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RUBRICS AS SELF-ASSESSMENT TOOL OF MATHEMATICAL EDUCATION

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Abstract. The source of the majority of disputes, misunderstandings and disagreements in a mathematics teacher-pupil relationship is testing, evaluation and classification of pupils. These parts of education are nowadays marked by defects which are an outcome of constant changes in lives of teachers, pupils and their parents. The focal point of education is no longer just acquirement of facts and but also development of teaching quality, creation of a good base for lifelong learning, increase of creativity, communication, digital literacy, the ability to resolve problems. The feedback accommodated to these demands on learning in a 21st century school should be new trend in university education of next generation mathematics teachers. According to a conventional approach, evaluation is solely an assessment of learning results, but evaluation ought to support the progress of the learner, as well as the process of learning itself. At any rate, the teacher should evaluate pupils' outputs while providing them with a space for self-assessment. Our experiment gives answers to fundamental questions: Are pupils currently able to evaluate their own knowledge and skills? Do they underestimate or overestimate themselves? Is self-assessment affected by their age or gender? Results of the experiment could be the initial motion for changing the current approach of teachers, for preparing next generation of mathematics teachers to evaluation of pupils and pointing it to the right direction of change – to the developing assessment and to new assessment tools, e.g. Assessment

Keywords: evaluation, self-assessment, experiment, assessment rubrics, mathematical education

Mathematics Subject Classification: Primary 97B10; Secondary 97C60

1 Introduction

The source of the majority of disputes, misunderstandings and disagreements in a mathematics teacher-pupil relationship, sometimes involving parents as well, is testing, evaluation and classification of pupils. These parts of education are nowadays marked by certain defects which are an outcome of constant changes in lives of teachers, pupils and their parents. The focal point of education is no longer just acquirement of facts and but also development of teaching quality, creation of a good base for lifelong learning, increase of creativity, communication, digital literacy, the ability to resolve problems and the skill of

working with information. The feedback accommodated to these demands on learning in a 21st century school should be new trend in university education of next generation mathematics teachers. According to a conventional approach, evaluation is solely an assessment of learning results, however it should convey a more important message. Evaluation ought to support the progress of the learner, as well as the process of learning itself. At any rate, the teacher should evaluate pupils' outputs while providing them with a space for self-assessment. After all, it is self-assessment that is a tool for improvement of learning feedback. The new generation mathematics teachers should be notified with requirement and possibility of assessment changes and should be prepared to manage pupils´ self-assessment.

2 The level of pupils' self-assessment skills

This experiment gives answers to fundamental questions: Are pupils currently able to evaluate their own knowledge and skills? Do they underestimate or overestimate themselves? Is self-assessment affected by their age or gender? Results of the experiment, statistically very easily derived into graphs, could be the initial motion for changing the current approach of teachers and for preparing next generation of mathematics teachers to evaluation of pupils and pointing it to the right direction of change – to the developing assessment and to new assessment tools, e.g. Assessment Rubrics.

2.1 Rubric as a self-assessment tool

The aim of experiment is to determine the level of pupils' self-assessment skills. The most appropriate instrument for determining the level of pupils' self-assessment skills is Assessment Rubric. Whilst assembling the Rubric we first set categories, i.e. mathematical task and after that, we elaborated individual criteria of the categories, i.e. problems of varying difficulty. Thus, our Assessment Rubric contained four criteria levels in four categories. According to this Rubric, we prepared an exam with assignments that matched each problem, that is, the criteria of each type of mathematical task, that is, the category. Categories represented a type of mathematical task and each one was made up of four problems varying in difficulty – evaluation criteria.

