics for evaluating video game design, would not cover issues like learning and entertainment [19], educational and content [20] and gamification heuristics that encompass both intrinsic and extrinsic motivation, as well as context [26]. The latter are primarily concerned with games with an agenda to educate or gamification. The heuristics selected would be listed in next three paragraphs.

- i. For Game Play: G1 The player is interested in the storyline. If possible, the story experience relates to player's real life and grabs their interest. G2 The player experiences fairness of outcomes. G3 The game is easy to learn but is harder and challenging to master. G4 The players are interested enough to continue playing rather than quitting the game. G5 The game world reacts to the players and remember their passage through it. G6 The game learning goals are clear for the player. The game is presenting overriding, clear goals

- (both short and long term) early throughout the game play. G7 The player has the sense of control and influence onto the game world (like their actions matter and they are shaping the game world). G8 The player should feel a sense of control over their characters or units and their movements and interactions in the game world.
- ii. For Learning and Entertainment: L1 Clear goal and learning objectives (ED1). L2 The activities are interesting and engaging (ED2). L3 Can be used as self-directed learning tools (ED4). L4 Support self-learning skills (ED6). L5 Medium for learning by doing (ED6). The player is developing the emotional connection with the game world and/or game characters (player should feel emotionally involved in the game). L7 The game is enjoyable enough for the player to be eager to replay it again or replay some specific learning activities. L8 The game utilizes visceral, audio and visual content to further the players' immersion in the game.
 - iii. For Usability and Game Mechanics: U1 The player does not need to read the manual or documentation in order to play. U2 Upon initially turning the game on the player has enough information to get started to play. U3 Game controls are consistent within the game and follow standard convention. U4 Usage of multimedia elements are acceptable (MM1). U5 Combination of multimedia elements are adequate (MM2). U6 Uses aesthetic and minimalist design (UI1). U7 The interactivity of the game is suitable to learners' level (UI6). U8 Quality of user interface is acceptable (UI8).

Heuristics being used are sourced from Jerzak & Rebelo [19] except those with encoding in brackets at the end like ED1, MM1, UI1 etc are from Mohamed & Jaafar [20]. The heuristics are selected from Jerzak & Rebelo [14] due to their work on serious games and that of Mohamed & Jaafar [20] due to their work on educational computer game. Evaluators would be asked to record heuristics violations for each area and also for comments.

3. Results

3.1 Proof of Concept Through Comparative Analysis of Functionality

The findings for software features are as follows:

Table 3

Comparative analysis of EIGHT (8) features for Wick Editor and Flash

Assessment aspects	Wick Editor	Flash software
Application type	Web-based. Can be downloaded and used locally.	Desktop based.
License	Free and open source.	Proprietary.
Graphics	Supports both raster and vector. Drawing tools for vector but for raster seems limited. This can be side stepped by doing raster editing in other software like Paint3D or Photoshop.	Supports both raster and vector. Powerful tools for both.
Animation	2D animation using timeline, frames, keyframes and tween.	2D animation using timeline, frames, keyframes and tween.
Scripting	Uses JavaScript with reference in editor. Code may be embedded in clips, button and frame. Friendly for beginners.	ActionScript 3.0 only allows scripting in frames. May be difficult for beginners.

Database capability	Not available or unknown to us. But this can be side-stepped by-passing parameter values via URL to PHP scripts, which will write to database.	Integrates with database. [13]
Multimedia elements	Cannot directly import video. However, no problem with other elements. The video issue can be side stepped using iframe that links to externally hosted video content.	Supports all elements.
Elements of web based	Publish final work as single HTML file with all media and full interactivity.	Flash content may be blocked in certain web browsers. Requires Flash player.

Therefore, it is reasonable to conclude that Wick Editor musters the core functions of a multimedia authoring tool.

Both projects use storytelling, have clear main menus and uses both keyboard as well as mouse actions. In project 1, the game would be: perform simple good deeds like helping an old lady to cross the road without being knocked, find a missing cat and picking up rubbish within stipulated time frame. For project 2: a quiz game where a wrong answer resulted in loss of maximum 3 lives; the second game is second person player collecting masks without being killed by virus and the character can walk, jump and of course die.

3.2 Heuristics

There are a total of 18 evaluators who are educators from I-CATS University College (12), secondary schools (5) and community college (1). The results for Project 1 are as follows:

Table 4

Heuristics analysis for project 1. In heuristics approach, number of violations are used. The lower the score, the more favourable the result. For clarity, the results are rendered in % as well as perceived compliance

Heuristics	Violations	Violations in % out of max number of possible violations	Perceived Compliance	Remarks
Game Play	40	37% ⁽¹⁾	62.96%	G4 being top 20% with G1 and G3 trailing closely behind. 47% thinks it is a cosmetic, 29% major problem and 24% minor problem
Learning and entertainment	38	26% ⁽²⁾	73.61%	L7 being top 20% and followed by L6 and L2. 48% regards this as not a problem or cosmetic, 41% thinks it is a minor one with 12% deem major and catastrophic.
Usability and game mechanics	30	21% ⁽²⁾	79.17%	U1 being top 20% and followed by U3. 88% thinks it is minor, cosmetic or not a problem, 12% a major problem.

