EXAMINATION OF SOME FACTORS THAT MAY IMPACT ON STUDENTS’ ATTITUDE ON E-ASSESSMENT

M. Misutova¹, M. Misut²

¹ Slovak University of Technology, Institute of Applied Informatics, Automation and Mathematics, Faculty of Materials Science and Technology (SLOVAKIA)
² University of Economics in Bratislava, Faculty of Economic Informatics (SLOVAKIA)

Abstract

Student’s assessment is an important part of actual learning process. Many e-learning experts and educational technologists have emphasized that e-assessment can play a major role in improving the quality of student learning experiences, particularly in higher education. Acceptability is a required quality for a sound e-assessment. However, there still seems to be a need for investigating what students think and feel about this type of assessment.

Presented research had two principal aims. The first objective of the research was to find whether there is a correlation between the studied variables (a type of the study program, gender, type of secondary school completed) and attitudes of students towards the Mathematics I course. The attitudes of students towards the mathematics were identified through students’ engagement in the course, and the students’ opinions on applicability and the difficulty of the mathematics.

Another aim of the research was to determine whether the studied variables (a type of the study program, gender, type of secondary school completed, and the ability to produce ideas (fluency)) do have an influence on students' perceptions of e-assessment.

The obtained results indicate that the type of the completed secondary school and the kind of the study program both have a significant correlation with the perception of the difficulty of the Mathematics I course. Furthermore, research results showed that the kind of the completed secondary school has an influence on the students’ opinions about the applicability of maths. The type of the study program and gender also have a significant impact on the engagement of students in the Mathematics I course. However, the combination of these factors was not found to have an influence on the attitudes of students towards the Mathematics I course. Additionally, the results have shown that the attitudes towards e-assessment are not influenced by either of the studied factors or by the combination of the factors. It was presumed that creative students (who have tested high in one of the factors indicating creativity) would be less willing to use the e-assessment because they could view this type of assessment as a constraint. Nevertheless, results revealed that the students that are more creative did not have any problems with using the e-assessment.

Keywords: e-assessment, attitude, mathematics, digital technology.

1 INTRODUCTION

Student’s assessment is an important part of effective learning process. [1] Recently it is possible to notice that the role of ICT in assessment rose to the extent that we can speak about e-assessment. [2] The term e-assessment is often used to emphasize novelty and on-line technology utilized in the assessment. E-assessment can be defined as a process where information and communication technology is used for the management of the end-to-end assessment process. In other words, e-assessment deals with methods, processes and web-based software tools (or systems) which allow systematic inferences and judgments to be made about the student’s skills, knowledge, and capabilities. [3]

Summative assessment, which is one of the objects of technology usage in education, has had a special place within digitalization of education [4]. Assessment procedures are being adapted to new learning environments by moving from isolated summative assessments to more integrated assessment forms, illustrated in some studies, for example in [5], [6], [7].

The recent increasing number of reports of online forms of course-based assessment is not surprising, given the potential benefits of this approach. These benefits include (compared with traditional pen and paper modes of delivery) cost and time savings because of automated delivery, scoring and
storing of responses; scope for providing tailored and/or immediate feedback, which may have pedagogical benefits; enhanced levels of student engagement because of the relative novelty and appeal of the approach; enhanced flexibility, for example in allowing students to be able to submit an assessment or assignment remotely without coming into college; and enhanced validity because of automation of the marking process that can reduce scope for human error [8]. However, studies that have attempted to measure attitudes towards and perceptions of online assessment methods do exist, e.g. authors in [9] proposed a model, predicting user intentional behavior towards e-assessment. However, there is also a clear need for further studies investigating students’ attitudes, perceptions and preferences in relation to online assessment methods, because the evidence that exists to date remains largely inconclusive.

Numerous research studies have shown that the use of instructional technologies helps to improve the teaching and learning processes of mathematics. [1] Assessment in math courses is fundamental to the whole educational process, as pointed out by Webb [10]. Therefore, there has been an extensive effort in the recent years to identify methods and possibilities of the instructional technologies implementation to support assessment as an integral part of the learning process (e.g. [7, 11-14]). Extended use of technology caused frequent usage of tests for assessment, as well.[15] The problem with the use of e-assessment in mathematics is the use of tests to verify students’ ability to solve mathematical problems because they are focused on procedural knowledge. As Sangwin and Jones declared in [16], in mathematics, assessments typically attempt to measure one or both the procedural knowledge and the conceptual understanding. The reasons for emphasizing procedural items when appraising the assessment of mathematics is that they are relatively easy to produce and can be scored objectively [17].

