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Color codes: comparative conclusions

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ABSTRACT

This paper presents new research results on the Color code method for a real time learning process assessment. The method uses three color codes: red for "problem", yellow for "work in progress" and green for "job done". The buttons of colors are incorporated in the EdX LMS and are always shown on the screen. The experiment took part in the Autumn of 2018 with 1st year Riga Technical University master stu-dents. Results show that 75% of the students used the color buttons. This is a big difference compared to the 2017 bachelor students from which only 34% of the students had used the color buttons. Differences in pushed button colors: 44% of green or "Done" pushes from the 2018 master students, but 67% from the 2017 Bachelors, and 49% yellow or "Process" pushes from the 2018 masters versus only 25% from 2017 bachelors; Red button "Problem" in 2018 was used 7%, which is the same as from the 2017. It could point to a trend that 7% of any course material is either poorly executed (technically or content-wise) or a minor part of the students have difficulties in understanding the material, most believably it is a case of the mix of them both. A tendency that bachelor students had more concentrated on finishing the learning materials, but the master students – more on the learning process itself can be observed.

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1. Introduction

Today we have the great advantage of having extensive and fast growing amount of educational data, that gives us the opportunity of deriving much knowledge about the learning process as never before. So, it is important to use the possibilities provided by technologies - like data gathering and data analysis – in a new level to use the results to improve course assessment and improve the learning process. There are tools and methods available, but none of them is a solution to everything. New technology-enhanced learning approaches, which have the potential to democratize higher education, are emerging at a time when traditional models of higher education are often criticized for being increasingly unaffordable and ineffective for addressing educational inequality [1]. During the several years of research work a new method for real time learning process assessment is being developed. The method is called the Color code method and its purpose is to understand students' learning process. The method uses three color codes: red for "problem", yellow for "work in progress" and green for "job done". The method has been tested with success in both the class learning process and in the e-study environment [2]. This idea has been incorporated into a broader concept about a new adaptive learning management system [3].
The first hypothesis was that Color code usage improves learning process evaluation, teacher's reaction ability and learning pace. An experiment was conducted to test the hypothesis and the Color code method in a real learning environment. The experiments took part in the first grade (7-8 years old children) and in the fourth grade (10-11 years old children) in Latvia. The results imply that the implementation barriers of the Color

code method are less and lower for the children of the mentioned age groups than was previously predicted. Research showed that pupils got used to the new method quickly and were excited to use the cardboard color codes and it seemed that most of the children didn't find using or remembering to use the Color code method to be an extra load [4].

The biggest challenge linked to the method implementation was found on the teachers' side, because teacher is the one that faces the biggest process changes (in comparison to pupils) – teachers have to adjust the flow of the learning process with color codes, need to remember to remind the pupils of the method, need to remember to look at the codes and analyze the process in the classroom in a different way. Most of all – teacher needs to believe in the system to make it work and to make it an every day habit. Another conclusion from the first experiments in the classroom is that the Color code method is easier adopted in non-formal education field and for teachers and trainers that work with changing learner groups, because it makes the learning process for the teacher more understandable in a shorter time-frame, which consequently make the Color code method more worthy in the eyes of a teacher to implemented and used this method. Teachers and learners would benefit also because the Color code method serves as a good tool in changing teachers' tacit knowledge to explicit knowledge which can benefit in knowledge sharing and operationalization. Another conclusion was that the colors in the Color tool need to be complemented with a graphical or other color independent pattern to be suitable for people with color blindness. Overall, it was clear that the method worked, and the next step could be taken to test the method in the computer-based learning environment [4].

Massive Open Online Courses (MOOCs) have been one of the most significant technological developments in Higher Education in the past decade [5]. Consequently, it was obwious that a MOOC based platform should be chosen for the Color code method implementation. Next step was to choose the exact learning management system, and after a research edX learning platform was chosen. As a MOOC platform and as an open online platform it was suitable for the new color tool and code block generation, as well as for sharing this code with others. More on why the edX platform was chosen and also edX analysis in comparison with Moodle, that is one of the most popular learning content platforms, can be found in the research of Zagorskis and Kapenieks [6] that states edX platform to be more engaging to the youth than Moodle.

After the method implementation the first testing work was done. The color buttons worked as predicted and the data were gathering in the database. The first experimental test group was 1st year bachelor students. The gathered data about their behavior linked to the color buttons gave an insight of which learning items get the most attention by learners, rating by the usage of color buttons. Some quantitative results were drawn and showed that 45% of students that attended e-learning course at least once, used color buttons as well. The most used button was the green button "done" (67.2% of all pushes), the second largest was orange "process" (25.4%), but the least used was red "problem" button (7.4%). Mostly the codes were used in online tests (75%), but some part went to peer assessment (9%), informative learning materials (8%) and homework (5%) [7].

The button design was tested in four student groups and the button press data analyzed taking into consideration students' gender and exam marks. Student survey showed that button design needs some improvement. Research shows that the highest button usage activity had the least course non-finishers and the highest number of students that got the highest mark. As to student's gender, no major differences were found, but the percentage of female students using the buttons were slightly lower [8].

During the Color code method implementation process and deeper insight in the university learning process, it was clear that the higher education is not changing accordingly, despite a lot of research and rapidly developing knowledge and technological possibilities. Thus, rose a question "why" and the need for understanding the underlying reasons and historical background of this situation to be able to move towards a sustainable higher education system and to make the color method more suitable for it. During this research work [9] seven major contradiction groups in higher education nowadays were distinguished and researched: Willingness to teach comprehen-sively VS availability of finance; Traditions VS novelties; Willing-ness to learn VS financially survive; Student VS student; "Women professions" VS "male professions"; The mission of a higher education institution; Graduate skills and knowledge VS skills and knowledge needed by the employer. The analysis was more focused on the situation in Latvia and the post-soviet space since the authors are well acquainted with the system. The main future research object from this research branch should be the university mission, since from the mission statement analysis it was found that low rated universities are lacking the distinction between education and training in their mission statements, having bigger stress on training. This redirected universities' focus could grow into future problems and graduate unsuitability to

tackle global problems, think creatively and holistically, and this situation interferes with the sustainable education goals.