1. 108 possible violations (6 heuristics * 18 responses; zero responses for 2 heuristics)

2. 144 possible violations (8 heuristics * 18 responses)

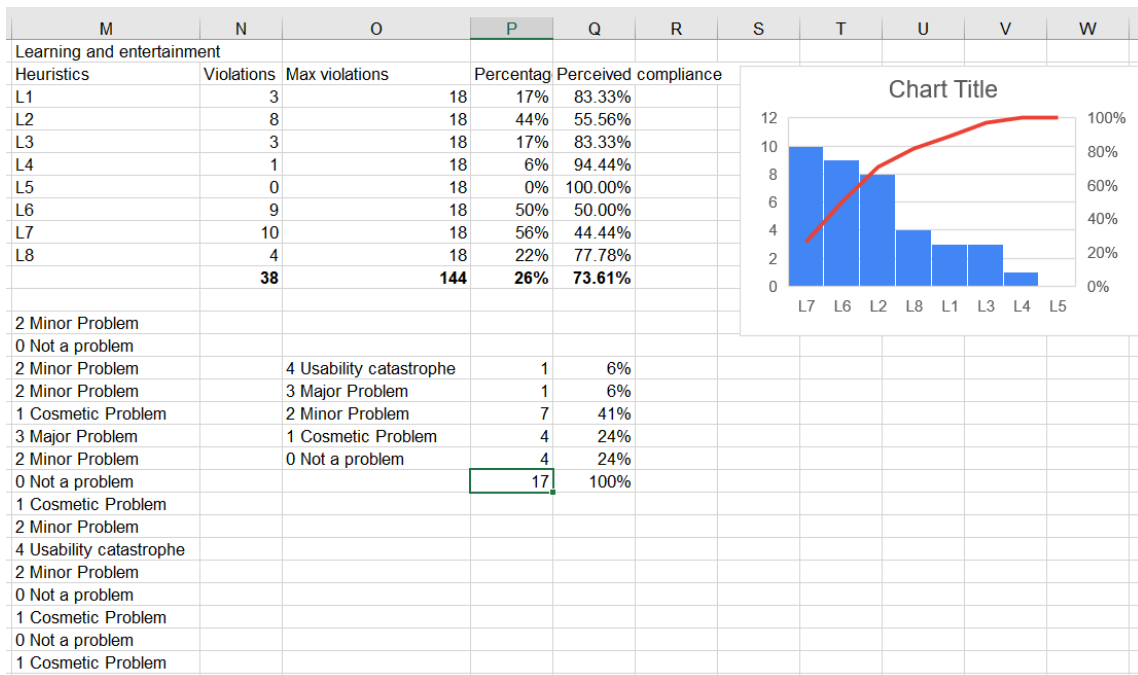


Fig. 3. The above is a screenshot of the spreadsheet showing how the results for learning and entertainment heuristics' results are computed. The pareto chart is used to identify the top 20%

Table 5

Heuristics analysis for project 2. In heuristics approach, number of violations are used. The lower the score, the more favourable the result. For clarity, the results are rendered in % as well as perceived compliance

Heuristics	Violations	Violations in % out of max number of possible violations	Perceived Compliance	Remarks
Game Play	29	20% ⁽¹⁾	79.86%	G1 being top 20% with G4 and G6 trailing closely behind. 94% thinks it is a minor, cosmetic or not a problem while 6% thinks is a major problem.
Learning and entertainment	23	16% ⁽¹⁾	84.03%	L6 being top 20% and followed by L7 and L2. 53% regards this as not a problem or cosmetic ,41% thinks it is a minor one with 6% deem major.
Usability and game mechanics	29	20% ⁽¹⁾	79.86%	U1 being top 20% and followed by U8. 82% thinks it is minor, cosmetic or not a problem, 6% a major problem

* 144 possible violations (8 heuristics * 18 responses)

Taking into consideration that the above projects are merely student work and to be completed within half a semester period after learning Wick Editor in the earlier half, it would be reasonable to conclude that Wick Editor has the potential to be authoring tool for developing educational games albeit, as suggested by above findings, with much attention to design issues.

3.3 Discussion

Table 3 shows clearly that Wick Editor is an alternative to Flash software and with additional insights not mentioned in Basir and Rasam [1], whose concern is for multimedia cartography. The additional insights are likely due to the first author's experience in teaching multimedia course using Flash software and now Wick Editor.