The teaching of mathematics in engineering studies has been worldwide reported as problematic due to the low level of student retention rate, e.g. [18] or [19]. To improve retention rate and to support and enhance students’ math skills development at the universities, we have designed a new teaching model. [20] The new design puts emphasis on continual learning, activity, independence, and creativity [21] and contains education and assessment blocks and a database of tasks that require the application of knowledge. The assessment, which is a part of the new teaching model, was substantially redesigned and adapted to the use of technology. Since students were not accustomed to such form of assessment in mathematics, we did research of accepting of e-assessment by students.

2 METHODOLOGY

The research had two principal aims. The first objective of the research was to find whether there is a correlation between the studied variables and attitudes of students towards the Mathematics I course. The studied variables, further in the paper named as factors, were: a type of the study program, gender, and a type of secondary school completed. The attitudes of students towards the mathematics were identified through students’ engagement in the course, and the students’ opinions on applicability and the difficulty of the mathematics.

Another aim of the research was to determine whether the studied factors or their combination (a type of the study program, gender, type of secondary school completed) and the ability to produce ideas (fluency) do have an influence on students' perceptions of e-assessment.

We have defined the following research questions by the above-stated objectives:

- Is there a statistically significant difference in the attitudes to Mathematics I of students who have completed various types of secondary schools?
- Is there a statistically significant difference in attitudes between men and women to Mathematics I?
- Is there a statistically significant difference in the attitudes to Mathematics I of students studying different study programs?
- Is there a statistically significant difference in the attitudes of students who study different study programs on e-assessment?
- Is there a statistically significant difference in attitudes between men and women towards e-assessment?
• Is there a statistically significant difference in the attitudes of students who have completed various types of secondary schools to e-assessment?
• Is there a statistically significant difference in the attitudes of students who have different ability to produce ideas on e-assessment?
• Is there a statistically significant difference in students' attitudes towards e-assessment, caused by a combination of several factors?

The research was conducted via questionnaire built according to the semantic differential. The attitudes were measured using several five-degree Likert scales. The Likert scales consisted of two adjectives or verbs. The lowest value (1) corresponded to an adjective or verb expressing a negative attitude, and the positive attitude corresponded to the value of 5 on the 5-degree Likert scale.

Based on the completed questionnaire, we created a semantic profile of the Mathematics I subject regarding engagement, applicability, difficulty, and e-assessment acceptance factors. The students' engagement in Mathematics is expressed by the fact how often students attended lectures and actively studied. The applicability of Mathematics I expresses the students' view of the use of the knowledge gained on the subject in a further study and practice. The difficulty of the Mathematics I course is expressed by the students' view of the difficulty of the academic subject. Acceptance of e-assessment is expressed as a value of 5 when students do not have a problem use the e-assessment and value 1 when students have difficulties to use e-assessment. We measured the ability to produce ideas (fluency) by applying a simple graphical task: to complete a graphic shape to create different objects. We have recorded the number of objects created by the students as the value of fluency.

