Summary

Published by
Finnish Education Evaluation Centre (FINEEC)

Name of Publication
Oppia ikä kaikki – Matemaattinen osaaminen toisen asteen koulutuksen lopussa 2015

Author
Jari Metsämuuronen

The report assesses the level of mathematical competence and the factors connected to it at the end of upper secondary education in secondary schools and vocational education. The materials used represent the fourth set of materials that have been gathered from the same students; the mathematical competence of the students has been monitored at the transitional phases of their primary education after the 2nd grade in 2005, after the 5th grade in 2008 and at the end of the 9th grade in 2012, as well as at the end of their vocational and secondary school education in 2015.

The final target group included 3,912 students, of which 2,051 answered the test and the related background survey – of these, 1,310 were from upper secondary schools (high school/grammar school) and 741 from vocational institutions. Of these potential respondents, 1,861 (48%) did not want to participate in the data collecting despite being offered to do so on numerous occasions. Of the students, 3,773 could also provide their results from the 9th grade and 1,004 students their matriculation examination information. The students who participated were on average somewhat more motivated and advanced in their mathematical competence than those who did not participate. As such, when we describe the results that were provided by the end of the upper secondary education, please note that these results provide a slightly overly positive picture of the competence level in high schools and vocational education. However, these materials include a fairly comprehensive number of students representing all levels of competence at the end stage of their upper secondary education from the different parts, municipality types and language groups of the country.

Two versions of the competence test were developed: one for high schools and one for vocational education. Both versions of the tests were based on the test that the students completed in the 9th grade. 78 per cent of the tasks were taken directly from that test – part of the tasks were from the 6th grade test and part from the 3rd grade test. The vocational education version included two tasks from the 1998 test for mathematics in vocational education and one problem-solving task related to a practical situation from an old matriculation examination. The secondary school test included two tasks from the matriculation examination of the basics mathematics syllabus and

two from the matriculation examination of the advanced mathematics syllabus. In addition to completing the tasks, the students answered a background survey. Information on the number of completed courses and the competence of those students that did not participate in the data collection were gathered from school and institution registers. Matriculation examination grading information was also utilised as additional material.

When evaluated as a whole, there is a clear increase in mathematic competence during the upper secondary education. A large part of this increase can be explained by the effect of the advanced syllabus courses in mathematics in high schools. There is a clear difference in competence between the basic and advanced syllabus mathematics in high school as well as between high schools and vocational education. Even though the differences between the educational forms are already great at the beginning of the upper secondary education due to selection, they grow as studies progress.

From the point of view of longitudinal materials, it is apparent that the differentiation in mathematical proficiency happens during the early school years, but this differentiation is especially apparent when arriving in the upper classes of basic education in the 9th grade and continuing from there on out until the end of the upper secondary level. The mathematical competence level of those vocational education students and secondary school students that only completed the minimum number of courses remained at the level that they achieved during the 9th grade.

Men are markedly more successful in mathematics than women by the end of the upper secondary education. The competence of women in secondary schools trails men by approximately one year, and by two years in vocational education. By the end of the upper secondary education, 27 per cent of the most mathematically proficient students are women and 73 per cent are men. In every proficiency level group, female students felt markedly more negative emotions on a larger scale during their studies and, except for the very best students, their self-efficacy was lower than that of male students'.

Different language groups provide the chance of achieving an equal mathematical competence level. Swedish-speaking students rose to the level of Finnish-speaking students from clearly weaker starting points and achieved the level of Finnish-speakers by the beginning of the 6th grade, after which there were no differences between any of the groups that were studied. The change has been especially major in the non-urban areas of the former province of Southern Finland.

The differences between secondary school students can largely be explained by the number of mathematics courses chosen during secondary school and the grades received: with the minimum number of courses, the 9th grade competence level in mathematics can barely be maintained, but for those students that completed over 13 courses and received at least a mark 8 (good), there is a clear rise in their competence level – 84 PISA scale units on average. In secondary schools, it is obvious that the competence required for a good grade is very different for basic and advanced syllabus courses. The competence of those students that complete the minimum number of basic syllabus courses (6 courses) and receive a mark 10 (the highest possible) is equivalent to the competence of those students that complete the advanced syllabus (12 courses or more) with a mark 6–7 (lower than "good"). The competence of those students that complete more than the

minimum number of basic syllabus courses (7–11 courses) and receive a mark 10 is equivalent to the competence of those students that complete the advanced syllabus (12 courses or more) with a mark 8.

Vocational education offers the chance of achieving a competence level that is equivalent to an adequate, basic mathematics syllabus competence level. When the students are active, their level does not deviate from the average level of competence produced by the advanced syllabus in mathematics in secondary schools. Therefore, a vocational education does not prohibit those interested in mathematics from developing themselves and achieving a very high level of mathematical competence without a double degree, but this requires personal interest in the matter, as this level is not reached by just following the basic requirements of a vocational education degree. The number of students in vocational education who reach a good level, or especially an excellent level, is very small.

There is a clear connection between having parents with a secondary school education and a better result in mathematics by the end of the upper secondary level in both secondary schools and vocational education. If both parents have completed their matriculation examination – independent of the compositions of their matriculation examination tests or the points received – this adds around a 1.5–2 year study advantage for overall competence in both secondary schools and vocational institutions when compared to those students whose parents are not secondary school graduates. The benefit of a matriculation examination does not seem to increase in secondary school education: the difference between secondary school graduate parents and non-secondary school graduate parents is formed during the lower grades and remains the same throughout the school years in both secondary schools and vocational education.

When assessing the pedagogical solutions of teachers, the key factor for explaining competence in both vocational and secondary school education is how often the students feel that the matters studied became clear to them. It is unclear whether the lack of competence in students is the result of the matters not become clear to them or if the matters do not become clear to them since their level of competence is lower than others'. It seems likely that, in the best student groups, the best results are achieved in the groups where the teachers combine a meaningful differentiation between competence levels and assess the results' meaningfulness. However, the change in competence cannot really be explained with factors related to the pedagogical solutions of the teachers. The majority of the changes in competence during the upper secondary level can seemingly be explained with other factors.

In vocational education, the variation in student competence levels with different educational organisers is so great that the organiser's actions do not explain their competence at all, with their effect being around 0.5–1 per cent. In high schools, the school's role in both competence and in the change in competence is 8–9 percent, which is at a similar level as in basic education. The size of the school/organiser does not explain the variance in competence.

The given school marks (4–10) in schools with the best and weakest results do not match. Those schools that receive the best results clearly require more competence for the student's final marks than those schools that receive the weakest results. This phenomenon is especially apparent in

high schools, but it can also be noticed in vocational education as well. The differences between the different mark groups are very significant, around three grades worth: a mark 6 from a high school with a high performance seems to correspond to a mark 9 from a high school with low performance. The difference is apparent and leads to a clear imbalance when students apply for further education, assuming that the secondary school certificate is used as part of the application process.