A Gamified Platform for Surveying Digital Maturity of Primary Schools

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Abstract

In this paper we present a gamified platform that we have implemented for surveying the digital maturity of primary schools as part of the Framework for Digitally Mature Schools (FDMS) in order to add a pupils' perspective to the already existing principals' and teachers' perspectives in the framework. The platform consists of an elaborate on-line role-playing game, a survey tool as well as a data analytics application. The platform has been pilot tested in 20 primary schools (students from grade 1 - 4) in Croatia as part of the e-Schools (cro. e-Škole) project with an additional meta-survey to gather student satisfaction and additional feedback. Initial results show that most students were satisfied with the implemented platform and it's ease of use.

Keywords: gamification platform, survey, digital maturity, primary schools

1 Introduction

As part of the project e-Schools - Development of Digitaly Mature Schools' System (cro. e-Škole - Razvoj sustava digitalno zrelih škola) the FDMS and an instrument for assessing the level of schools' digital maturity was developed [1]. The proposed framework includes a survey including questions for the assessment of digital maturity in 38 areas. These questions are aimed towards educational experts (e.g. teachers, principals, education researchers) and thus FDMS allows assessment from a teacher's and/or management's perspective. The only perspective which hasn't been covered by FDMS until now is the student's perspective.

In order to fill this gap, we have developed a gamified survey platform that will allow us to additionally survey students and provide data analytics about their view on digital maturity.

Gamification represents the introduction of computer game related concepts into other, not necessarily game related processes in order to foster motivation of participants [2-4]. Whilst it has been applied to numerous domains, it is most prominently used in educational contexts often with great success [5-7].

In order to foster survey participation we have chosen to use gamification principles to enhance FDMS and make it more accessible to elementary school students, especially grades 1 to 4. The rest of this paper is organized as follows: firstly, in section 2 we provide an overview of digital maturity. Then, in section 3 we describe the architecture and implementation of the platform. In section 4 we provide results from an initial pilot study, which was performed using the platform. In the end, in section 5, we draw our conclusions and provide guidelines for future research.

2 Digital Maturity

This study contributes to the field of digital maturity of schools by proposing a game developed as a part of the FDMS and the instrument for assessing the level of schools' digital maturity. The FDMS and the instrument recognize five areas divided into 38 elements described across five different levels in the form of a rubric [1]. The assessment instrument enables schools to measure their level of digital maturity form the principal perspective, from the teachers' perspective and pupils' perspective. The developed framework and instrument support educational institutions in assessing, promoting and integrating digital technologies in their teaching, learning and organizational practices. The FDMS and the instrument were developed in the scope of the "e-Schools programme: Establishing a System for Developing Digitally Mature Schools" in order to support the development of digitally mature schools in Croatia and for assessing the level of schools' digital maturity in self-assessment and external assessment of schools. The instrument was developed in a form of rubric together with assessment questionnaire [8]. The purpose of the assessment is to determine the initial level of the digital maturity of schools in order to enable planning of a systematic approach of raising the level of digital maturity of schools and the most suitable means of support for schools in accordance with all stakeholders.

Self-assessment and external assessment are based on defined indicators in the Framework. In self-assessment, the principal with his/her team is answering the questions in the questionnaire. In external assessment the evaluators interviewed school principals and other members of school staff using the questionnaire. They also gathered some evidence supporting answers in the instrument, such as strategic documents, curriculum, and infrastructure.

During the self-assessment process it is very important to collect opinions from pupils and teachers in a school. So, every school has the ability to send an anonymized links to its teachers and to collect their reflection to some questions in the online instrument. Such an approach is helping school principals to receive opinions form their teachers and to report more objectively about the current status of the school in regards to the elements of digital maturity. For the self-assessment process it is important to collect also pupils' opinion and a questionnaire is not the best form for collecting feedback from pupils in primary schools. Thus that was reason why gamification was used to asses digital maturity from pupils' perspective.