### Table 1. Descriptive statistic of respondents group.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Level of Factor</th>
<th>N</th>
<th>engagement Mean</th>
<th>applicability Mean</th>
<th>difficulty Mean</th>
<th>fluency (creativity) Mean</th>
<th>e-assessment acceptance Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>276</td>
<td>4.684783</td>
<td>4.028986</td>
<td>4.061594</td>
<td>5.829710</td>
<td>4.307971</td>
</tr>
<tr>
<td>type of secondary school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>type of secondary school G</td>
<td></td>
<td>95</td>
<td>4.663158</td>
<td>4.315789</td>
<td>3.578947</td>
<td>5.800000</td>
<td>4.347368</td>
</tr>
<tr>
<td>type of secondary school SOS</td>
<td></td>
<td>181</td>
<td>4.696133</td>
<td>3.878453</td>
<td>4.314917</td>
<td>5.845304</td>
<td>4.287293</td>
</tr>
<tr>
<td>study program</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>study program AIA</td>
<td></td>
<td>63</td>
<td>4.793651</td>
<td>4.222222</td>
<td>3.682540</td>
<td>5.761905</td>
<td>4.365079</td>
</tr>
<tr>
<td>study program BOZ</td>
<td></td>
<td>27</td>
<td>4.814815</td>
<td>4.148148</td>
<td>3.703704</td>
<td>6.148148</td>
<td>4.703704</td>
</tr>
<tr>
<td>study program KPR</td>
<td></td>
<td>26</td>
<td>4.230769</td>
<td>4.269231</td>
<td>4.346154</td>
<td>5.038462</td>
<td>4.230769</td>
</tr>
<tr>
<td>study program MI</td>
<td></td>
<td>12</td>
<td>5.000000</td>
<td>4.416667</td>
<td>3.416667</td>
<td>5.416667</td>
<td>4.500000</td>
</tr>
<tr>
<td>study program PMA</td>
<td></td>
<td>43</td>
<td>4.441860</td>
<td>3.837209</td>
<td>4.511626</td>
<td>6.395349</td>
<td>4.093023</td>
</tr>
<tr>
<td>study program PPP</td>
<td></td>
<td>41</td>
<td>4.609756</td>
<td>3.658537</td>
<td>4.560976</td>
<td>6.170732</td>
<td>4.512195</td>
</tr>
<tr>
<td>study program PPT</td>
<td></td>
<td>29</td>
<td>4.827586</td>
<td>3.758621</td>
<td>4.206897</td>
<td>5.310345</td>
<td>4.034843</td>
</tr>
<tr>
<td>study program VTE</td>
<td></td>
<td>22</td>
<td>5.000000</td>
<td>4.227273</td>
<td>3.636364</td>
<td>5.990991</td>
<td>4.000000</td>
</tr>
<tr>
<td>study program VZS</td>
<td></td>
<td>13</td>
<td>4.692308</td>
<td>4.076923</td>
<td>4.400000</td>
<td>5.380462</td>
<td>4.384615</td>
</tr>
<tr>
<td>gender Z</td>
<td></td>
<td>86</td>
<td>4.674419</td>
<td>4.000000</td>
<td>4.383721</td>
<td>5.988372</td>
<td>4.313953</td>
</tr>
<tr>
<td>gender M</td>
<td></td>
<td>190</td>
<td>4.689474</td>
<td>4.042105</td>
<td>3.915789</td>
<td>5.757895</td>
<td>4.305263</td>
</tr>
</tbody>
</table>

The group of respondents consisted of 463 first year students of nine bachelor's full-time study programs at the MTF STU in academic year 2014/15. An anonymous questionnaire was distributed to students at the end of the semester when students have already had personal experience with the e-assessment. The return rate of the questionnaire was 59.6 %, it is 276 students.

ANOVA, T-test and linear models were used for the testing of hypotheses following from research questions.

### 3 RESULTS AND DISCUSSION

#### 3.1 Attitudes of students towards the Mathematics I course

##### 3.1.1 Results for the whole group

The overall results have shown that students consider Mathematics I to be a difficult one (M=4.061594), but with good applicability (M=4.028986) in further study and practice. The difficulty is
obviously the reason why they are very much involved in the study of Mathematics I (engagement \( M = 4.684783 \)). The average values of all three components of student attitudes to Mathematics I are higher than four on the Likert scale, which represents a positive attitude towards the topic (value three accounts for a neutral attitude and value five a highly positive attitude). Student engagement value is almost 5, meaning that students are aware of the importance of Mathematics I for further study and practice and therefore regularly attend lectures and actively study with the support of on-line materials. On the other hand, it is likely that the questionnaire was filled mainly by students actively involved in the study of Mathematics I. The return rate of the questionnaire (59.6%) corresponds to the retention rate in the Mathematics I subject in the long term (see i.e. [22]). This fact entitles us to the assumption that, in addition to personality prerequisites for studying, Mathematics I also requires to have a personal engagement.

3.1.2 Results for the different factors

The obtained results indicate that the type of the completed secondary school, gender, and the kind of the study program all have a significant impact on the perception of the difficulty of the Mathematics I course.

The results confirmed the statistically significant difference in the perceived Mathematics I difficulty (difficulty, \( p < 0.000005 \)) and applicability of the knowledge from Mathematics in further study and practice (applicability, \( p = 0.00046 \)) depending on the type of secondary school that the students have finished (see Tab. 2). Students - grammar school graduates perceived the difficulty factor of Mathematics with an average value of 3.5789 and students - SOŠ graduates on average of 4.3149. The result confirmed our assumption that students, who are graduates of the SOŠ, will perceive Mathematics as a challenging subject. It results from the fact that mathematics has a much lower teaching hours count at SOŠ than at grammar schools and therefore SOŠ graduates come to a university with a lower level of knowledge. Students - graduates of grammar schools, compared to students - graduates of the SOŠ have assigned a factor of Mathematics I difficulty lower value, but they also perceive the subject of mathematics not as an easy but demanding subject.

