

## Enhancing Students' Motivation in the Inverted CS2 Course: a Case Study

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**Abstract:** We study the influence of students' self and time management skills to their attitude to the inverted CS2 4<sup>th</sup> semester pilot course offering, which took place in Vilnius University of the Applied Sciences. We compared students' attitudes to the inverted offering just after the course started and no self and time management tool has not yet been introduced and after the self and time management tool has already been introduced to the students and students gained their experience in using the tool. Confirming our hypothesis, we found out the positive shift of students' attitudes to the inverted offering. The effectiveness of the simple self and time management tool was confirmed as well.

**Categories and Subject Descriptors:** K.3.2 [Computers and Education]: Computer and Information Science Education-Computer Science Education.

**Key words:** inverted classroom, flipped classroom, CS2, blended learning, novice education in computing.

### INTRODUCTION

#### Flipped learning

Flipped or inverted learning becomes more and more popular with increasing attention from the part of educators and scientists. It seems to be natural, as modern technologies like Web2.0, visualization, gamification, and e-learning empower students with strong self studying abilities including learning content as well as outstanding self studying environments. On the other side, the modern industry provides on-demand requirements for the educational content; herewith the students' ability to become the self-learners is as well important and better valued than other abilities and competences.

The general idea or "a guiding principle of the flipped classroom is that work typically done as homework (e.g., problem solving, essay writing) is better undertaken in class with the guidance of the instructor. Listening to lecture or watching videos is better accomplished at home. Hence the term *flipped* or *inverted classroom*." [3].

#### Advantages and disadvantages

As any new technology, the inverted offering has its advantages as well as disadvantages. Among advantages Fulton [1] reports on: students' possibilities to move at the own pace, which is also important and for not native language speakers; deeper teachers' insight on students' difficulties as homework is done in class; curriculum could be easily customized; students are supported with distance learning possibilities, what allow them to combine out of the class and leaning activities.

At the same time, there are several problems identified by teachers [3]: students must be active at home; the course must be carefully prepared and include visual and interactive materials.

#### Flipped learning in CS education

CS education requires new and innovative methods to be involved in. The demand for educated professionals in the field is increasing with the time. On the other hand, this is a traditionally difficult field to study and for many students a sufficient literacy level is a challenge. Lockwood and Rachel [5] report on inverted introductory CS course. The inverted classroom includes online workbooks, guided problem solving activities, lab exercises, homework, and exams.

Horton et al. [4] report on positive results of inverted CS1 course which took place in the University of Toronto. The authors report on significant increase in students' final

course outcomes comparing with a traditional CS1 course. Walker et al. [8], [7] introduce a lab-based approach to CS1 course. The method is based on extended amount of laboratory exercises which supports students' activities and collaboration. Gannod et al. [2] introduce an inverted classroom for teaching of the software engineering module.

### **Difficulties and students expectations**

Stayer [6] reports on flipped introductory statistics class less satisfied students: "Students in the inverted classroom were less satisfied with how the classroom structure oriented them to the learning tasks in the course, but they became more open to cooperative learning and innovative teaching methods."

Generally, "students new to the method may be initially resistant because it requires that they do work at home rather than be first exposed to the subject matter in school. Consequently, they may come unprepared to class to participate in the active learning phase of the course. Faculty solve this problem by giving a short quiz either online or in class or by requiring homework that references information that can only be obtained from the outside reading or videos" [3].

Inverting the classroom moves students to the front-end of an educational process. "The flipped model puts more of the responsibility for learning on the shoulders of students while giving them greater impetus to experiment." [1]. Horton et al. [4] report that the inverted offerings did not increase student enjoyment of the offering or the enjoyment of beginners in particular.

### **THE COURSE**

The 4<sup>th</sup> semester pilot course, took place in Vilnius University of Applied Sciences, covers the object-oriented programming basics, focusing on C# (Microsoft) basics and intermediate meanings. Students expected to have pre-knowledge of basic structural programming and algorithms. The course includes introduction live lectures, e-learning materials, lab exercises, periodical knowledge tests in the form of individual assignments, and final exam. Live lectures covered only introduction material and introduction to more comprehensive topics like programming objects and interfaces.

