

ASSESSMENT IN CADETS' TECHNOLOGY COURSE

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Abstract

In many technology related courses in addition to the new content, previously learned knowledge about science and science related supportive tools are simultaneously studied. In the field of applied sciences, the aim is to apply technology applications derived from these scientific methods and models to the operating environment. From the point of view technical disciplines in cadets' education are important but narrow in scope, so there is a need to look for solutions that meet the educational goals of the local community. In this research, it is considered to build a broader assessment, to support learning to be motivating, and also to guide teachers at their work. This empirical research consists of findings from three successive courses in the sensor technology education for cadets. Examination structure is analyzed according to the test scoring and student success. As a conclusion, a course of specific mix of quiz can be recommended. Moreover, the principles of the presented form-based test are transferable to electronic assessment environments.

Keywords: structure of assessment, summative test, technology education.

Introduction

The National Defense University (NDU) is a training institution responsible for educating the future leaders of Finland's armed forces and Border Guard. Due to a clear link to work life, training can emphasize professional aspects and, in particular, the practical skills required in the first job. Nevertheless, the education should take into account academic research and general capacity building for lifelong skill development. Also, efforts have been made to reform the structure of the training for organizational needs or for the external reasons. The latter include the Bologna process or the Karvi audit (Karvi, 2017). This study discusses the teaching and development of specific surveillance and target accusation course. Findings from previous implementations of the course have been discussed earlier (Rissanen, 2010, 2014). This research focuses on students' assessment in three successive courses in years 2014–2016. As a formative assessment, cadets' learning was monitored through colloquial discussions and short exercise assignments related to lectures. In the end of the course a summative test was held for grading.

Evaluation as Part of Teaching

University learning is aimed to a permanent change that can be derived from the student's personal work during the course. In general, the first step is to use assessment tools to collect information on student learning (measurement) and then to evaluate each

student's learning level (assessment) (Snowman, McCown, & Biehler, 2008). In the military context, most of the courses include a number of learning objectives, some of which can be considered as tacit knowledge, which is difficult to measure without real [military] activity and the real threats associated with it. Anderson's and Krathwohl's (2001) taxonomy classifies learning types with verbs, separating lower-level skills (remember, understand) and higher levels (applying, analyzing, evaluating, creating) from each other. The basic level of military technology knowledge is based on the transformation of remembrance into understanding and later on to the ability to apply key information. Technological education defines the process of technology and leads to identify relevant problems for solving.

Over its basic function an exam could also support other educational aspects such as long-term learning, creative thinking, and motivation. In that task it would be fine to provide proof of competence and assessing its level using a real operating environment. However, larger groups of students for whom applied exercises are limited due to resource allocation must be satisfied with traditional tests. A versatile exam structure can motivate and inspire students. In practice, several types of exams are required. Often, the course content controls which types of tests produce the best overall outcome. In practice, the aim is to find a solution that reliably measures learning but is equally easy for an inspector to write reviews and grades for students. The development of evaluation must be seen as part of better education.

Research question 1. What new information did the analysis of the case course provide for the development of the assessment?

Research question 2. How can the results be taken into account in the development of the evaluation?

Research Methodology

The focus of action research is on the influence of action and on the participation and involvement of researchers in the organization's everyday life. Attendance is combined with subject analysis and influencing into practice. Kemmis and McTaggart (2000) emphasized that in reality the process may not be as straightforward as sequential parts of independent design, operation, observation and reflection. The described modules may overlap, and the original plans may become obsolete based on experience and new information. In O'Leary's (2004) model, action research was seen as an experimental learning approach, with goals including refining the needs of the methods, knowledge, and interpretations based on the understanding of previous cycles. In this research three successive cycles were given. Interventions were made to proceed towards a better assessment of learning outcomes.

Research Setting

The exams should measure the student's skills and also support students' learning in the long term, provide the teacher with information on how to continue the course, but also lead to the plans that balance the workload of the teacher. Occasionally, students' and the teacher's perception of the learning goal may differ. For this reason, in the case of large entities, the teacher strives to focus on key areas. Guskey, (2000) has pointed out

that lazy students may complain that the tips of the offered reading list did not match so that it would be easy to complete the whole course, and even with great honors. For this reason, giving straight tips to the test is not entirely meaningful.