### Table 2. T-tests results for type of secondary school factor.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1: G Mean</th>
<th>Group 2: SOŠ Mean</th>
<th>t-value</th>
<th>df</th>
<th>p</th>
<th>Valid N G</th>
<th>Valid N SOŠ</th>
<th>Std.Dev. G</th>
<th>Std.Dev. SOŠ</th>
<th>F-ratio</th>
<th>Variance G</th>
<th>Variance SOŠ</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>engagement</td>
<td>4.6632</td>
<td>4.6961</td>
<td>-0.3541</td>
<td>274</td>
<td>0.733272</td>
<td>95</td>
<td>181</td>
<td>0.7937</td>
<td>0.7464</td>
<td>1.1358</td>
<td>0.481020</td>
<td>0.000462</td>
<td>0.813145</td>
</tr>
<tr>
<td>applicability</td>
<td>4.3158</td>
<td>3.8785</td>
<td>-3.5447</td>
<td>274</td>
<td>0.000462</td>
<td>95</td>
<td>181</td>
<td>0.9140</td>
<td>1.0037</td>
<td>1.2059</td>
<td>0.313348</td>
<td>0.000462</td>
<td>0.813145</td>
</tr>
<tr>
<td>difficulty</td>
<td>3.5789</td>
<td>4.3149</td>
<td>-6.4799</td>
<td>274</td>
<td>0.000000</td>
<td>95</td>
<td>181</td>
<td>1.0677</td>
<td>0.7925</td>
<td>1.8151</td>
<td>0.000462</td>
<td>0.000462</td>
<td>0.813145</td>
</tr>
<tr>
<td>fluency (creativity)</td>
<td>5.8000</td>
<td>5.8453</td>
<td>-0.1240</td>
<td>274</td>
<td>0.901369</td>
<td>95</td>
<td>181</td>
<td>3.1844</td>
<td>2.7118</td>
<td>1.3790</td>
<td>0.067951</td>
<td>0.000462</td>
<td>0.813145</td>
</tr>
<tr>
<td>e-assessment acceptance</td>
<td>4.3474</td>
<td>4.2873</td>
<td>0.4719</td>
<td>274</td>
<td>0.637338</td>
<td>95</td>
<td>181</td>
<td>0.9975</td>
<td>1.0085</td>
<td>1.0202</td>
<td>0.918822</td>
<td>0.000462</td>
<td>0.813145</td>
</tr>
</tbody>
</table>

Furthermore, research results showed that the kind of the completed secondary school has an influence on the students’ opinions about the applicability of maths (see Table 2). Regarding applicability of mathematics in further study and applicability, students - grammar school graduates assigned a value of 4.31578 to the 5th-degree scale and students - graduates of the SOŠ value of 3.87845. Value 1 expressed the view that the knowledge of mathematics the student does not use in the next study and practice and value five the opposite view. Students of both groups recognize the importance of mathematics knowledge in further university study and practice. The Higher value was attributed to students - graduates of grammar schools. One of the possible causes may be their better overview of mathematics acquired at secondary school.

The gender factor significantly influences the students’ view of the difficulty of the Mathematics I subject. Men consider the subject Mathematics I as a lighter subject (\( M = 3.9158 \)) in the comparison to the women (\( M = 4.3837 \)) (see Table 3).

The study program factor is not directly related to the personality or student experience. Because the questionnaire was filled by students studying at university for less than three months, the effect of the university’s environment on students could not be fully reflected. Therefore, the influence of the study program factor illustrates more the relationship between the interest of students in the same type of study and their personal characteristics and experience than the impact of the kind of study itself.
Table 3. T-tests results for gender factor.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Z</th>
<th>Mean M</th>
<th>t-value</th>
<th>df</th>
<th>p</th>
<th>Valid N Z</th>
<th>Valid N M</th>
<th>Std.Dev. Z</th>
<th>Std.Dev. M</th>
<th>F-ratio Variances</th>
</tr>
</thead>
<tbody>
<tr>
<td>engagement</td>
<td>4.6744</td>
<td>4.6895</td>
<td>-0.151</td>
<td>27</td>
<td>0.879458</td>
<td>86</td>
<td>190</td>
<td>0.7584</td>
<td>0.7652</td>
<td>1.0183</td>
</tr>
<tr>
<td>applicability</td>
<td>4.0000</td>
<td>4.0421</td>
<td>-0.3254</td>
<td>27</td>
<td>0.745155</td>
<td>86</td>
<td>190</td>
<td>0.9075</td>
<td>1.0330</td>
<td>1.2956</td>
</tr>
<tr>
<td>difficulty</td>
<td>3.8337</td>
<td>3.9158</td>
<td>3.8391</td>
<td>27</td>
<td>0.000153</td>
<td>86</td>
<td>190</td>
<td>0.7541</td>
<td>1.0096</td>
<td>1.7925</td>
</tr>
<tr>
<td>fluency (creativity)</td>
<td>5.9884</td>
<td>5.7579</td>
<td>0.6156</td>
<td>27</td>
<td>0.538674</td>
<td>86</td>
<td>190</td>
<td>2.8553</td>
<td>2.8921</td>
<td>1.0259</td>
</tr>
<tr>
<td>e-assessment acceptance</td>
<td>4.3140</td>
<td>4.3053</td>
<td>0.0665</td>
<td>27</td>
<td>0.947008</td>
<td>86</td>
<td>190</td>
<td>0.9237</td>
<td>1.0397</td>
<td>1.2669</td>
</tr>
</tbody>
</table>

