Bonus exercises as motivational aspects in the learning process

Sanna Heikkinen

Aalto University
Espoo, Finland

ABSTRACT: The study presented in this article was conducted in a large university of applied sciences in Finland, in the field of machine and electrical engineering. Four student cohorts in the same course were compared. It was anticipated that the more students attempt and solve tutorial-style bonus exercises, the higher marks they would obtain in the examination. The research approach undertaken was to check whether there was a correlation between the time used for studies and the results obtained. It was also expected that if a student classified himself/herself as a motivated student he/she would obtain better marks. The expected results did not materialise, but some differences between the groups were found.

Keywords: Bonus marks, motivation, university of applied sciences

INTRODUCTION

Teaching methods and the level of learning can be strongly connected together but motivation and motivating stimulation can have a notable effect. Occasionally, it may be better to present students with the opportunity to learn more effectively and to use more time rather than forcing students to study. In this analysis, four groups of students were followed, and the relationship between motivation and results in exercises were researched.

TYPES OF MOTIVATION

When looking at teachers at any level of schooling, one of the most published topics is how teachers feel about their students' motivation. Teachers worry about students who aspire to high grades but do not show any interest in the subject or who attend classes only sporadically. At the same time, teachers enjoy seeing students sharing the same interests and a passion to learn more without thinking only about grades [1]. The passion for studies is about motivation, but it has several dimensions. A study among children has shown that having an ongoing task, of the method of evaluation and the nature of control and authority in a class room have an impact on the results of learning and how students are motivated [2].

Studies in a university of applied sciences are much more *controlled* than are studies in universities in Finland. Studying at a university of applied sciences can be compared to studies in a high school. The structure of studies is predetermined and number of the elective courses is limited, if there are any. There is no reason to criticise the way studies are organised, but it is possible to recognise the similarity between teaching in lower and higher education. This assumption shows that is it possible to compare studies in lower level groups and in groups in the universities of applied sciences.

Intrinsic motivation itself is defined as undertaking an activity for an inner reason and not for reaching an outer goal, like a grade. Attaining the main point of intrinsic motivation has to be viewed in contrast to extrinsic motivation when it is motivation that concentrates on an interest or enjoyment in the task itself [3][4]. Intrinsic and extrinsic reasons can also lead to a variety of results, when students study the same material under different conditions of extrinsic and intrinsic motivation. Extrinsic motivation can lead to ineffective and low-level learning [5]. Intrinsically-motivated behaviours originate from a person himself or herself, but extrinsically motivated behaviours can have varying sources when a person himself or herself can be a part of it [6-8].

Active learning can be defined, generally, as any instructional method that engages a student in the learning process and requires a student to think [9]. When mentioning active learning, it is also worth mentioning active experimentation that involves doing something e.g. discussing something or explaining or testing something [10].

Traditional lectures are normally for providing information and instruction, but they can also be used as a part of active learning. It is important to note that in most cases, information moves well from the front to the back of the hall but not vice versa. It does not move well from side to side either. An active lecture suggests that students' mental models need to be challenged. In most of the cases, it indicated questions to students. The most important item is to remember to offer time to students to think and answer [11]. Teaching methods in a course have to be thought through wisely. New methods, such as active learning, should provide learning options to both stronger and weaker students [12].

Active learning has been shown to lead more often to intrinsic motivation rather than passive learning [13] and there are correlations between active learning and motivation [14]. Motivated students spend more time, work harder at their tasks and are not discouraged when facing difficulties [1]. In this case, active learning is learning by doing when students have to calculate, measure and think about various types of topics, and solution are not provided automatically. Teaching is not lecture-based, but a lot of information is offered during lessons and laboratory hours.

Students have individual backgrounds and differ from other students in the extent of their interest. Some topics may have more purpose than others. This is one aspect of motivation, but it does not explain it in every form. As one can now assume, motivation is important. However, both motivation, generally, and the type of motivation are important [1].

As indicated earlier, a student can gain suitable grades and can seem to be motivated, but trying to achieve a higher score in an examination can also be a sign of extrinsic motivation. The achievement goal theory is one academic motivation theory that classifies students in academic activities according to separate goals when some students are motivated only, because they want to gain an *A* to show they are smart [15][16].