E-learning material included e-books and workbooks. Students expected to study theoretical material at home and to conduct lab exercises in class individually or in groups. This is a 16 week course. The course was formally divided in 8 two-week periods. To motivate students' activities, each two-week period was summarized by knowledge test with sufficient impact on the final grade. The course could be classified as inverted lab based and assignments based course as periodical assignments play a key role as for students' motivation as well as for measuring students' level of knowledge.

The study plan for the classical course includes 32 live lectures and 16 lab exercises. Each two live lectures accompany 1 lab exercise. The final test is in the form of final exam. Inverted offering allows inverting the course to 32 labs classes. The inverted class also includes 8 periodical (each two weeks) assignments in the form of hand writing tests and final exam.

### **THE STUDY, HYPOTESIS, AND SOLUTIONS**

We wanted to know if implementing a self and time management activity into the course would improve students' motivation and enhance positive attitude to the inverted teaching method as itself. We hypothesized that the lack of self and time management skills and competences causes the students' negative attitude to inverted offerings. At the same time we would like to test and offer the set of practical tools for self and time management. Such tools should deal with the course study and activities plan and include daily planning and self management tools. The tool is based on Google tools

and consists of a web recourse integrating the study plan and individual student planning and self management resources.

## RESULTS AND DISCUSSION

The first students' opinion check was done during the first month of the course. Almost 53% of the students responded that they do not accept the inverted offering and for 35% it was difficult to say something definite about the option. And only 12% of the students accepted the course. The results are displayed in the Fig. 1.

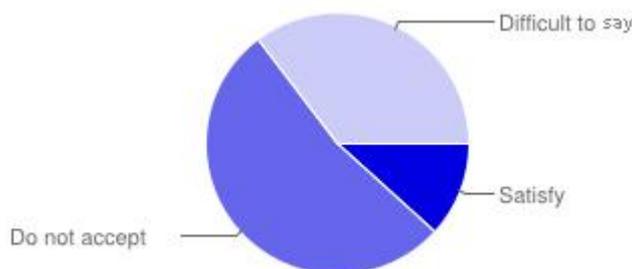


Fig. 1. Students' attitude to the inverted method at the beginning of the course

The main difficulties students complained for are presented in the Table 1. As we see from the presented data, only 15% reported about any difficulties with the course. It is also interesting to see, that only 8% reported about problems/concerns with their self and time management.

Table 1. The main difficulties students reported at the beginning of the course

Do not understand theoretical material /need help in home studying	27%
Need too much assistance in lab exercises	15%
Difficult to manage my time for home studying	8%
Difficult to concentrate at lab sessions	12%
No difficulties at all	15%
I don't know	23%

The second observation was done at the last stage of the course in week 16. There is a significant shift to the acceptance of the course. The results are presented in Fig.2. Only 13% of the students did not accept the inverted offering with 73% of satisfied students.

At the same time the observation of students' opinion on self and time management system was done. The results are presented in Tables 2 and 3. Summarizing the responses, 73% of the students reported about their positive attitude to the self and time management tool integrated in to the course and 76% reported about the tool was among the most helpful supporting features.

To observe the threats for validity, the next remarks should be done. As a pilot course, the only one group of students participated in the survey. There is a definite need to improve the validity of the study results by increasing the number of students and moving from the pilot to the finally accepted inverted offering. To reduce the negative influence of a number of factors which were beyond the researchers' control, a strong emphasis on observation of the study variables was done and this could also be improved by increasing the number of students participating in the study.

