

Matriculation Examination in Finland; Electrification experiment with ViLLE

Markus Kitola
University of Turku
Turku
Finland
+358 41 502 3996
makito@utu.fi

Einari Kurvinen
University of Turku
Turku
Finland
emakur@utu.fi

Erkki Kaila
University of Turku
Turku
Finland
ertaka@utu.fi

Teemu Rajala
University of Turku
Turku
Finland
temira@utu.fi

Mikko-Jussi
Laakso
University of Turku
Turku
Finland
milaak@utu.fi

ABSTRACT

According to the Finnish Matriculation Examination board, students who start upper secondary school in the autumn of the 2013 are going to write some of the subjects electronically. The first electrical Matriculation Examination will be arranged in 2016 but only with three subjects; Germany (extended and short), geography and philosophy. The rest of the subjects are going to be electrified in three-year transition period.

The first experimentation of electrical Matriculation Examination in Finnish history was organized in upper secondary school of Mynämäki early this year. Each candidate had an opportunity to choose whether they wanted to participate in electrical or traditional exam of English language. Both the electrical and traditional exam had identical content.

Matriculation Examination of English was converted to electrical version in ViLLE learning environment making use of the benefits of e-exam, e.g. automatic assessment and easiness of typing answers. Immediately after experimentation the candidates were asked opinions about the electrical Matriculation Examination and e-exams generally. Those opinions were the main research aspect in this journal in addition to consumption of time (compared to traditional versions).

As the final result we will find out that students are ready for e-Exams including course-exams and Matriculation Examination. However it is an entirely different matter when the teachers and the society will be prepared well enough.

Categories and Subject Descriptors

K.3.1 [Computers and education]: Computer Uses in Education – Collaborative learning.

General Terms

Design, Reliability, Experimentation, Security, Human Factors.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

Conference '10, Month 1–2, 2010, City, State, Country.
Copyright 2010 ACM 1-58113-000-0/00/0010 ...\$15.00.

Keywords

Matriculation Examination, E-assessment, Automatic assessment, eExam, Immediate Feedback, Education

1. INTRODUCTION

Electronic exams are quickly making their way to different levels of Finnish education system. Curriculum reform is in action and should be completed by the autumn of 2016. No one has yet all the answers but hopefully our experiment about the electric Matriculation Examination with ViLLE [16] gave more answers than created new questions. At least it showed us that students are completely ready for new innovations and the problems are located in other parts of education system.

Electronic exams are strongly related to automatic assessment and immediate feedback both of which have been widely studied in last few years. Most of the researchers have noticed that the major part of students prefer the electrical version over the traditional one. The main reasons for this have been assumed to be the flexibility regarding the time and the place, as well as the possibility to get the results faster. [2][17][14][3]

Also some contradictory results have been found.[4] Usually technical problems or poor user experiences are behind those results. According to the last few experimentations related to ViLLE learning environment, the first impression about the electronic exam system is one of the most important single aspects when teachers decide whether to continue with e-exams or not.

The main aspect of this paper is to find out what are the attitudes of students regarding this electrification process and research the effects of time management point of view. We also try to answer the question of what kind of project electrification of the Matriculation Examination is going to be and find all the important things that need to be done for avoiding the biggest pitfalls.

This paper has the following structure: in the next session related works about main components needed in electric Matriculation Examination are considered shortly. In third section the Finnish system of education and the Matriculation Examination is presented more specifically. Fourth section is dedicated to ViLLE learning environment and its potentialities to operate as an electronic exam system. The research design and results are presented in fifth and sixth sections. These are followed by a section in which the results are discussed and, finally, conclusions and the future works are presented.

2. Related work

Even though Matriculation Examination is studied widely from various points of views, this electrification process isn't old enough to have existing related works. Instead main components (electronic exams, automatic assessment, immediate feedback, electronic assessment) have been studied extensively all over the world. In the following paragraphs terms are presented shortly with a few aspects that other researchers have noticed.