A classic example of multiple goal orientation can lead to positive learning outcomes for students [17]. The idea is not to judge extrinsically motivated students, but it is interesting to compare the concepts of intrinsic and extrinsic motivation. Research has shown how behaviour can change in a college where intrinsically motivated students were using cognitive strategies reaching deeper processing of the material [18].

Another point is that learning strategies and a personal interest in deep learning have an effect on learning results [19]. According to one study, contextualisation and personalisation led to significant growth not only in students' motivation, but also in their commitment to learning [20]. Furthermore, there have been suggestions to develop thinking abilities in the context of the procurement of knowledge [21].

If possible, connection of new and old information and earlier courses can keep motivation high. It is easier to assimilate new information when it can be connected with earlier knowledge [22].

GROUPS AND BACKGROUND

Four separate courses were included in this study. The courses were taught in the years 2012 and 2013 over the spring or the autumn terms. All courses involved the same teacher and the same content. The topics were in electrical engineering or electronics. Most of the lessons were typical classroom activities. At the beginning of a lesson, the teacher offered some background information to a topic, presented theories and some examples. Then, students started to study the material themselves and tried to solve relevant tutorials in electrical engineering. The teacher guided the class and offered tips and models on how to solve the problems. The same structure was used in the two laboratory assignments in all four courses.

The concept is based on a theory in which students have background information that provides them with a plan of how something might work. It is their possible earlier experience of the subject. Next they acquire new information and they have to use their earlier experience to process it. They have to reflect on their earlier knowledge and apply it to new information. This activates their thinking processes, and they can finally test the new notion by calculating or measuring something, for example, as outlined by Healy [23].

A total of 55 students sat for the final examination in the four courses. Some students followed a course most or part of the time, but did not take part in the examination at the end. They did not respond to a motivational survey either. Only three out of the 55 students were women. This is a typical distribution in most of the courses in technical fields in universities of applied sciences in Finland. This distribution should be taken into account when comparing the results with those in other fields of study.

Four groups, A, B, C and D were involved in this study. Group A was the most talented group in many approaches from the teacher's point of view. However, it included some students who required extra help. The group was active during the lessons and seemed to be motivated to complete the course.

Group B was even more active than Group A. Some students arrived at the class early to ask questions. They were also willing to practice their new skills outside the classroom and found many practical examples related to the day's topic. It was not possible to see the difference in motivation levels during the classes.

Group C was the largest group. Some of the group seemed not to be motivated or interested in study at all. Some students played with mobile phones or Sudoku. Others in the group were talented and wanted to receive every benefit from the course. The teacher's assessment of the Group's motivation in this group was divided into two parts.

The students in Group D were the most equal in their skills levels. It was the easiest group to teach because the students were neither especially talented nor were there any students with lower skills compared with other students. The only problem was that the students lacked some of the skills that the students in other groups mostly had.

STATISTICS

Both homework and grading of homework have been under discussion [24] and there have been tests at several universities [25][26]. Discussion within the teaching unit about whether extra marks could support learning and lead to higher results preceded the collection of some statistics on the topic.

In the teaching unit's courses, some of the exercises are defined as bonus exercises. These are typical exercises, but not counted as a part of the classes' obligatory exercises. Students who undertake bonus exercises get more practice. This is an approach to encourage students to study more and harder, and to reward them by offering extra marks.

The groups and their statistics are shown in Table 1. The sizes of the groups in a university of applied sciences are minute compared with typical university level Bachelor degree courses. The average age of the students was about a year or two higher than might have been expected in Groups A, B and D. A student approved to study immediately after finishing high school or vocational school would typically be 19 when their studies begin.

Table 1: Details of the groups taken into account in this study.

Group	Number of students	Age	Study time (years)	Examination marks (max. 30)	Bonus marks (max. 7)	Total marks (max. 37)	Level of motivation (1-3)
A	15	24.0	3.0	18.53	5.93	24.46	2.43
B	10	25.3	3.0	17.80	5.20	23.00	2.60
C	20	23.4	3.1	17.95	4.50	22.45	2.35
D	10	26.4	3.5	14.70	3.70	18.40	2.50

Most male Finns undertake compulsory military service year straight after completing their lower level studies and they are usually one year older when starting studies at a university or a university of applied sciences. According to this schedule, the students should be 23 years old on average if they are joining this course at the third year of studies. As can be seen, on average the students were third year students.

