

# REDESIGNING METHODOLOGY FOR STUDENT COUNSELLING IN THE FIRST YEAR IT EDUCATION

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## Abstract

It is typical for the first year engineering and information technology students to have several problems in their studies. Various studies have been conducted on the curriculum redesign as well as on improvements in the teaching methodology. Still, one area that is typically paid less attention to is the student counselling. In this paper, we present a four year study, where the student counselling methodology was thoroughly redesigned in the Department of Information Technology, University of Turku. The goal of the redesign was to improve students' performance and social networking as well as the communication between students and the department staff. In the redesign, several new methods were presented, including various improvements to group counselling and individual meetings. Moreover, an enhanced technology support was designed and developed to assist the counsels and to help students' self-reflection during the first year of IT studies. These include, for example, the usage of RFID technology to record attendances and homework. Besides the methodology redesign, we discuss the results of the redesign in relation to various student performance statistics collected during the freshman year.

Keywords: Student counselling, Educational guidance, Methodology redesign, Student performance, First year studies

## 1 INTRODUCTION

Freshmen students often have difficulties in adapting to university studies. The new studying environment practices take a while to get accustomed to. Moreover, the study schedules are often less formal and the progress less supervised than in high schools, which is an advantage for more skilled students, but on the other hand might lead to some students falling behind with their studies. Hence, it is often typical for the introductory courses to have quite high dropout rates. The problem is even worse with the socially less skilled students, who typically have difficulties in forming social networks that might encourage them to participate more actively. The lack of social networks is a problem that is reflected to professional life after graduation as well, since the networks play a big role in employment and in professional career.

Student counselling and tutoring can potentially be used to solve a lot of problems described above. With an adequate amount of personal guidance, most difficulties with the studies can be overcome. Moreover, assuming that the methodology is well designed, the counselling can be used to improve students' networking and group forming. In this paper, we describe a four-year study where the student counselling and the educational guidance methodologies in the Department of Information Technology at University of Turku were thoroughly redesigned. The paper is structured as follows: first, a short literature review is conducted. After that, the methodology redesign is presented in detail, followed by observations on the effect of the redesign into student performance. Finally, conclusions based on the results are presented.

## 2 RELATED WORK

Denison et al. [1] analyzed the skills of 34 medical students at the University of Aberdeen through a formative assessment five months before the corresponding summative assessment, and provided poorly performing students with tailored support. They conclude that early recognition and tailored intervention is required in order to rescue the students who are about to fail.

Latomaa [2] reports the students' perceptions of prerequisites of good education in the context of Finnish university students who study translation. Students see good education to be self-defined and collaborative. The knowledge should be built through interaction with others, using multiple education methods, mentoring and constructive feedback. The links between theory and practice should be clearly visible to the student.

Selfhout et al. [3] studied the emerging adolescent friendship networks through personality traits, and concluded that these friendship networks form within the first three months, and that those with extrovert and agreeable traits are more likely to succeed in forming friendships.

Mäkinen and Olkinuora [4] note that freshmen of many different fields of study in Finnish Universities are insecure about their choice as a field of study. They state that especially arts and natural sciences have a special group of students who are not dedicated to their studies. Mäkinen and Olkinuora speculate that this group exists due to lack of effort in gaining the study position, as in Finland it is in some cases possible to achieve a university study position without participating to an entrance exam.

Benyo et al [5] introduced an attendance monitoring system that was based on near field communications (NFC) at the Budapest University of Technology and Education. The system also had an alternative fingerprint-based identification, and it was tested with 30 terminals and over 1000 students.

Newman-Ford et al [6] conducted a large-scale investigation on the relationship between attendance and attainment using an electronic attendance collection scheme. In the study they concluded that there is a strong positive relationship between attendance and attainment: students who attend to classes, achieve better grades than those students who fail to attend to classes

### **3 REDESIGNING STUDENT COUNSELLING METHODOLOGY**

In this section we describe the changes made into student counseling methodology in the IT department before the semester of 2011 to 2012. Although the first steps of the redesign were implemented for the aforementioned semester, the methodology was revised during 2013 and 2014, based on our experiences and the students' learning performance. Hence, these changes are also discussed in this section.