2.1 Electronic Assessment (e-assessment)

Students are currently assessed for a variety of reasons. It has a great significance to identify students' strengths and weakness which at the same time provides an accurate measure of students' performance to enable teachers, administrators, and other key decision makers to make effective decision. [11] The biggest challenge is that traditional assessment is often done summative at the end of the course. Because of the continuous assessment (formative) requires e-assessment or huge resources, its benefits are then disabled and possible problems with learning are often recognized too late.

The concept of e-assessment is very large and it can be defined [4] as an end-to-end electronic assessment process where ICT is used for the presentation of assessments and the recording of responses.

The main benefits of e-assessment are among others, the possibility to give instant feedback, objectivity of grading, scalability, time and place independency, and students' possibility to modify answer easier. [2]

2.2 Automatic assessment

The difference between e-assessment and automatic assessment is that e-assessment includes everything that utilizes ICT while automatic assessment is something what computer is able to do independently. Automatic assessment is needed for taking full advantage of continuous assessment and immediate feedback.

As challenges can be listed e-assessment systems which often provides very limited range of interaction, answers should be based on list of correct answers and deeper understanding is harder to test. [3]

2.3 Electronic exam (eExam)

Electronic examination is kind of a subclass of electronic assessment. Usually its purpose is to serve summative assessment and make course-evaluation faster. Ayo [1] defined e-examination as "a system that involves the conduct of examinations through the web or the intranet".

Negative side of eExam is that exams still need to be either manually assessed or contain only questions which are easy to assess automatically (such as multiple choice questions or short answer) [7]

On the other hand eExam contains many substantial benefits which are often closely related to e-assessment (presented in chapter 2.1). Some of the benefits might seem to be obvious but as we shall see later on things like typing answers via keyboard or possibility to include question types (for example multimedia use) which are not possible with pen and paper will make a big difference.

2.4 Immediate feedback

Immediate feedback is usually related to automatic assessment but it can also be given statically in dependently depending on students' answers. Usually the latter scenario is combined to a self-evaluation by giving hints or correct answers. The biggest challenge is to provide feasible feedback in larger courses which usually have more or less limited resources [13]

On the other hand immediate feedback can be the key to grow up limited resources by "cloning" teachers to several places at the same time.

3. The Finnish Matriculation Examination

In the Finnish system of education, primary education is comparable to elementary-school education in the United States. The Matriculation Examination, which is compulsory for all upper secondary school students, is performed after the completion of 12 years of schooling and is approximately equivalent to one year of college in the United States. [6] The exams are held each spring and autumn during a two-week examination period. The examination consists of at least four tests but only the candidates' own native language is compulsory. [14]

The Matriculation Examination was first arranged in Finland in 1852 and since then it has gained strong and distinguished position in Finnish culture. In the beginning the examination was more like an entrance examination to the University of Helsinki. The Matriculation Examination has experienced several changes during those years, but the biggest change is coming in year 2016 when a part of the exams will be done electronically. In 2019 the whole Matriculation Examination should be totally electrical. [14]

Naturally the electrification process causes different kinds of problems. The possible problems can be divided into three groups; First group includes problems of insufficient infrastructure, which includes electricity and networking. Each workstation needs at least one electrical outlet and one network cable which means a lot of wires and challenges for sustainability of the electricity system. Also physical security issues are related to this group. Physical devices like an uninterruptible power supply (UPS) for local server, server itself and switches are more like things that needs to be taken care of than actual problems.

Second group is related to students and focus on devices supported on Matriculation Examination. First limitations of hardware solutions are already published and can be read at digabi.fi. The purpose is that students should bring their own devices (byod) which are running Linux based operating system from some external device. This should make cheating utilizing own device in practice impossible.

Third group focuses on software solutions which includes at least operating system when own laptops are used, platform used for answering (by candidate) and some kind of system for assessment process for teachers and the censors of The Matriculation Examination Board. ViLLE is one option for exam environment but a final decision will be made by the end of the year 2013.