The heuristic analysis suggests project 2 to be a better educational game in all three areas of game play, learning and entertainment as well as usability and game mechanics. This is partly due to the amount of material being presented in project 2 and also a more complex as well as attractive game. As such highest violations for project 1 is that the game is not interesting enough and for project 2, is a weak storyline. For project 1, an evaluator wrote *"I can't proceed past level garbage drop, cannot drag properly. in the end I didn't finish..."* while some others wrote *"Depends on the age of players, if they were teenagers or adults, they may feel boring on the game"* and *"A bit unrealistic outcome of conversation in this chosen situation of attempted suicide. It can be triggering to at-risk people."* An avid game player wrote for project 2 that *"hahaha that was fun. so much better. should we just die? like no options to be safe omg. very fun though"*.

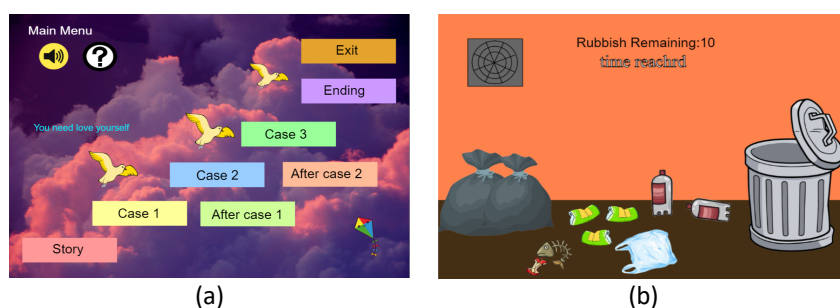


Fig. 4. Screen grabs for Project 1 (a) Main menu (b) One of the games

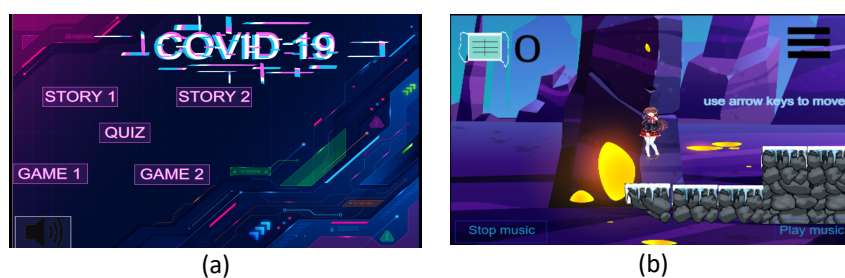


Fig. 5. Screen grabs for Project 2 (a) Main menu (b) One of the games

For learning dimension, the project 1 is not enjoyable enough for players to play again. For project 2 they find the game lacking in emotional connection. An evaluator wrote *"For the storyline I believe can be one of the learning tools regarding the covid-19. However, the games and the storylines, can be improve more on the relation between them."* For project 2, there is a disconnect between the material presentation and the game. An evaluator wrote on project 1 *"so for me my expectations are a bit high. can improve (way more) ... nevertheless the good intentions and morals are there so points for that. for 0 experience players this should be okay"* which suggests and emotional connection.

In regards to usability and game mechanics, the evaluators rate both projects as more or less equal with the highest violation being that the game design is not intuitive enough to be self-

explanatory. An evaluator wrote extensively in regards to project 1 as follows: *"The story in the game was good and meaningful and few functions need to be improved. After player completed each function, the game shld go back to main page. ... For Case 1: the car shld appeared and move from left side or right side (in the game, it seem the car appeared in the middle of the both lanes). For Case 3: the rubbish hard to drag and drop with fast action ..."* For project 2, the comments include amongst others *"Luckily the game comes with proper instructions. Story 2 should have a better indicator to close the narrative boxes."* and *"very hard i just skipped to the end (and died a few times...)"*.

Evaluators were asked on their views on Wick Editor and some of their comments produced verbatim include: *"It is an interesting tool to make the learning become more enjoyable, however the educator needs to spend some time to learn on how to use the tool"*, *"A decent tool to use. But it needs to be a bit more aesthetic in order to capture attention. Curiosity towards the game content won't last long if game visual is not up to users' standard or preference"* and *"Overall, it is a good tool to develop games. Even at a very young age, children can manage to develop games in order to add skills. This such tools can be an eye opener to further improve our approach to heuristic problem-solving methods. Problem-solving methods that are based on practical experience and knowledge can be sharpened using this such tool."*

The above findings point to opportunities for improving game functionalities and design. For future study, building an educational game catering for specific needs may be considered. To evaluate the end products, a heuristics protocol would be used with the notion of iterative development and continuous improvements. In a targeted study, only experts in the relevant field would be chosen and be fewer in number with interviews to properly clarify the heuristics used as exemplified in other studies [21,22] mentioned earlier.

4. Conclusions

This study presents Wick Editor as a free and viable alternative for creating educational game. In doing this, besides creating software artefacts as proof, a heuristics protocol is employed to gauge feedback from educators. In order for educational games to be used extensively and democratization of educational games development, a free and accessible authoring tool must be made available for educators. The spirit underlying heuristics protocol is a mindset of continuously improving usability of game functionalities and an open-ended enquiry approach towards the same, contrary to a quantitative study often confining itself to issues of validity and correlation.

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