2.1 Areas and levels of the FDMS

In the FDMS five different levels of digital maturity of schools are defined: Basic (lowest level with almost no digitalization – Level 1), Initial (Level 2), e-Enabled (Level 3), e-Confident (Level 4) and e-Mature level (the highest level of digital maturity – Level 5). The main areas of the FDMS are: Planning, Management and Leadership, ICT in learning and teaching, Development of digital competences, ICT culture and ICT infrastructure. The area Planning, Management and Leadership is based on the vision and/or strategic guidelines of ICT integration expressed in school documents such as the yearly plan, work program and the curriculum. It emphasizes the importance of data management gathered through various information systems to improve student success and to manage the school's business process. The area ICT in learning and teaching emphasizes the importance of systematic introduction of information and communication technology into the teaching and learning process and the creation of digital educational content. This area deals with the integration of the contemporary teaching, learning and evaluation methods into the educational process with objective to achieve the determined educational goals and including innovative, ICT supported teaching and learning methods. The area Development of digital competences is based on identified need for the systematic development of the digital competences of the educational and administrative staff through their inclusion in educational programmes and the evaluation of their developed competences. The area ICT culture refers to a school's ability to enable its teaching staff and students corresponding access to the equipment, to properly define the usage of all ICT resources as well as online behavior of teachers and students. Finally, the area ICT infrastructure

describes ways of ensuring all the infrastructural prerequisites for reaching a desired level of digital maturity of a school.

3 Game Design and Implementation

In order to make the survey accessible to elementary school students the first step was to eliminate all questions from the survey which students could not answer due to lack of knowledge about the topic or processes addressed. After this step a total of 15 questions remained which had to be put in a game related context.

Whilst there are numerous gamification techniques, we have chosen to implement a whole game that includes a number of such techniques. The chosen techniques were:

- **Graphical game interface** for the player (student) the tool is a game, not a survey tool.
- Avatars each player was able to create an own virtual avatar that would be used as the main game protagonist.
- **Quests** each player has to solve a number of quests (tasks) in order to win the game.
- Awards each player is promised an award if the game is won.

The genre of the game was role playing game (RPG) in which the player enacts a predefined character and has to solve various quests in order to advance in the game. For the graphical game interface the RPG Maker MV game development tool and game engine has been used. Figure 1 shows the initial welcome screen of the game.



Fig. 1 Initial welcome screen

In order to foster engagement we have used a character creation system in which students are able to create their own character by changing their face, eyes, eyebrows, nose, mouth, cloths, hairstyle and accessories. Figure 2 shows the character creation screen.



Fig. 2 Character creation

For us, the objective was that the player (a grade 1 - 4 student) answers all the given questions by solving such quests. A simple technique that we have used is for the player to collect a given number of items in order to get a reward. In our case, we have chosen that these items are collectible cards of which 10 have to be collected in order to win the reward. Figure 3 shows the actual album in which such cards have to be collected.

The cards are given out by non playing characters (NPCs) which were designed to be usual people children in grades 1 - 4 come into contact with (parents, grandparents, teachers, friends). In order to find them, they have to navigate a number of maps (home, city, park, playground, school yard, school) on their way from home to school (see figure 4). From this journey, we have derived the name of the game - Journey to e-School (cro. Put do e-Škole). Players have to talk to each NPC and answer their questions (which are the actual questions from the survey) to get a card.

In order to provide the students with a sense of achievement we have implemented a special reward for the students which finish the game by collecting all the cards (and thus answering all our questions). The award is a diploma, which is presented to the player when the game is finished and can be printed out (by the teacher for example) and taken as a token of achievement.

All of the answers provided by the students who participate in the survey by giving their answers through the implemented game mechanics, can be quickly analysed, filtered, and downloaded using the provided data analysis system and its interface. Considering the nature of the survey described in this



Fig. 3 Album of collectible cards



Fig. 4 Four example maps of the game (city, home, park, schoolyard)

paper, and the nature of the project it is related to, the interface at its current state allows one to filter the gathered data based on the county of the survey taker, and the specific question. Additionally, the answers to each question are by default visualised in an approachable way. Naturally, this interface, and the underlying data analysis system, are expected to be further developed, along the planned future development of the survey tool.

The system is implemented to be anonymous, and no private data of students is stored in the database. The architecture of the implemented platform is shown on figure 5.