A part of those problems can be solved easily and some of them are actually already solved but a lot of work has to be done before everything is ready. For example the supply of electricity is solved

only on newer school buildings and a choice of environment used for answering is one of the most important single solutions.

4. ViLLE – Learning environment

ViLLE (<http://ville.cs.utu.fi>) is a web based collaborative education platform developed at the University of Turku. ViLLE allows teachers to create virtual courses and automatically assessed exercises of different kinds easily. Exercises in ViLLE are designed to support learning especially via automated assessment, immediate feedback and problem visualization. Automated assessment saves teachers time from going through exams and allows giving immediate feedback for students. Immediate feedback is designed to be supportive and informative, so it can enhance learning. Visualization aims to assist in the process of conceptual development. Multiple studies shows encouraging results of the effectiveness of previously mentioned features. Previous studies cover learning programming in upper secondary school and university's freshman year. [8][9][10][16][13] One study has also been conducted in primary school to study learning of math using ViLLE. [12]

ViLLE is an ideal environment for electronic exams, because it's designed to keep track of students' achievements and progress. Also the basic feature of automatic assessment reduces the time spend on grading exams. The same exercises used for learning, can also be used in electronic exams. This means, that electronic exams take advantage of automatic assessment and immediate feedback in all exercise types. An important aspect to notice is, that ViLLE is not limited to be a stand-alone exam platform but a full scale learning environment, hence students are familiar using ViLLE and its various exercise types in exam situations. Besides automatic assessment, ViLLE is also capable of manual grading of assignments, for example essays or open questions.

5. Research Design

For solving the problems were presented on previous chapter we organized the first electrical Matriculation Examination experimentation in Finnish history. The experimentation was implemented by converting a year old Matriculation Exam (English language) to ViLLE learning environment.

Most important limitation (given by teachers) was that access to public network had to be disabled. We were able to guarantee this only with local network which was built on top of the local ViLLE-server. In addition candidates were not allowed to use their own computers.

5.1 Method

Local network was only limitation given from outside but we had to deal with some other security issues too. One thing was to prepare against blackouts (electric) which was taken care with UPS-system to give emergency power to the ViLLE-server. Fully charged backup laptops were ready not only against power failure but also in case of workstation failures. All data was stored on local ViLLE-server which also took an auto save from each candidate once of every three minutes in case if someone had forgotten to save an essay answer for example. Students were also given a traditional paper exam in case of someone would want to read the source material from paper instead of display. Also traditional scrap papers were given but only a few of the candidates used those.

5.2 Participants

The participants were upper secondary school student volunteers from two different upper secondary schools (Upper secondary school of Mynämäki and Upper secondary school of Kerttuli, Turku). Even though participants came from two different upper secondary schools, results were possible to combine in the same stack because of identical exams. Only difference between Mynämäki and Turku was that candidates in Turku were allowed to leave after final submit without a lower time limit. (Time limits are presented later on this paper) A total of 23 candidates participated in the experiment.

5.3 Materials

Exam itself included five kinds of different assignments. First assignment (in two parts) was a reading comprehension that included 25 multiple choice questions and five open questions. Multiple choice questions (part 1.1) used automatic assessment and candidates were able to answer unlimited times. Open questions (part 1.2) had to be assessed manually by teacher.

Second assignment was about grammar and vocabulary and it was also divided into a two part. First part (part 2.1) included 25 multiple choice questions in line with a text and second part (figure 1, part 2.2) consisted of 15 short answer questions. Both parts used automatic assessment.

Third assignment (part 3) was an essay where candidate had to write a composition of between 150 and 200 words about one of a four specific topic. This assignment was assessed manually but ViLLE was able to count the words on behalf of the candidates.

In each assignment candidates were able to see their old submitted answers and change those unlimited times.