#### **3.1 Old methodology**

Before the redesign, the student counseling in the department was based on students' own activity. The students could book a meeting with a counsellor whenever they wanted, but no joined counseling or group activities were arranged. In practice, this meant that only the socially active students typically sought for counseling while the quieter ones were left alone with their questions. Moreover, the socially active students typically have fewer questions about the study practicalities as they usually have stronger social networks to seek help from. The problems were reflected into the study performance as well as into the number of students actively participating into studies. Hence, a redesign of the whole counseling methodology was planned and implemented between 2011 and 2014.

#### **3.2 Step 1: Encouraging Student-Student Interaction**

Being a part of a group is important to students for three reasons: first, there are the social and psychological reasons; second, there are the study related reasons; final aspect is the professional reasons. The first category covers up students' well-being and the sense of being part of a group. This factor can have a high effect on students' motivation to participate in lectures and other study activities: when student has a feeling of being part of a group (or several different groups), it is likely, that he or she sees lectures and other study sessions partly as social events, which encourages participation. In other words, students with friends among other students are probably more likely to arrive into campus area just to meet them. The group can also provide positive peer-pressure for attending lectures and other events.

The second positive effect for being a part of a group is related to studies. Group work and collaboration have been proven to be highly beneficial for learning. Study groups enable mentoring of weaker students in the group as well as informal peer-reviewing of answers and projects. Moreover, completing the group projects with familiar people can be easier (although practicing group work with previously unfamiliar people is important as well), as the group dynamics already exist. Since there are several group projects and a lot of collaborative work included in the curriculum, existing groups enable socially less-skilled students to find collaborators and join the groups easier.

The third aspect is the development of professional network. As the groups formed consist of students in the same department, it is likely that most of the students in the group will be employed in the same professional area. Hence, it is possible to start forming the professional network during the studies. Knowing people working in the same area likely makes job hunting easier and enables easier

professional co-operation and collaboration. As typically at least some people in the network are employed abroad, the relationships formed during studies can enable international employment as well.

As the aforementioned aspects can be seen highly important for students, the group forming is strongly encouraged in the redesigned methodology. First, when the students arrive in the department, they are traditionally divided into tutoring group, with each group instructed by an older student. These groups are mainly meant for familiarizing students with study practices, premises and student organizations. The groups typically consist of eight to ten freshman students, and the older students are awarded some study credits from guiding their groups. However, the problem with the method has previously been the disintegration of the groups after the first study period: as the students get accustomed to study practices, they naturally don't see a need for guidance anymore.

In the redesigned method, some changes were made to keep the tutoring groups together more tightly. First, the groups were used as demonstration (i.e. assignment) and study groups in all courses of the first year curriculum. Instead of allowing students to choose their groups freely, they were required to join the groups listed in the timetables. Though socially skilled students usually form groups of their own easily (which was by no means restricted in the redesigned methodology either), the less skilled ones typically have a tendency to drop out of social groups entirely. Enforcing the groups in the first year courses was hence adapted to prevent the drop-out of the latter ones. The tutoring groups were also kept together for all student counseling meetings, and the tutors were encouraged to organize free time activities with their group during the first year.

### **3.3 Step 2: Formalizing the Study Schedule**

In Finnish universities, academic freedom is an important concept. Among other things, this means, that the students can freely design their study schedules and their own timetables. However, academic freedom must always be accompanied with academic responsibility, as without any formal supervision the study times can grow exponentially, and the study progress can be very slow. With this in mind, we decided to formalize the first year study plan. This was done for two reasons: first, the students are already accustomed to formal schedules and pre-organized study plans in high school. Second, the whole concept of academic freedom requires enhanced abilities for self-organization and adequate knowledge about study practices. However, the first year students usually lack proper knowledge in these areas.