It was a surprise to see that the differences in the final examination marks between the groups were not considerable compared with the motivational levels of the groups as perceived by the teachers. However, the studies used to measure motivational level showed no great differences in the motivation levels when asking the students. The students were asked to evaluate their motivation on a scale of 1 to 3.

On the scale, 1 was *not motivated at all*. A student had to choose this level if she/he was not present during the lectures or did not concentrate on the subject. On the scale, 2 meant *somewhat motivated or partly motivated*. A student who was present most of the time and studied the provided material but did not undertake anything extra or were not interested in the topic had to choose this level. Reporting 3 on the scale meant that the student was *motivated student who attended classes regularly and on time, studied most of the given material and asked questions.*

The statistics of total marks at the different motivational levels are shown in Table 2. As can be seen, the level of motivation does not correlate equally in every group. The lowest motivation level has the lowest total marks in every group, but the highest level of motivation does not always have the highest marks. In Groups A, B and C, the students who were not motivated at all had lower marks than the students in the other two categories.

In Group D there was no difference between the students who were not motivated at all and the students who were at least partly motivated. One explanation could be that the students in Group D, on average, seemed to have generally lower skills than the students in other groups. Overall, the marks in Group D are lower than those obtained by students in most of the other groups. One explanation could be, for example, that Group D was not as united as the other groups and they might not have as much support from other students in the group.

Table 2: Comparison of total marks and motivational levels.

Motivation level	Group A	Group B	Group C	Group D
1	17.7	20.0	6.7	17.0
2	26.5	25.5	19.6	17.0
3	26.2	22.7	29.2	19.3

Comparing the bonus marks and the motivation level in Table 1, it can be see that Group D is also different. Group D gained the lowest number of bonus marks, but the students felt themselves more motivated than the students in Groups A and C. If counting the average values of all the groups together, the students who ranked themselves at the lowest motivation level reached 15.33 marks on average in total, including both the final examination marks and the bonus marks. The medium motivation students received 22.14 marks, on average, and the highest motivation level students got 24.37 marks, on average. Overall, these cases support the view that having more marks in an examination and earning more bonus marks when a student feels more motivated is true, but it does not correlate in every group.

When comparing only the bonus marks and motivation levels, the results are shown in Table 3. It is rather confusing to see that the students mainly undertook more or the same number of bonus exercises if they were only partly motivated rather than motivated. In all other cases except for Group B, the students with the lowest motivation level did not undertake as many exercises as students in other motivation levels. The difference in Group B is easy to explain, because there was only one student in the lowest motivation level and he/she decided to pass the course even without having any interest on the topic.

Table 3: Comparison of bonus marks and motivation levels.

Motivation level	Group A	Group B	Group C	Group D
1	5.3	7.0	1.3	1.0
2	7.0	6.5	4.0	4.0
3	5.9	4.6	5.8	4.0

CONCLUSION

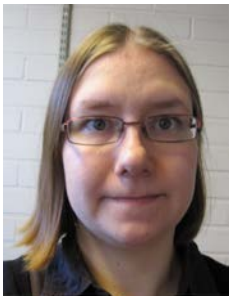
It has been shown that effect of motivation is not simple to explain. Motivation itself does not totally explain the students' success, but there seems to be a strong correlation between motivation and higher marks. Further research as to why Group D students did not succeed should be undertaken and it would be interesting to know if variables other than the lack of some necessary skills were involved. The target is to continue this study and test the same situation in several new groups to find out if there is a stronger or weaker correlation between motivation and bonus exercises.