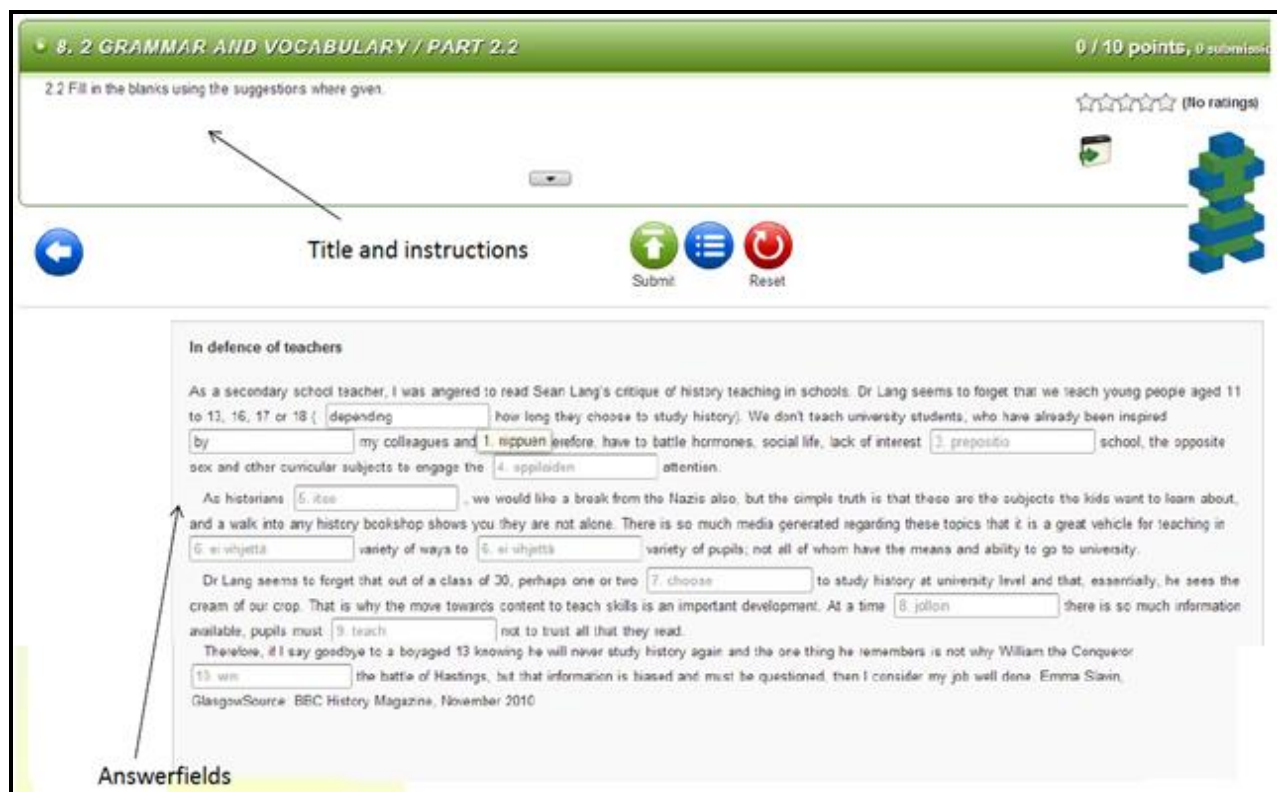


Figure 1. Part 2.2 - Fill in exercise in experimental Matriculation Examination

5.4 Procedure

The experimentation of electric Matriculation Examination was performed such way that it was as identical as possible with actual Matriculation Examination. The experimentation was arranged in week five (six weeks before actual Matriculation Examination) on the same day when also the traditional paper exam was done. Both groups had exactly the same Matriculation Examination booklet; only the way of doing it was different.

The experiment ended with answering the feedback form. Some of the candidates also participated with teachers and organizers to a press conference and told their opinions in both official languages.

6. Results

The focus of this study was on Matriculation Examination candidates' opinions and experiences using ViLLE as an e-exam platform rather than the grades achieved. Main reason for this was that the traditional version was in substance the same and we expected no difference between the grades. Other important aspect

was the amount of time candidates spent during the exam compared to traditional pen and paper exam.

