The relationship between fun and the overall score of the MEEGA360 scale

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Abstract
Fun plays a significant role in learning. Given its positive impact on education, the role of fun has often been investigated in the context of gamification and educational games. An important problem with the study of the role of fun in learning is the lack of consistency in the assessment. There are a few existing tools for the evaluation of fun alone, but it is rarely assessed along with the other features of usability and gaming experience on a single scale. With the intent to fill this gap, we present MEEGA360, a modified version of the MEEGA+ scale. Strengths and limits of the MEEGA+ scale will be described, along with our solutions, and a first application.

1 Background
Although the emphasis in the design and development of educational games is on learning, fun plays an important role in engaging the player. There is ample evidence of the importance of fun in learning [Tisza and Markopoulos, 2021]. Fun in learning promotes engagement and motivation in the subject, is associated with better learning outcomes, and its positive effects have also been proven from a neuroscience perspective. Moreover, if the activity is presented as fun, people are more likely to participate. The definition of fun is controversial and there is little agreement in the literature [Tisza and Markopoulos, 2021, McManus et al., 2010, Sim et al., 2006]. There is no clear definition of the term (see McManus and Furnham [McManus et al., 2010] for a detailed account of the issue) and it is often used interchangeably with other constructs and especially with enjoyment. Despite the similarity between the two terms, we agree with Tisza and Morkopoulos [Tisza and Markopoulos, 2021] when they note that "fun" and "enjoyment" are similar but not completely overlapping and that "fun" is a more specific and complex construct than "enjoyment".

Designing a gamified learning environment is full of challenges. As described in detail by Morschheuser and colleagues, it is not enough to simply apply game mechanics to a software in order to provide either fun or learning with certainty [Morschheuser et al., 2018]. We still know little about what game elements actually contribute in making learning fun and motivating people, what influence do individual differences have, and how all these findings can fit into a model for gamified learning [Koivisto and Hamari, 2019]. In addition, choosing the right assessment tool is important to get meaningful results about the effectiveness of these solutions. Regarding this last topic, fun is one of the most commonly considered features when evaluating game-based learning [Tisza and Markopoulos, 2021, Loderer et al., 2020]. Literature indicates that there is plenty of scales and questionnaires used to evaluate fun, most of them self-developed for the occasion, and just a few are tested in validity and reliability [Tisza and Markopoulos, 2021]. Some tools (i.e., FunQ) are specific for the evaluation of fun in games [Tisza and Markopoulos, 2021], but they do not assess any other feature of usability or player experience related to educational games.

2 Five Key-points Of Fun In Learning
In view of the literature and what was briefly described in the previous section, it follows that: (1) fun is fundamental in learning and the effectiveness of educational games derives from the combination of learning and fun; (2) there is no clear and unambiguous definition of fun, and there is still confusion between fun and other constructs that are more or less closely related to fun. This makes it more difficult to design and subsequently evaluate educational games; (3) little is known about guidelines for designing effective educational games and gamified tools. Introducing game elements is not enough to create an effective tool, and poorly designed educational games do not accomplish their goal. In the future, it will be important to develop and test a model that supports the design of educational games and gamified apps. (4) There is a large number of scales and questionnaires used to assess fun, but only few of them are standardized, which makes comparing and summarizing research results very complicated [Koivisto and Hamari, 2019]. (5) The few existing standardized instruments for assessing fun do not evaluate all other features related to usability and user experience. To do so, one would need to use more than one questionnaire in the same session.

In summary, for an effective educational game or gamified app, two missing elements are needed. First, we need a reliable model that can help us design a game that is both fun and educational. Second, we need a complete and standardized tool that can actually assess usability, user experience, fun, and learning across a limited number of items. To address this gap in the literature, we will focus on the second part (fourth and fifth items in the list). We will introduce in the next sections, the MEEGA360 scale [1], an improved version of the MEEGA+ scale [Petri et al., 2018], and a first application of the tool for the evaluation of a gamified software.


3 Meega360

3.1 Why the MEEGA + scale is a good starting point

The MEEGA + scale was developed by Petri and colleagues [Petri et al., 2018] as a model for evaluation specifically of educational games. The greatest strength of the instrument is its ability to assess fun and perceived learning, among the other features of usability and game experience. The limited number of items (35) makes the MEEGA + scale a quick but comprehensive tool for evaluating educational games and gamified apps. Furthermore, the MEEGA + scale has already been tested for validity and reliability on more than 700 students [Petri et al., 2018].

3.2 Limitations and solutions

In addition to many advantages, the MEEGA + scale also presents some flaws. First of all, we found that three items (“The software allows customizing the appearance (font and/or color) according to my preferences”, “The software prevents me from making mistakes”, “There was something interesting at the beginning of the game that captured my attention”) were not really appropriate to evaluate player experience or usability. In the first case, we think that customization of appearance has little to do with
the accessibility of the game, dimension to which the item refers. As for the second item, trial and error is an important method in problem solving [Campbell, 1960] and we think that a game that prevents the player from making mistakes is not necessarily more effective than games that let the player progress by trial and error. Finally, we think that discovering something interesting at the beginning does not guarantee that interest will be maintained throughout the game. Moreover, even if you do not find any interesting feature right at the beginning of the game, that does not preclude you from finding it interesting later on. We decided to remove these items in the MEEGA360 scale.