The formalization was done by preparing the study timetable for each student. In practice, the students were divided into groups based on their tutoring group (see previous section), and the groups were handed timetables before each study period started. The timetables contain the basic courses meant to be completed during the first study year. Special counseling and timetable modification was however enabled for two groups of students: first, some students enter the university with previous studies from another university, another faculty or from polytechnic schools. These students had their timetables prepared separately, or were provided informal suggestions on which courses to take. Second group in need of some special attention were the students who wanted to complete more courses than what was included in the basic timetables: the schedule contained the courses needed to graduate in average time of three years, but faster students were allowed to pick more courses if they felt they could complete them.

To make thing easier for students, they were all registered into all courses in the timetable automatically. Traditionally (and still after the first year) the students need to register into courses by themselves either using an electronic registration, or by attending the first lecture of the course. Besides registering the students automatically into the courses, they were divided into assignment or demonstration groups according to their tutoring group. This was done to keep the tutoring groups together throughout the first year, and to hence enable peer-support to all students regardless of their social skills.

### **3.4 Step 3: Offering Collaborative and Individual Counseling**

It is highly important, that the students are offered sufficient counseling throughout their studies. Hence, most universities around the world offer dedicated student counseling for those in need. Still, it is typical, that some students who would require counseling do not contact the counselors by themselves. This is especially true for the first year students, who might not even be aware of the counseling possibilities, or might not know who to contact with their problems. With this in mind, the first year counseling was thoroughly renewed between years 2011 and 2014.

The first improvement was the introduction of a period information event, which took place before the study period started (or at the first day of the period). The curriculum is divided into four or five separate study periods in all universities in Finland. Each period consists of separate courses, and ends with a week dedicated into final exams and such. The idea of the event was to provide the freshman students the necessary information about the courses in the upcoming period. For each course, a detailed schedule and personnel information was provided. More importantly, the counsellors provided additional information about the courses based on their experiences. In the latter events, statistics about previous period was also provided to offer students a possibility for self-reflection. These statistics included for example the attendance averages, exam grade averages and assignment completion percentages. The period information events were also utilized to provide any other important information necessary. The events concluded with students' questions answered.

Besides the period info events, a lot of individual counselling was provided. At the final third of each period, a student counseling meeting session was organized. The students were invited to the session one or two tutoring groups at a time. Each student discussed with a counsellor alone while the remaining students discussed with another counsellor as a group. In individual discussions the students were interviewed about the courses in the period, including their progress and / or possible problems in the courses. If a student had dropped out of a course, reasons for this were queried. Moreover, the students could provide confidential feedback about the courses, materials, teachers and practices. The information gathered from the discussions was used to enhance the quality of teaching and curriculum structure as well as to address the problems reported.

Another reform was the introduction of mentoring: two mentoring sessions were organized each week, one for programming and computer science courses, and one for mathematics (with separate instances for CS and IT students). Some second, third or fourth year students were selected as mentors, with exemplary study record as a requirement. In the mentoring sessions, the students would solve the current week's assignments in small groups, and the mentors would provide assistance if required. Roughly two hours were reserved for the session, but often the students stayed in the classroom one or two hours after the session to complete the assignments. The students mentoring the computer science courses also assisted the students in the course tutorials [7].

All in all, the student counselors tried to be as accessible as possible by visiting the student organization facilities regularly, and being present when the lectures started or ended. The idea was to further lower the threshold for the students to contact the counsellors, especially with quick questions. The students also had a possibility to book a time with any of the counsellors whenever they wanted. Additionally, all counsellors had an hour scheduled weekly to meet students without prior appointments.