6.1 Use of time

In actual Matriculation Examination candidates must use at least three hours before they are allowed to return their papers. Maximum time limit is normally six hours but in some special cases extra time can be admitted. Same time limits (from three to six hours) were used in our experiment but use of time is calculated in such way that candidates were counted ready when their last submit was received. The fastest candidate passed exam with an average grade within just 55 minutes. The slowest candidate used 4 hours and 49 minutes. Average amount of time used was 2 hours and 27 minutes suggesting that the traditional time limits were somewhat oversized.

We would have wanted to compare those times with the times that the candidates spent in actual Matriculation examination but so far we have failed to receive that data.

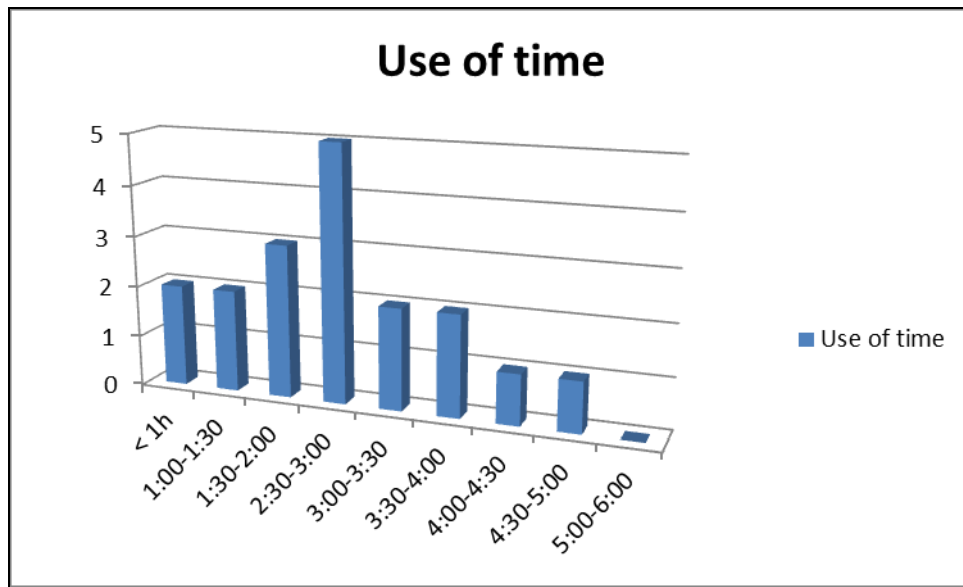


Figure 2. Time usage in Experiment of electrical Matriculation Examination

6.2 Opinions of the candidates

Candidates were asked three questions after they had submitted their final answers. First question “I think available time was..” was about the time consumption. We had (previous subchapter) all the data about their time consumption, but we wanted to ask this in case of some of them would have needed full time before submit.

Free translation of the second question was “If I had to choose, I would like to make the actual Matriculation Examination of the English language with ViLLE”. The third question “Making this experimentation with Ville was overall a successful trial” was in a bit more general form which supposed to give us some kind of an overall rating about this experiment.

Table 1. Students’ feedback in experimental Matriculation Examination (freely translated).

Students' feedback		1	2	3	4	5		avg
n=23								
I think available time was..	Too short	0	0	6	12	5	Too long	3,96
If I had to choose, I would like to make the English language the actual matriculation examination with ViLLE	Strongly disagree	0	0	4	6	13	Strongly agree	4,39
Making this experimentation with Ville was overall a successful trial	Strongly disagree	0	0	0	1	22	Strongly agree	4,96

As we can see from the table above, the candidates are fully ready for electrical Matriculation Examination. 19 of 23 candidates were ready to do actual Matriculation Examination with ViLLE right away in the same spring and the rest four candidates had no opinion. At the latest the last question about the successfulness of this experimentation proved that we are on the right track.