Another problem with the scale is that Petri and colleagues [Petri et al., 2018] note that MEEGA [Savi et al., 2011] - the scale from which MEEGA + is derived - assesses motivation, learning, and user experience in educational games. However, motivation is not directly assessed by the MEEGA + scale. Fun, immersion, and satisfaction of the needs for autonomy, competence, and relatedness underlie motivation but do not overlap with it. We considered adding new items to specifically assess motivation and engagement in the educational game. Since the total of the scale is given by summing the scores of the individual items, we thought that changing the total number of items might change the validity and reliability of the scale in a consistent way. Therefore, we decided to replace the three items described above with three new items related to motivation (“I was motivated more by the game itself than by external rewards”, “I was determined to finish the game”) and engagement (“I was deeply concentrated in the game”). The MEEGA + scale does not contain any reverse statement. The issue of including or excluding reverse items is complicated, and many reasons can be found in the literature for both using and avoiding reverse items (see Vigil-Cole and colleagues [Vigil Colet et al., 2020] for a full dissertation on the topic). Reverse items are proposed primarily to control for acquiescence bias, but this practice can affect reliability [Krosnick and Presser, 2010]. Acquiescence bias is more common among individuals with lower social status [Lenski and Leggett, 1960, Krosnick and Presser, 2010] and fewer years of formal education [Narayan and Krosnick, 1996, Krosnick and Presser, 2010], and because educational games are often intended for students, it may be useful to control for acquiescence bias with reverse items. To balance the advantages and disadvantages of controlling for acquiescence bias while not compromising reliability, we chose to include four reverse items (“I find this game complicated”, “I find this game annoying”, “The game contents are distant to my interests”, “The game becomes monotonous”) without including them in the evaluation score. In addition, we chose to phrase the items in such a way that they change the direction of the overall meaning of the sentence without using negations, because it is well known that including negations in a questionnaire can cause confusion in the reader and increase the possibility of errors [Wason, 1961]. Furthermore, reverse items are effective when the strength of the statement matches the meaning of the original, positive one, and this cannot be achieved by simply adding a negation in the sentence [Krosnick and Presser, 2010].

Finally, in Petri and colleagues’ scale [Petri et al., 2018], participants express their agreement with each item through a five-point Likert-type scale. As is so often the case with Likert-type scales, the edges of the MEEGA+ are excessively distant from the center (i.e., from strongly disagree to strongly agree). Though, this common practice may lead participants to be biased to select items closer to the center rather than the distant ones [Alexandrov, 2010, Samuelson and Zeckhauser, 1988]. Also, verbal anchors tend to
influence the perceived distance between the points of the scale to which they refer [Lantz, 2013] and this is the basis for a perceived asymmetry in the scale that causes an end of scale effect. Therefore, we decided to use more moderate verbal anchors, especially for the edges of the scale (disagree, somewhat disagree, neither agree or disagree, somewhat agree, agree).

4 Analysis

PapyGame[^2] is a gamified software, developed to help master degree students in Computer Science in learning specific modeling aspects using Papyrus for UML [Bucchiarone et al., 2020]. This has been possible by extending the Papyrus[^3] modeling tool with gamification features. See Bucchiarone and colleagues [Bucchiarone et al., 2021, Bucchiarone et al., 2020] for further informations on PapyGame.

We administered the MEEGA360 after the use of PapyGame to 16 students. Considering the overall score, PapyGame reaches a good level of quality, in line with the fun levels (mean = 3.65; standard deviation = 0.8). Examining the items related to the fun construct, we decided to focus mainly on the first one ("I had fun with the game"), since the other item relates only to situational events. Fun levels show a medium-large correlation with the overall quality score (Pearson correlation, standardized r = 0.52, p < 0.05), suggesting that fun may play an important role in the global evaluation of a gamified software. Also, there is no difference in the levels of fun in relation to students’ expertise in digital games (Mann-Whitney U test, w = 32.5 p > 0.05), suggesting that the software works well regardless of the student's background. Further analysis will be provided in future works, in particular to analyze how fun items correlate with other features of the scale (i.e., perceived learning, motivation and engagement).

[^2]: https://www.papygame.com
[^3]: https://www.eclipse.org/papyrus/

5 Conclusions And Future Works

In this paper we focused on the evaluation of fun in learning, and in particular on the need of a tool to briefly evaluate not only fun, but all the other features regarding usability and user experience. We highlighted the flows we found in the existing version of the MEEGA+ scale and how we intend to fix them. Future steps will concern the evaluation of the MEEGA360 scale in its validity and reliability, along with the comparison with other tools assessing fun in learning.

Declarations

Ethics: The subject voluntarily participated in the experiment within a UML university course. All data was collected through an online form and completely anonymized.

Declaration of conflict of interest:
The authors declare that they have no known conflict of interest that could have appeared to influence the work reported in this paper.

References