2. 2 Hypothesis

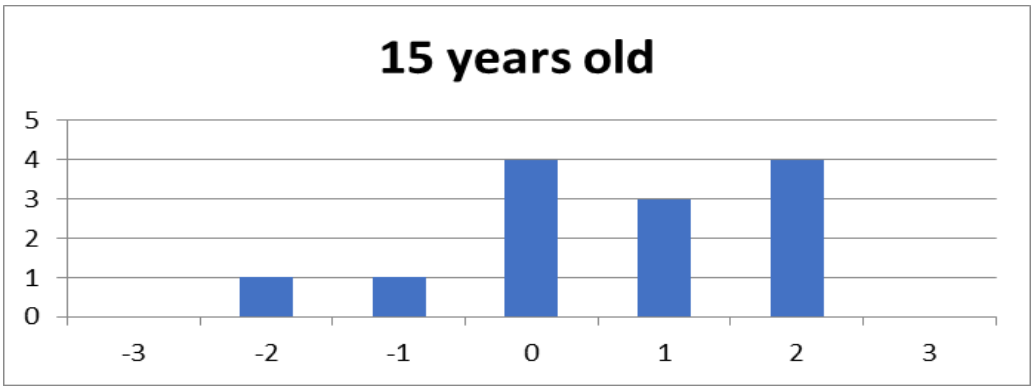
Pupils of the first grade up to the fourth grade of High school of business were given an Assessment Rubric containing categories and evaluation criteria during a mathematics class just before an exam. The pupils were asked to assess their abilities and current knowledge. That essentially meaning to guess what grade they would get from the exam if the problems on the exam were picked from the Assessment Rubric they had seen. Founded on pedagogical experience, we assumed that pupils were not capable of objective assessing of their knowledge, and therefore unable to classify themselves into a fitting category. After they had guessed, the pupils took the exam. We subsequently graded and classified the pupils based on their filled exam sheets.

2. 3 Results of the experiment

Based on the acquired entries from pupils' self-assessment task and from grading their filled exam sheets, we drew a comparison between the actual results of pupils' examining and the results that pupils had expected before being handed the exam.

2.3.1 Pupils in the age category of 15 years old

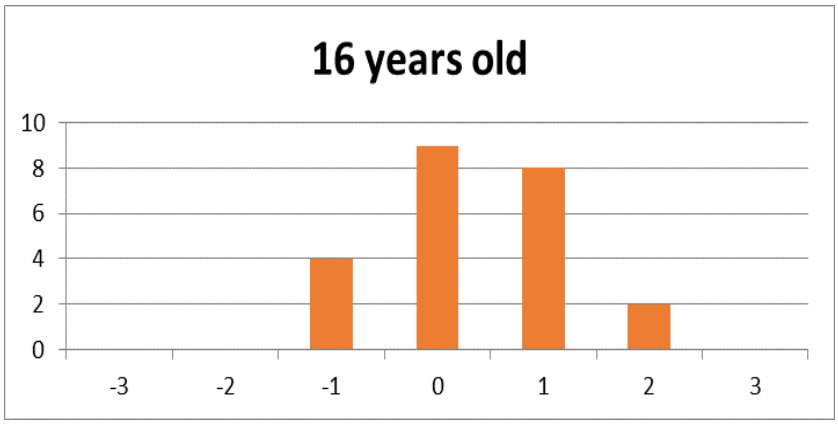
Graph 1. contains the results of self-assessment of pupils in the age category of 15 years old. It shows that, in percentage representation, 30.8% of pupils had guessed correctly. The same percentage of pupils had assumed they would get a mark two grades worse than what they actually received. 23% had assumed to receive a mark one grade worse. Only 7.7% had assumed a mark one or two grades better than what they received.



Graph 1. Pupils in the age category of 15 years old.

2. 3. 2 Pupils in the age category of 16 years old

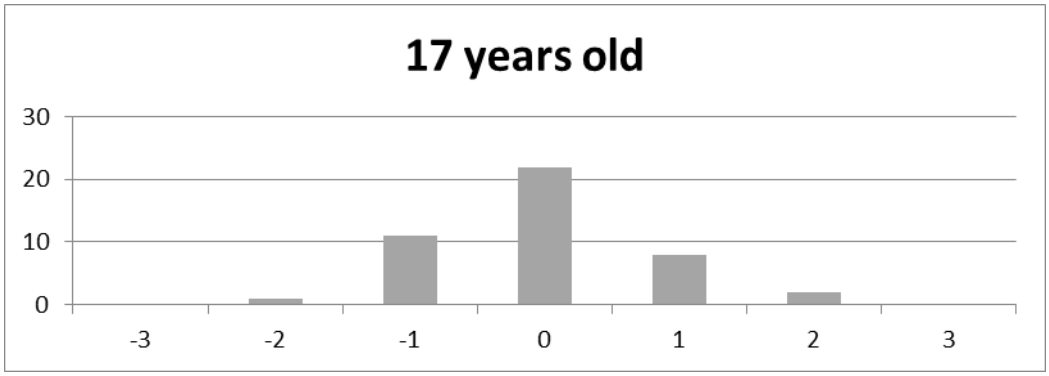
Graph 2. demonstrates pupils in the age category of 16 years old. It points out that 39.1% of pupils had guessed their mark accurately, 34.8% had guessed they would get a mark one grade worse, 17.4% had assumed to get a mark one grade better and the last 8.7% of pupils had expected a mark two grades worse than the actual one they received.