In the end of the feedback form we asked (with open questions) development proposals and subjects that candidates find suitable for e-exams or electrical Matriculation Examination. With development proposals word was free and comments were asked which unfortunately gave us mainly praises instead of development proposals.

“The successful experiment. I hope the e-exam / Matriculation Examination widespread.”

“Fill In-exercises were much clearer when I saw the outcome of the text as a whole and did not need keeping an eye on two different labels. E-exam was clearer compared to paper version. In Essay did not have to use scrap paper as thoughts can be written to the text field and dissect to wholeness. Nothing negative to say..”

Other open question “I think that e-exam / electrical Matriculation Examination would be the best in following subjects.” indicated that candidates reacted seriously and had really thought about those things because almost everyone told that they find mathematical subjects very challenging but respectively they were ready to do actual Matriculation Examination with computer right away in languages and general studies.

“In any subject area. Mathematical subjects can be a little tricky to implement, because they often have to draw a different set designs and patterns, etc.”

“ All subjects except mathematics, physics, chemistry, etc others where numbers and formulas are needed”

According to a few candidates mathematical subjects were probably considered more challenging because of a low amount of experiences of systems which are able to provide help with those subjects.

7. Discussion

As already mentioned this paper focuses on time usage and students' opinions. We noticed that time limit from three to six hours in Matriculation Examination is oversized when the exam is done on a computer. Only five of 23 candidates used more than three hours which is the lower limit of traditional Matriculation Examination. As an example can be mentioned that one student which had been granted extra time in actual Matriculation Examination performed in little more than two hours in our experimental Matriculation Examination. Of course, we have to remember that candidates will probably work more carefully in an actual situation, but also in this experiment the exam grade affected the final course grade. On this experiment the largest time savings came from essay question. More thorough research needs to be conducted to draw profound conclusions on time usage.

Besides time efficiency, ease of answering was another advantage of e-exam arises from open questions. In traditional Matriculation Examination in languages' reading comprehension questionnaires students have to follow three separate sheets: an optical answer sheet, the actual material and the answer options. Answer options and material are on the same notebook but options are usually located in very inconvenient location considering proficient answering. ViLLEs exercises got acknowledgement from students for making it easier to answer questions. Essay writing on a computer is also one of the biggest advantages of e-exams. Drafting, editing and refactoring is a lot easier for students. When essays are written on a computer, teachers won't have to tolerate poor handwriting and grading is more objective than compared to traditional handwriting essays.

Based on the open questions, students seem to be ready for electronic Matriculation Examination. All the feedback was very positive, excluding one comment concerning usability.

“Exercises 2.2. hints were hidden, I could not find them at first. However, the biggest problem was that after

choosing a question to answer I can't close the question without answering it. As a whole, the system is well functioning and I hope that electronic Matriculation Examination will be proceeded.”

The usability issue was fixed immediately after exam. Even after addressing the usability issue, the student was very positive on e-exams.

When asked about the suitability of e-exam in Matriculation Examination, nine of the eighteen students showed hesitation on mathematical subjects (mathematics, chemistry and physics). Writing math on a computer is known to be time consuming and needing to learn a special syntax. We have some ideas how to lower the barrier of writing math on computer for e-exam purposes, even though it still needs further development and research.

The last question was about the success of e-exam. Average of 4,96 sounds very high but it showed that when things are designed well we have great opportunities to success in this electrification process. One might argue that the high average could also be explained by tech-savvy user volunteering on the e-exam, but in the teachers opinion some of the students doing pen and pencil examination would have been “more suitable” for this test. Most of the students wanted to do the authentic Matriculation Examination to practice for the real examination.

8. Conclusions and Future Work

The first experiments on electrical Matriculation Examination showed that we are ready for e-exams. After all everything went as good as possible and this experimental of electrical Matriculation Examination was noted in almost all of the national media including TV, radio and newspapers. We also got some good ideas for the future and for example in this experimental we did not allow students to get immediate feedback after the final submission. Next fall, when the experiment is going to be repeated with candidates' own computers, we are going to enable feedbacks and make some improvements to the exercise types.