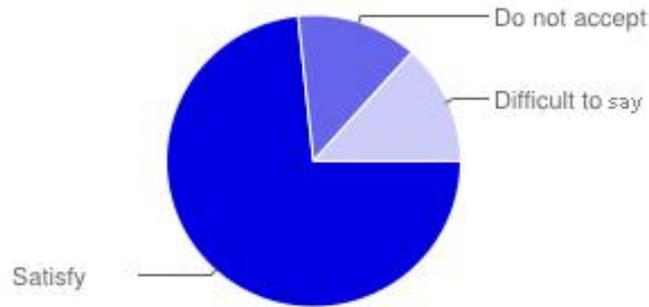


Fig. 2. Students' attitude to the inverted method at the end of the course

Table 2. Students' attitude to the self and time management tool

It helps to deal with the inverted offering	46%
It does not help	14%
It is time consuming	13%
No problems with the tool	27%

Table 3. The most helpful supporting feature for the inverted offering

The time was needed to understand advantages/disadvantages of the inverted offering	24%
The improvement of my personal self management skills helped a lot	35%
The self and time management tool supported well enough	41%

## CONCLUSIONS

The inverted CS2 course covers the main topics of introductory object-oriented programming and is based on C# programming language. The inverted approach allowed enlarging the number of in class hours student spent solving practical exercisers. As the pilot course brought the new experience to participating students, many of them had a negative attitude from the beginning of the course. The main difficulties students reported were the need to plan and to synchronize the out of the class and in-class activities. The other problem students reported was the increasing amount and difficulties in the home work. To overcome the described difficulties, the self and time management and activities planning system based on Google tools was introduced and incorporated in to the course.

The aim of such self and time management system is twofold. On the one hand, the system helps to systemize students' activities in the inverted course, and on the other hand, the simple tool for self and time planning and management was introduced with the intention to possibly assist students with their further professional activities.

As it was already mentioned, in the beginning of the course most of the students reported about their negative attitude to the inverted offering. After the self and time planning and management system was introduced, students reported about the significant change in their attitude with a definite shift to acceptance of the inverted option. This is especially true for such students who have indicated spending a sufficient amount of time with additional activities like sports, part time job and others. Besides accepting the inverted option as it is, such students were more motivated in using self and time planning and management system for pre planning their in-class and out of the class activities.

The study confirmed a self and time planning and management system could be an effective solution for enhancing students' attitudes towards the inverted CS course

and could be easily designed and integrated in to the course. This helps students with their learning activities and systemizing their knowledge about the inverted offering on the whole.

## REFERENCES

- [1] Fulton, Kathleen P. "10 reasons to flip." *Phi Delta Kappan* 94, no. 2 (2012): 20-24.
- [2] Gannod, Gerald C., Janet E. Burge, and Michael T. Helmick. "Using the inverted classroom to teach software engineering." *Proceedings of the 30th international conference on Software engineering*. ACM, 2008.
- [3] Herreid, Clyde Freeman, and Nancy A. Schiller. "Case studies and the flipped classroom." *Journal of College Science Teaching* 42, no. 5 (2013): 62-66.
- [4] Horton, Diane, Michelle Craig, Jennifer Campbell, Paul Gries, and Daniel Zingaro. "Comparing outcomes in inverted and traditional CS1." In *Proceedings of the 2014 conference on Innovation & technology in computer science education*, pp. 261-266. ACM, 2014.
- [5] Lockwood, Kate, and Rachel Esselstein. "The inverted classroom and the CS curriculum." In *Proceeding of the 44th ACM technical symposium on Computer science education*, pp. 113-118. ACM, 2013.
- [6] Strayer, Jeremy F. "How learning in an inverted classroom influences cooperation, innovation and task orientation." *Learning Environments Research* 15, no. 2 (2012): 171-193.
- [7] Ustek, Dilan, Erik Opavsky, Henry M. Walker, and David Cowden. "Course development through student-faculty collaboration: a case study." In *Proceedings of the 2014 conference on Innovation & technology in computer science education*, pp. 189-194. ACM, 2014.
- [8] Walker, Henry M. "A lab-based approach for introductory computing that emphasizes collaboration." In *Computer Science Education Research Conference*, pp. 21-31. Open Universiteit, Heerlen, 2011.

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**The paper has been reviewed.**