Graph 2. Pupils in the age category of 16 years old.

2. 3. 3 Pupils in the age category of 17 years old

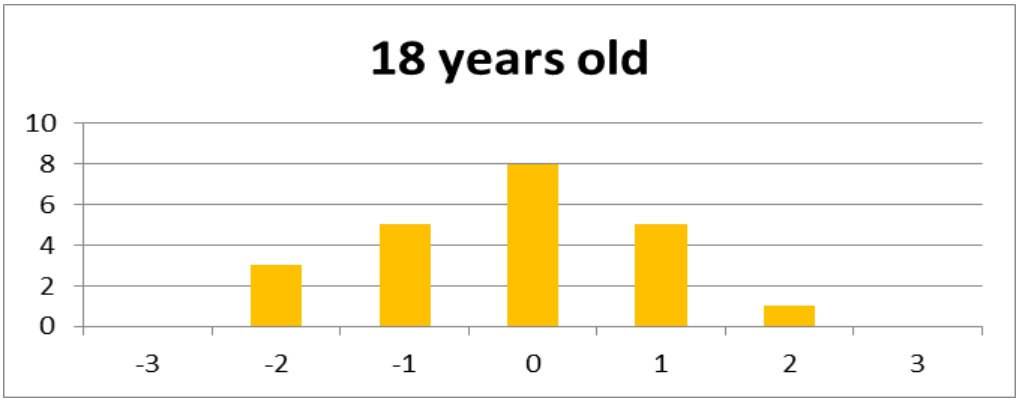
Graph 3. indicates that almost a half of 17-years-old pupils, i.e. 49.94%, had guessed their mark correctly. 24.97% had guessed to get a mark one grade better, 18.16% had expected a mark one grade worse, 4.54% had predicted a mark two grades worse and only a small percentage of just 2.27% had expected to get a mark two grades better.



Graph 3. Pupils in the age category of 17 years old.

2. 3. 4 Pupils in the age category of 18 years old

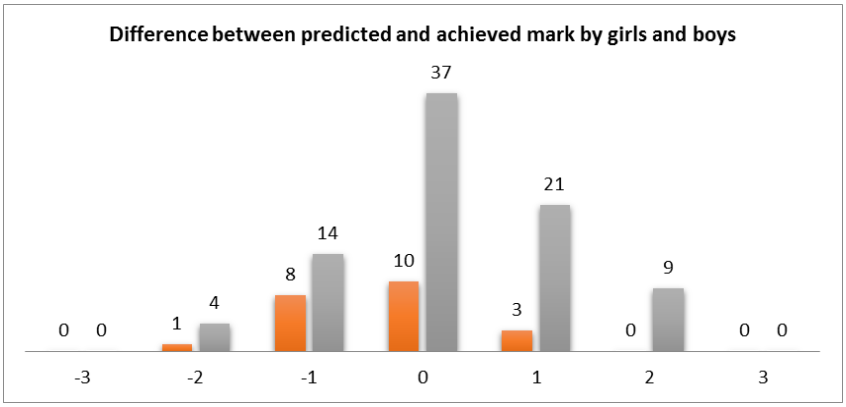
Graph 4. shows that 36.4% of pupils had not made a mistake in their guessing, 22.75% had expected a mark one grade better, but the equal percentage had expected a mark one grade worse. A two grades better mark had been anticipated by 13.65% and only a single pupil representing the last 4.55% had expected a mark two grades worse.



Graph 4. Pupils in the age category of 18 years old.