Moreover Finnish national assessment of mother tongue will be carried out with ViLLE next spring which requires completely new exercise types and more capacity from ViLLE-server.

9. REFERENCES

- [1] Ayo C. K. & Akinyemi I. O & Adebisi A. A & Ekong U. O. (2007). *The prospects of e-examination implementation in Nigeria. Turkish Online Journal of Distance Education, 125-134.*
- [2] Bernik, I., & Jereb, E. (2006). *Students' Readiness for Electronic Examinations. Proceedings of the 5th WSEAS International Conference on Education and Educational Technology*, (pp. 142-145). Tenerife.
- [3] Cook, J., Jenkins, V (2010). *Getting started with e-assessment. Bath: University of Bath.* Doukas, N., & Andreatos, A. (2007). *Advancing Electronic Assessment. International Journal of Computers, Communications & Control* , 56-65.

- [4] Fluck, A., Pullen, D., & Harper, C. (2009). Case study a computer based examination system. *Australasian Journal of Educational Technology* , 509-523.
- [5] Hairul Barriah Mohsin (2011). *An agent-based approach for supporting assessment in e-learning environments*
- [6] Häkkinen, I., Kirjavainen, T., Uusitalo, R. (2003) *School resources and student achievement revisited: new evidence from panel data*. Economics of Education Review
- [7] Holvitie, J., Haavisto, R., Kaila, E., Rajala, T., Laakso, M.-J. & Salakoski, T. (2012). *Electronic exams with automatically assessed exercises*. Appeared in ICEE 2012 - International Conference on Engineering Education, July 30th - August 3rd, Turku, Finland.
- [8] Kaila, E., Rajala, T., Laakso, M.-J. & Salakoski, T. (2009) *Effects, Experiences and Feedback from Studies of a Program Visualization Tool*. *Informatics in Education* 8 (1). 17-34.
- [9] Kaila, E., Rajala, T., Laakso, M.-J. & Salakoski, T. (2010) *Long-term Effects of Program Visualization*. In 12th Australasian Computing Education Conference (ACE 2010), January 18-22, 2010. Brisbane, Australia.
- [10] Kaila, E., Rajala, T., Laakso, M.-J. & Salakoski, T. (2011) *Important features in program visualization*. Appeared in ICEE: An International Conference on Engineering Education, 21-26 August 2011, Belfast, Northern Ireland, UK.
- [11] Kellough, R.D. & Kellough, N.G. (1999). *Secondary school teaching: A guide to methods and resources; planning for competence*. Upper Saddle River, New Jersey Prentice Hall
- [12] Kurvinen, E., Lindén, R., Rajala, T., Kaila, E., Laakso, M.-J. & Salakoski, T. (2012). *Computer-assisted Learning in Primary School Mathematics Using ViLLE Education Tool*. 12th Koli Calling International Conference on Computing Education Research, November 15th to 18th, 2012, Tahko, Finland.
- [13] Laakso, M.-J. (2010). *Promoting Programming Learning. Engagement, Automatic Assessment with Immediate Feedback in Visualizations*. TUCS Dissertations no 131.
- [14] Lester Gilbert, V. G. (2008). Report on Summative E-Assessment Quality. Southampton: University of Southampton.
- [15] Matriculation Examination Board, <http://www.ylioppilastutkinto.fi/en/index.html>
- [16] Rajala, T., Laakso, M.-J., Kaila, E. and Salakoski, T. (2008) *Effectiveness of Program Visualization: A Case Study with the ViLLE Tool*. *Journal of Information Technology Education: Innovations in Practice* 7. IIP 15-32.
- [17] Osang, F. (2012). *Electronic Examination in Nigeria, Academic Staff Perspective—Case Study: National Open University of Nigeria (NOUN)*. *International Journal of Information and Education Technology*