Bar Charts Literacy Serious Game

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Abstract—**Literacy has a broad definition across different fields. However it is an important topic in any area, but when it comes to visualization literacy, we cannot say it receives the same attention as text literacy. More specific in the data visualization, narrowing it down to bar charts, people's literacy level is below the expected. Even though bar charts can be considered one of the simplest data visualization graphics and also one of the most common in our daily lives, people are usually not interested in improving their literacy level, what can cause misunderstanding and misinformation. The knowledge about building or reading a bar chart has been taken for granted when it should not. Regarding this issue, this project aims to develop a serious game that can teach people the meaning of each element in a bar chart (e.g., labels, axis, etc), also teach them how combine those elements in order to build a bar chart, at last the game will improve their capacity of interpret the bar chart visualization, in other words, improve their literacy level.**

Keywords—*Visual, visualization, bar charts, literacy, serious game.*

I. INTRODUCTION

Bar charts (BC) are one of the graphical representations most commonly used in data visualization. Even though, the ability to build and interpret BC is considered as common sense, in the work developed by Boy et al. [1] as the authors assess the visualization literacy (VL) of participants, they realize the average of VL for bar charts is very low, so to compensate that they dumbed down the difficulty level of their assessment test in order to normalize its results. From a test in graphicacy [2] the authors concluded that the adult level of VL is achieved in fourth grade, and after that there is little to no room for improvement. However, they are not sure about what is an adult level in VL, another aspect to be considered is the fact that like many abilities we may have, when we do not practice them, they may fade out with time.

According to Bleed [3] even though, the way people are accessing and interacting with knowledge has changed, the way the institutions tend to teach and assess content hasn't changed as much, and the entertainment industry has a huge influence in people's lives, mostly for young adults that are growing up around movies, computers, the Internet, smartphones, video games, etc. Bleed [3] also claims that playing video games made people very familiar with problem-solving skills in order to accomplish a defined goal. A statement of the author about video games in education: "In a well-designed game, people learn new skills and see the consequences of their knowledge, or their ignorance, as their scores climb or fall" [3].

Having these ideas in mind, it is possible that people do not feel motivated enough to keep practicing/improving their VL skills using the existing means, but once it may lead them to misinterpretation or misinformation - defeating one of the main goals of a data visualization, we should provide better tools to support the process of teaching and assessing VL. Furthermore, these tools must approach people in an engaging and technological way, where they can learn with their mistake, and build up on their abilities.

To address this issue this project proposes to design ([4], [5]) and implement a serious game that aims to engage people while helping them to improve their VL level by both building and interpreting bar charts. An early evaluation of this tool should be done by assessing the participant's VL level before and after playing the game.

II. METHODOLOGY

A. Target Audience

The targeted audience is people in fourth grade or higher. Our goal is not to introduce concepts about bar charts (BC), but to help to consolidate and improve concepts about building and interpreting BC. Regarding that, we assume people who play our game have already been introduced to the topic. Once people tend to achieve their VL skills already in fourth grade [2], any person from that point would be a potential user of this game.

B. Educational goals

The educational requirements were listed and we categorized them in groups of tasks as follow:
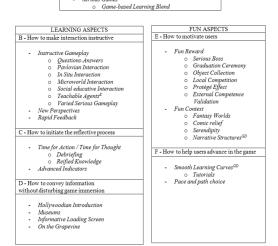
-Basic tasks: this group of tasks should teach the player to identify and understand the role of each element in a BC. It should include activities to simply find elements, and to place elements in their positions.

-Analytical task: it will include analytical activities such as the comparison of two bars, sorting bars and being able to make a statement about what they can interpret from the chart.

-Advanced tasks: this category will introduce different styles of BC including inverted axis, baseline and three-dimensional (3D) BCs.

-Advanced analytical tasks: after getting to know more advanced styles of BC, in this group of tasks we intend to test the players analytical skills in them.

The main goal of the basic tasks is to consolidate the structure of a BC, because a BC as other kinds of graphics are generally used for analytical tasks (e.g., comparing two bar values). However, if the person does not understand how a BC

Fig. 1. Synoptic view of our pattern taxonomy for Serious Games. Patterns are in Italics. [5]

Fig. 2. List of serious game Design Patterns organized in the Six Facets Framework. [4]

is built, then performing those analyses would be complicated. That is the reason the basic block of tasks is presented, and only after they have been completed we introduce the analytical tasks. After concluding the first two groups of tasks, the player is encouraged to learn how to read and interpret advanced BC models by finishing the last two group of tasks.

C. Game design

We agree with Huynh-Kim-Bang et al [5], that provides a design pattern where fun and learning are combined (Figure 1). The design pattern list provided by Marne et al [4] categorizes the design patterns in Six Facets Framework (Figure 2). They both agree in combining knowledge from an expert in teaching and an expert in game design, this collaborative work can result in a better designed serious game.

After defining the kind of tasks the game should present, we defined the game play experience as leveled system (based on Farm Heroes [6]), where the player has different levels represented by bars in a chart and their character is supposed to reach the tallest bar. In each level the player starts with a three stars health, and when he or she starts to make mistakes, health will be lowered. In order to successfully complete a level the player has to finish it while keeping the minimum of two stars. If the player's health reaches one star, even though he or she has failed already, it will still be possible to conclude the level (learning by trial and error). As a result of that, when they attempt to pass the level again, they will be more familiar with the problem. If a level is completed with three stars, the player will receive a reward.

The implementation will be web based, using JavaScript, HTML5 and CSS.

D. Evaluation

In order to evaluate the game, an assessment test provided by Boy et al. [1] will be applied, where the participant is asked to perform a series of tasks (from basic to advanced) within a time limit for each trial before they start playing the game, and the same test will be applied when they finish playing. If their assessment grade has a significant improvement after playing, the game can be considered effective. The evaluation will be done via a crowdsourcing platform, where web workers get paid a small amount per task, but it offers researchers almost immediate access to hundreds of users [7]. In our experiment, participants' VL will be assessed before and after they play the game. Once they finish playing it, they will receive a monetary compensation to be decided.

III. CONCLUSION

In this paper we have proposed a new tool to improve visualization literacy (VL), the proposed serious game will help people to practice and improve reading and analysing bar charts.

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