### **3.5 Enhancing Student-Teacher Communication**

The final step in the redesign was to enhance the communication between students and the department staff. Though the students meet some of the staff during the first year lectures, the communication is usually one-directional due to large class sizes. Moreover, some of the staff only teaches advanced courses, which the students take in the third year or later in their studies. Another typical problem in the communication is that the students often find the threshold of contacting teachers quite high. This is especially true if the students are having problems in the courses or with other practical issues (such as needing to wait for exam results for too long).

To solve these issues, a dedicated student counselling team was founded. The team contained all student counsellors in the department (a total of four to six, depending on the year). Moreover, there were representatives from both student organizations of the department. The team gets together on weekly basis for a short (typically 15 to 30 minutes) meeting. The idea is again to lower the threshold for contacting someone when problems or questions arise concerning studies. The student representatives deliver the messages anonymously into student counselling team, where solutions are then sought or problems delivered to persons responsible. This way the students don't need to contact the staff themselves with sometimes delicate matters.

Moreover, two joint events for staff and students were organized. In the introduction week (the first week in university before the courses start) the students and the staff assembled to throw disc golf together in the local track. The goal was to have an informal event where the participants can get to know each other and discuss casual issues. Another similar event was organized at the end of the freshman year, with students, student councils and the other department staff came together to spend time in casual activities.

### **3.6 Redesign Schedule**

The redesign started before the academic year of 2011 to 2012, and continued gradually until the academic year of 2014 to 2015. Some steps were taken initially at 2011, and based on the feedback and experiences more modifications were presented until 2014, when the current version of the redesign was implemented. Most of the steps listed in this section were somewhat implemented in the earliest version, but most of them were further redesigned and modified in consequent years. Hence, the comprehensive results presented in this paper are mostly of the latest instance, although some results and experiences are presented from the earlier years as well. At 2014 the counseling was also recognized as a formal course, meaning that the students attending aforementioned sessions could gain 2 study credits.

## **4 UTILIZING EDUCATIONAL TECHNOLOGY TO ENHANCE STUDENT COUNSELLING**

Although participation in the counselling sessions was not mandatory, we still decided to register the attendances in different events. This was implemented to the full extent at the academic year of 2014 to 15. For easy registration of attendances, we decided to use an educational tool called ViLLE. ViLLE is a collaborative education tool, developed at the Department of Information Technology, University of Turku. It is an exercise-based learning platform with support for teacher and student collaboration. ViLLE contains several dozens of exercise types as well as an existing library of more than 20,000 public exercises and more than 1,000 public courses. A complete description of the tool can be found in [8].

### **4.1 Registering Attendances with RFID Readers**

For collecting attendances, a support for radio-frequency identification (RFID) tags was developed into ViLLE. Computers working as readers were installed into all major lecture halls in our department (and in some other lecture halls used by our teachers around the university). The computers were equipped with an RFID reader attached to computer's USB port. When a student displays his or her RFID card or dedicated ViLLE RFID chip into reader, the reader sends the details (including the lecture hall id and the time stamp) into ViLLE main server. The server then records the attendance to a defined event. This enables real-time monitoring of attendances for both, students and teachers. The reader machines were equipped with a heartbeat system, which notifies ViLLE main server in short intervals. This way the main server can alert the administrators if one of the readers is down. Since there was a need to register attendances in varying locations, and since it was not practical to equip all smaller lecture halls and computer labs with the reader machines, the attendances can also be registered by connecting a portable RFID reader into ViLLE via USB port.

All new students in our department are given an RFID card at the introductory week. Fortunately the key cards given to students (used typically to access computer labs, student organization rooms and other facilities available for students) already contained an RFID chip that can be read by the ViLLE readers. This meant, that not additional cards were needed for the attendance registration. Moreover, the students usually carry their key cards with them most of the time. If the student had forgotten his or her card, the teacher could manually register the attendance in ViLLE. As there are students from other majors and faculties attending the courses where the RFID readers are used, these students were given separate ViLLE RFID tags for registering their attendances. Nowadays, ViLLE readers are used throughout the university in various faculties, and hence the tags are given to students by the university's IT services.