The study program factor has a significant impact on engagement (p=0.000727) and difficulty (p=0.000728). Although gender and type of secondary school factors have no significant impact on engagement, the division of students into study programs has led to a change in engagement with mathematics. This fact justifies us believing that the interest in a certain type of study is linked to the personality characteristics of the students, especially the interest in learning and responsibility for their learning outcomes within Mathematics I course.

The combination of the study program type and gender factors also has a significant impact (p=0.046963) on the engagement of students in the Mathematics I course (see Fig. 2). However, the combination of these factors was not found to have an influence on the applicability (p=0.256861) and difficulty the Mathematics I (p=0.905240). Other combinations of factors did not have a significant effect on student attitudes towards Mathematics I.
3.2 Attitudes of students towards the e-assessment

The obtained results clearly confirmed that students' attitude towards e-assessment is positive ($M = 4.307971$) and such a method of assessment in Mathematics I does not cause problems to students. Only 9.42% (26 out of 276) of students expressed a negative attitude, and only 13 students have a neutral attitude towards e-assessment (see Table 4).

Additionally, the results have shown that the attitudes towards e-assessment are not influenced by either of the studied factors or by the combination of these factors. This fact surprised us as we expected the acceptance of e-assessment to be affected by the examined factors. The possible reason for such a result is the continuous growth of digital literacy of students and the practical experience with the use of digital technologies to the extent that the gender differences among students, in contrast to the past, have not been realized.

We presumed that creative students (who have scored high in one of the factors indicating creativity) would be less willing to use the e-assessment because they could view this type of assessment as a constraint. Nevertheless, results revealed that also the students that are more creative did not have any problems with using the e-assessment. To be sure, we also performed a correlation analysis, the results of which showed a nearly zero correlation between creativity measured by fluency and acceptance of e-assessment. The results of the analysis are presented in Table 5.
Table 5. Correlation matrix of fluency and e-assessment acceptance.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Means</th>
<th>Std.Dev.</th>
<th>fluency (creativity)</th>
<th>e-assessment acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>fluency (creativity)</td>
<td>5.829710</td>
<td>2.877497</td>
<td>1.000000</td>
<td>-0.033410</td>
</tr>
<tr>
<td>e-assessment acceptance</td>
<td>4.307971</td>
<td>1.003308</td>
<td>-0.033410</td>
<td>1.000000</td>
</tr>
</tbody>
</table>

The graphs of the perception of e-assessment by the students of the different study programs are presented in Fig. 3.

4 CONCLUSIONS

Presented research has revealed two significant findings for us:

- Although there is a different perception of the applicability and difficulty of Mathematics I, depending on gender, type of secondary school or study program, the whole sample of students perceives Mathematics I as a difficult course and recognizes its importance for subsequent university study and practice.

- Students largely accept knowledge and skills assessment through e-assessment in Mathematics I. Neither gender, type of school, type of study program, nor students’ creativity measured by fluency does not influence acceptance of e-assessment.

Research has confirmed that the form of knowledge verification through digital technologies does not make any problems to our students. However, technology-enhanced assessment significantly improves and objectifies assessment process. [23] The knowledge gained is entirely valid for the environment in which they were acquired. In order to verify their wider validity, it would be necessary to carry out similar research in the environments of other universities. However, it can be assumed that students of technical study programs will have a similar degree of e-assessment acceptance, regardless of the type of secondary school and gender.
The obtained results, as discussed in this paper, have been utilized for an adaptation of a teaching model that is extensively employing digital technology.

REFERENCES