The developed system consists of the following components:



Fig. 5 System Architecture

- **Database** main storage of school, player and survey data. The database has been implemented using PostgreSQL in form of an object-relational database.
- **Survery Server** server which provides a middleware between the database and the web server and includes convenience function for survey data handling. The survey server is implemented in Python.
- **Game Engine** the basic system that allows gameplay. A commercial engine called RPG Maker MV has been used for this prupose.
- Web Server a server that serves the various web pages related to the game interface and analytics interface. The web server has been implemented using Python Flask.
- Data Analytics Platform middleware which provides various analytics by using data from the database (also implemented in Python).
- Game Front-end a web based front-end for the implemented game. The front-end has been implemented using native RPG Maker scripting and JavaScript.
- Data Analytics Front-end a web based frontend which provides analytics and data visualization. The front-end has been implemented using Python and usual web technology (HTML, CSS, JavaScript).

4 Initial Pilot

In order to get additional feedback from both students and teachers about the implemented game, we have chosen to conduct a pilot study before a full scale study on all schools in Croatia. A total of 20 schools and 1194 students participated in the pilot study.

During the pilot study all teachers were provided with in detail instructions on how to start the game, conduct troubleshooting as well as print out diplomas for students. In addition to playing the game we have created a small survey to collect feed back information from both students and teachers.

The survey consisted of the following questions:



Fig. 6 Analytics Web-based frontend

- 1. Were the instructions clearly defined? (1 very unclear; 5 very clear)
- 2. How much time was necessary for the students to finish the game? (less then 10 minutes, 10-20 minutes, 20-30 minutes, more then 30 minutes)
- 3. How interested were the students in solving the game? (1 very uninterested, 5 - very interested)
- 4. Which part of the game was the most interesting one? (open ended)
- 5. Which part of the game was the most challenging one? (open ended)
- 6. Were the questions intelligible to students taking into account their age? (yes/no/undecided)
- 7. Do you have any additional suggestions for improving the game? (open ended)

A total of valid n = 134 responses was received. The results are very promising. The two numeric questions (1 and 3) have shown that the instruction were very clear (average 4.38, median 5) and that the interest of students was very high (average 4.35, median 5). Regarding the total play time the results were as shown on figure 7. None of the respondents thought the playtime was below 10 minutes, 29 % of respondents thought playtime was between 10-20 minutes as well as 20-30 minutes, and 42 % of respondents thought playtime was more then 30 minutes.

Regarding the clarity of questions, the results were as shown on figure 8. Most respondents (87 %) thought that the questions were clear.

Regarding the open ended questions, answers were inconclusive. The most interesting parts were related to various parts of the game including but not limited to NPCs, various quests to be solved, parts of the game mechanics etc. The most challenging parts were related to finding the appropriate NPCs to get the cards as well as the character creator at the beginning of the game.

There were some very interesting suggestions in the answers to the last question including to make the game a multiplayer game in which students can communicate, add additional gameplay and mechanics, and what is most important a few bugs in the game implementation were detected.

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Fig. 8 Question clarity

5 Conclusion

In this paper we have given an overview of a gamified platform implemented for surveying primary school students about digital maturity.

The implemented platform allows for the students to give their answers to survey questions while interacting with various NPCs, in a natural way of communicating with characters via a predefined set of replies, i.e. survey answers. Those characters are modelled as various real-life characters students might come into contact with, including grandparents, friends, and teachers. In addition to communicating with NPCs, the students are motivated to answer all the questions by the goal of collecting all the available cards, wherein each card is awarded for giving answers to a predefined number of questions Additionally, the ultimate award, awarded for collecting all the cards, is the appropriate certificate.

The feedback survey of the conducted pilot study showed that the interest of students was very high. Most students thought that the questions were clear and understandable. Additionally, the student gave us some interesting ideas to further enhance the game as well as detected some bugs that have to be resolved.

Our future research is oriented towards making the game even easier to use, especially for younger students (grade 1 and 2) and afterwards conducting a full survey with the game in all Croatian elementary schools to further enhance our FDMS framework and integrate a students' perspective of digital maturity into it.

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