A well-prepared assessment reflects the concepts, knowledge and skills that the teacher has emphasized in the classroom, in the textbooks, and in the learning material portal. The selected criteria for assessing student performance must be adapted to reflect the chosen approach. Under such conditions, an exam based on learning would not surprise students. Desired learning goals must be achievable for students and the course evaluation is one of the elements in the process. Instead of “teaching to the test”, one should evaluate what is taught and by what means. A good overall assessment of the situation serves as a meaningful source of information for teachers, helping them identify what they taught well and what they need to do (better) next time. (Guskey, 2003)

Occasionally, the estimate of the development may be a simple summary of how many students did not complete the performance at each assessment point or did not meet the pre-set criteria. When looking at these results, it is necessary to look at the quality of the assessment elements or criterion. Is the question ambiguous or unclear? Did the students misinterpret the question or what was meant to be measured?

Structure of the Final Exam

During the study the summative test consisted of 5 elements with light variation in amount and theme. The elements were:

- Explain concept, meaning and application which can be expressed in no more than five sentences, picked up from the content and lessons.
- Short answer. (This was wider than just explain concept, e.g. compare two items).
- Claim or statement (True / false).
- Task partition: Explain on the basis of the image.
- Task part: -essay or calculation task.

Yearly the exam was repeated at least twice based on each year’s lecturing material. For clarity reasons major part of the tasks were repeated year after year. Even though theme was not changed, light modifications were done e.g. for clarity reasons. As an example, two clear images types were utilized in the explain image section. The first one was the diagram of the Planck model of black body radiant heat as a function of source temperature. Usually the image contained four curves in the logarithmic scale. Identifying the image and naming the items using the Wien’s displacement law was enough for an accepted solution. The model answer included extra points for additional information. The other commonly asked image type showed atmospheric attenuation from UV radiation up to 15 μm . The aim here was to remember this very often repeated concept and to verify scale for visible light in the spectrum and also the so-called atmospheric windows. Both tasks required some insight, but the tips students could utilize were provided as correct information within the exam leaflet’s other parts. On the other hand, a broader essay task without quantitative delineation produced a lot of text and thus it was a burden to the teacher. Therefore, lot of preset structural order requirements and guidance were set to normalize answers. The alternative calculation was simple to grade but turned out less popular among students.

Research Results

The course and the examination were considered difficult. According to some students, it did not test every major theme from the course description. To analyze interventions, the student success in each section of the exam was listed and there after compared in three successive lecturing years. The listed details needed additional analysis from the instructors' observations and students' evaluation of teaching (SET).

Table 1 shows the six sections of the final exam in the technology course. Question types were listed as the guiding column. Each row showed: student group's average record in the specific question section, next the maximum score, and finally relative success (%). Because there were variations in the number of subtasks and the detailed structure of tasks in each year, only the relative values were compatible. The percentage value was determined by dividing the average score by the maximum reachable value given by the assessment model's data.

Table 1. Test scoring and student success in three different years.

Question types	2014			2015			2016		
	Average	max	(%)	average	max	(%)	average	Max	(%)
Explain concepts	4.9	6	82	4	7	53	4.5	7	64
Short answers	2.2	4	54	3.2	4	81	5.7	6	96
Claims(true/false)	12.5	16	78	15	20	76	18.2	22	83
Picture 1	1.3	4	31	2.3	6	37	3.4	7	48
Picture 2	2.1	4	53	4	6	62	3.7	8	46
Essee or calculus	7.1	12	59	5.7	10	57	6.1	12	56

Major finding was that a broader, detail full, and scaled-up test seemed to collect better results of knowledge even when the student's knowledge includes a non-organized set of individual knowledge and skills. Set of individual students' previous success was compared to the answers in this exam. In this case, a student who was uncertain about his / her knowledge, as the test progressed, worked on his knowledge. Therefore, he was able to exceed the critical limit to obtain such a score that he has passed the exam or even gained a little better grade than that. This finding was also positive, because expanding the number of tasks for each individual sup-part of the examination did not remarkably affect average grades.

Conclusions and Implications

This research pondered how the analysis of the assessment part of the sample technology course provided information on NDU's technology education arrangements. Because this research utilized only on narrow part of the technology education and the

observations were made only in three successive years, the data is beyond of wider generalization. So even though the material described in the study is large ($N = 369$) variation of parameters is limited. It seems that a summative test of 5 elements gave students more options to show their gained knowledge. But this is only a recommendation for further research where students' profile would guide what type of efforts will be selected to show knowledge and skill in the assessment. The findings include the option to export this form based (or paper and pen type) examination into a portal- based variant for a same type of course.

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