2. 3. 5 Gender differences in self-assessment

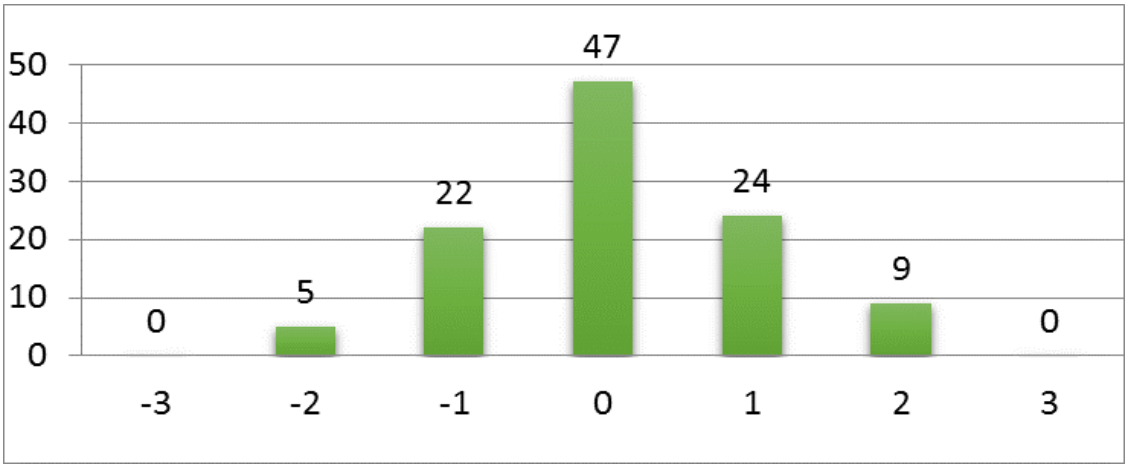
From the final graph, Graph 5., it follows that both genders had mostly guessed their mark correctly. According to the results, boys (45,45%) in our school show a tendency to predict the results of their exams more accurately than girls (43,53%), but the difference is minimum.



Graph 5. Gender differences of self-assessment.

2. 3. 6 Pupils´ of High school of business

The following Graph 6. summarizes the overall results of all the pupils who participated in the experiment. It indicates that 44.65% of pupils, that is almost a half, had guessed their mark exactly, 22.8% had expected a mark one grade worse, 20.9% had assumed to get a mark one grade better, 8.55% had expected a mark two grades worse and 4.75% a mark two grades better.



Graph 6. The level of pupils' self-assessment skills.

2. 4 Conclusion of the experiment

On each of the previous graphs, we could observe one common sign. No matter how many categories we divided the pupils into, the pupils who correctly estimated their knowledge

never dominated. From the charts, it might appear as if the majority of the pupils had adequately assessed themselves, but the exact self-assessment that occurred in the total number of pupils (i.e. 107) is less than a half. Only 43% of pupils had correctly assessed their knowledge and skills. This shows that 57%, meaning more than a half, had wrongly assessed their abilities. With this simple pedagogical experiment, we have discovered that the ability of pupils to self-assess themselves is low and they tend to underestimate their abilities. In addition, the experiment specified our hypothesis in a finding that 17-years-old pupils have the highest tendency to estimate their abilities correctly as they are, pupils of an age below 17 years old tend to underestimate and pupils above 17 years old overestimate themselves.

3. Conclusion

Examining of the subject, assessment, grading, classification of pupils all represent a feedback in education in a present-day school. The main goal of current pupils is to get a "good" mark, because it is everywhere presented as the most important. However, what is to be understood in educating is that our society doesn't need "straight-A pupils", but especially people who are able to communicate, to problem-solve, are digitally literate, people willing to continue learning. To obtain these qualities, education and, of course, evaluation should be adjusted. We should abandon the old way of classifying pupils to proficient and less skilled ones, and instead opt for the developing assessment with its integral part, the self-assessment. Our experiment has proven that the ability of pupils to evaluate themselves and their knowledge is low, at the level of forty-three percent. The resulting situation is also due to inadequate feedback tools, with one of the solutions being the usage of the developing assessment. Feedback in the mathematics education of 21st century should be enriched with a possibility of self-assessment. Self-evaluation brings a number of benefits such as higher pupil's engagement and eagerness in learning, better communication between a pupil and a teacher, increased pupil's motivation, providing of valuable information about a pupil to a teacher, enhanced pupil's self-confidence, activating the learner in the learning process. The important part of learning next generation of mathematics teachers should be not only mathematics skills, but also teaching skills. Our experiment shows the need and the ability for assessment change. University education of teachers should contain the self-assessment of pupils and creating assessment rubrics as a new trend in mathematics education.

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