REFERENCES

1. Svinicki, M.D. and McKeachie, W.J., *McKeachie's Teaching Tips: Strategies, Research, and Theory for College and University Teachers*. Canada: Nelson Education Ltd. (2011).
2. Ames, C., Classrooms: goals, structures, and student motivation. *J. of Educational Psychology*, 84, **2**, 261-271 (1992).
3. Oudeyer, P-Y. and Kaplan, F., What is intrinsic motivation? A typology of computational approaches. *Frontiers in Neurorobotics*, 1, **6** (2007).
4. Deci, E.L. and Ryan, R.M., *Handbook of Self-determination Research*. The University of Rochester Press (2004).
5. Fransson, A., On qualitative differences in learning: IV - Effects of intrinsic motivation and extrinsic test anxiety on process and outcome. *British J. of Educational Psychology*, 47, **3**, 244-257 (1977).
6. Deci, E.L. and Ryan, R.M., *Intrinsic Motivation and Self-determination in Human Behavior*. New Youk: Plenum (1985).
7. Ryan, R.M. and Connell, J.P., Perceived locus of causality and internalization: examining reasons for acting in two domains. *J. of Personality and Social Psychology*, 57, 749-761 (1989).
8. Hayamizu, T., Between intrinsic and extrinsic motivation: examination of reasons for academic study based on the theory of internalization. *J. Psychological Research*, 39, **2**, 98-108 (1997).
9. Bonwell, C.C. and Eison, J.A., Active Learning: Creating Excitement in the Classroom. ASHEERIC Higher Education Report 1, George Washington University, Washington, DC (1991).
10. Felder, R.M. and Silverman, L.K., Learning and teaching styles in engineering education. *Engng. Educ.*, 78, **7**, 674-681 (1988).
11. Michael, J.A. and Modell, H.I., *Active Learning in Secondary and College Science Classrooms*. USA: Lawrence Erlbaum Accociates Inc. (2003).

12. Bellido, F.J., Flores-Arias, J-M., Linan, M. and Moreno-Muæoz, A., Active learning in power electronics. *Proc. 1st Annual Global Engng. Educ. Conf. IEEE EDUCON*, Madrid, Spain (2010).
13. Benware, C.A. and Deci, E.L., Quality of learning with an active versus passive motivational set. *American Educational Research J.*, 21, **4**, 755-765 (1984).
14. Machemer, P.L. and Crawford, P., Student perception of active learning in a large cross-disciplinary classroom. *Active Learning in Higher Educ.* 8, 9-30 (2007).
15. Mattern, R.A., College students' goal orientations and achievement. *Inter. J. of Teaching and Learning in Higher Educ.*, 17, **1**, 27-32 (2005).
16. Pintrich, P.R. and Schunk, D.H., *Motivation in Education*. Englewood Cliffs, NJ: Prentice Hall (1996).
17. Harackiewicz, J.M., Barron, K.E., Elliot, A.J., Tauer, J.M. and Carter, S.M., Short-term and long-term consequences of achievement goals: predicting interest and performance over time. *J. of Educational Psychology*, 92, 316-330 (2000).
18. Pintrich, P.R. and Garcia, T., *Student Goal Orientation and Self-regulation in the College Classroom*. In: Maehr, M. and Pintrich, P.R., Advances in Motivation and Achievement: Goals and Self-regulatory Processes. 7, USA: JAI Press (1991).
19. Schiefele, U., Interest, learning, and motivation. *Educational Psychologist*, 26, **3-4**, 299-323 (1991).
20. Cordova, D.I. and Lepper, M.R., Intrinsic motivation and the process of learning: beneficial effects of contextualization, personalization, and choice. *J. of Educational Psychology*, 88, **4**, 715-730 (1996).
21. Glaser, R., Education and thinking: the role of knowledge. *American Psychologist*, 39, **2**, 93-104 (1984).
22. Armstrong, S.J. and Fukami, C.V., *Handbook of Management Learning, Education and Development*. India: Sage Publications (2009).
23. Healy, T., Work in progress: curiosity in the education of the engineer. *Proc. Frontiers in Educ. Conf.*, USA, 6-7 (2004).
24. Bluman, J., Rowland, M. and Mockensturm, E., Closing the homework feedback loop, an alternative approach to homework grading. *Proc. ASEE/IEEE Frontiers in Educ. Conf.*, Washington DC, USA (2010).
25. Ehrlich, R., Giving bonus points based on oral exams. *American J. of Physics*, 75, **4**, 374 (2007).
26. Gijbels, D., van de Watering, G. and Dochy, F., Integrating assessment tasks in a problem-based learning environment. *Assessment & Evaluation in Higher Educ.*, 30, **1**, 73-86 (2005).

BIOGRAPHY



Sanna Heikkinen graduated with a Master of Electrical Engineering from Helsinki University of Technology (Espoo, Finland) in 2007. Ms Heikkinen has been teaching and developing courses in the School of Electrical Engineering at Aalto University, and recently commenced her PhD. Her research focuses on motivation and learning processes in technical fields in higher engineering education.