2. Methodology and results

In this paper the research job was done to get more correlations and information for predictions, verifying the results using another student group. The data analysis was done using data analysis tools like SPSS modeler and MS Excel. The new students' test group was the first-year master students of Riga Technical University.
Experiment took part in the Autumn on 2018 in Riga Technical University, Latvia. The participants were 1st year Master program "Digital Humanities" students. The chosen course was "Natural science modelling", and the course was a blended learning course with most of the learning materials in the EdX learning platform and regular course meetings and discussions in the classroom. 22 people were enrolled in the course, but 5 of them didn't attended the lectures and didn't complete any of the course tasks so they were considered to be dropouts and were discarded from the further data analysis. The remaining 17 students were all female so there was no possibility to make any gender-based conclusions. The school year started at the beginning of the September and the button pushes started to record at database from 14th of the September.
4 (25%) of the 17 students never used the color buttons, but 13 (75%) used them. This is a big difference compared to the 2017 Bachelor students from which only 34% of the students had used the color buttons.
The graph in Fig. 1 and 2 shows interesting results from 2018 autumn students button pushes. As to the green and the yellow button pushes, there is a noticeable difference from the 2017 students: The Fig. 2 shows 44% of green or "Done" pushes from the 2018 Mas-ter students, but it was 67% from the 2017 Bachelors, and 49% orange or "Process" pushes from the 2018 Masters versus only 25% from 2017 Bachelors.

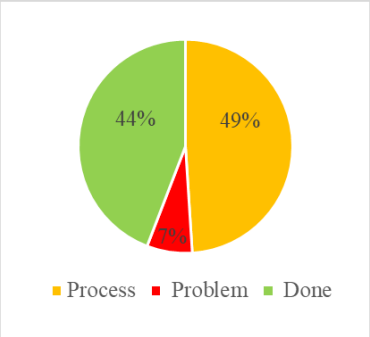

Figure 1. Proportion of pushed buttons (2018 autumn results)

The red button "Problem" was used in 7% on the all pushes, which is the same as from the 2017 first year Bachelor Economics course students. It could point to a trend that 7% of any course material is either poorly executed (technically or content-wise) or a minor part of the students will have difficulties in understanding the material, most believably it is a case of mix of the both.

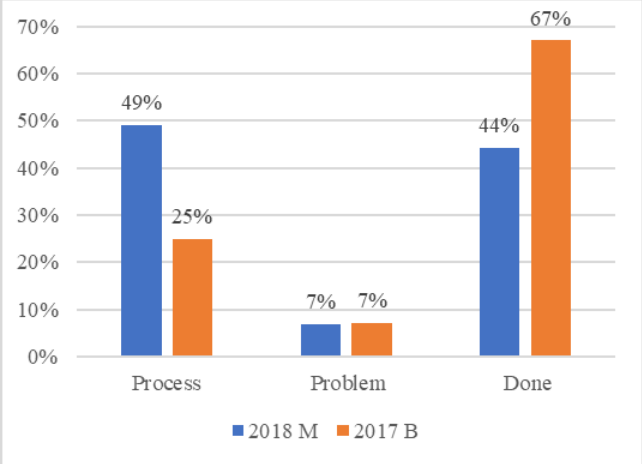

Figure 2. 2017 and 2018 button push comparison

To keep the results from both years more comparable, only a few reminders were given to the students about the button usage, the same as the last year. So, the difference that occurs in the button usage is mostly connected to the differences in students' personali-ties, motivation to learn, to use new approaches and their education level, and the slight difference in the button design.

3. Conclusions

The big difference in the proportion of students that used the color buttons in the 2017 group and 2018 group may have occurred because of three reasons: 1) The results and the overall engagement of the 1st years Bachelors studying Economics course were lower than that of the 1st year Masters studying Natural science modelling, and this might have resulted in less interest in the learning process and the online learning materials and bigger focus on the test results and having the course finished for the Bachelors; 2) Master students seems to be more motivated than Bachelor students overall, because less people choose to get the Master's degree, and the choice is more intrinsic, thus the motivation to learn is greater; 3) The Bachelor's program of 2017 experiment was more technical, but the Mas-ter's program consisted of more interdisciplinary subjects consist-ing of creative and humanities elements besides the technical part of the program, so the people choosing the program differs in their personalities and interests.

A tendency that Bachelor students had more concentrated on finish-ing the learning materials, but the Master students more on the learning process itself can be observed. Some part of the difference may be connected to a slightly different and improved button design based on the 2017 student survey. Also, the explanation of the but-ton meaning may have been more understandable because of the improved and developed idea based on the previous research work.

It is not possible to tell exactly the percentage of each differing stu-dent parameter influencing the difference in the button usage in the both experimental groups but observations from both groups seem-ingly shows that the biggest contributor to the elevated button usage in the 2018 group is the student personality features and motivation to learn, thus increased overall activity and engagement. We can tell that from the fact that less dropouts and students without the done tasks one time are in the 2018 group.

Another conclusion was that it is not clear from the "red" pushes what type of problem student has encountered with – technical, contextual, cognitive or other. So, it would be even more important to work on a user interface for the tutor to be able to detect the prob-lematic parts in real-time/very soon after the problem has encoun-tered and engage a private discussion or a public one about the issue to solve the problem as quickly as possible. This challenge is one direction of the possible further research and implementation of the Color code method.

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