To receive the events in ViLLE main server, a new dedicated server program was written. A thread in the program listens to a defined port, and after receiving an event (containing the lecture hall id, timestamp and the RFID id read from the student's tag or card) from a reader machine writes it into a temporary table in database. ViLLE's main server has another thread running that checks the temporary table between short intervals. If there is a suitable event defined for received time and the lecture hall, the corresponding assignment is marked as completed, and the user is awarded the number of points defined by the teacher (assuming that the assignment was not already completed – an event cannot be attended more than once).

### **4.2 ViLLE Mobile**

Informing students about events concerning studies is an important part of student counseling. With this in mind, ViLLE Mobile application was developed for all major platforms (including iOS, Windows Phone

and Android). The application is connected into ViLLE main server, and can be used for three main purposes: to receive messages from teachers, to answer lecture polls, use discussion forums and to get alarms about approaching deadlines. Since 2014, all new students are instructed to install the application into their mobile devices. When a teacher sends a message via ViLLE's main interface, all students registered into the course receive the message automatically via mobile application. Additionally, the message can be sent via email to reach the students not using the application.

Another useful feature of the mobile application is the deadline reminder. In ViLLE, all courses are divided into rounds. Each round consists of tasks (such as exercises, lecture attendances or other assignments), and has individual opening and closing times. ViLLE Mobile application automatically reminds users about approaching closing times. The feature was designed to help students manage their schedules during the study periods. Other features of the application were designed to enhance lecture activity and student-student communication. Still, they definitely have applications for student counseling in the future.

## **5 RESEARCH METHOD**

In this section, the data collection is briefly described. Most of the data was gathered by analyzing the study transcript records of the students in the department between years 2005 and 2014. Additionally, attendance data gathered with ViLLE and the RFID readers is utilized in analysis.

### **5.1 Active Students**

Due to abundance of irregularities and discontinuities in the university studies and study position selection processes, it is difficult to determine the exact amount of active students for any given time period. In this study, active students are defined as students that have received at least one study credit (ECTS) on a given observation period. One credit equals to 27 hours of work, and it is the smallest amount of work that is recorded in the study register.

In order to successfully complete their studies in the planned five years, students need to receive an average of sixty credits per year.

### **5.2 Data Pruning**

The student register data was pruned by removing all of the exchange students from the data set. This was done in order to remove the effects of imported credit records from other universities, as credits gained from earlier studies were present in the analyzed data sets.

## **6 RESULTS**

In this section, the results are presented. The results are divided into two sections: first, the improvements in the achieved amount of study credits gained are presented, followed by analysis of the connection between counseling attendances and achieved amount of credits.

### **6.1 Improvements in Amount of Achieved Median ECTS Credits**

Successful changes in the freshmen student counselling should have notable effects either on the amount of study credits (ECTS) that students receive, or on the amount of active students in the study program. The amounts of registered and active freshman students for years 2005–2014 are listed in Table 1.

Table 1 Amount of active CS and IT freshmen and median amount of received ECTS for those students in study years 2005 – 2014.

Year	Registered Students	Active Students	Median ECTS per Student
2005	221	124	27.0
2006	169	101	20.0
2007	141	60	26.0
2008	172	59	17.0
2009	164	105	32.0
2010	180	85	33.0
2011	156	78	28.0
2012	142	72	33.0
2013	171	70	35.5
2014	164	96	43.5

The table also contains information about the median amount of ECTS that the freshmen achieved on each year. The table shows that the proportion of active students is a normally distributed random variable (Shapiro-Wilk, p-value > 0.95), which remains in approximately 50% regardless of the treatment. This suggests that the actions that are presented in this paper do not have an effect on the amount of active freshmen.

Figure 1 shows the boxplots for amount of ECTS credits per freshman for the years 2005 – 2014.

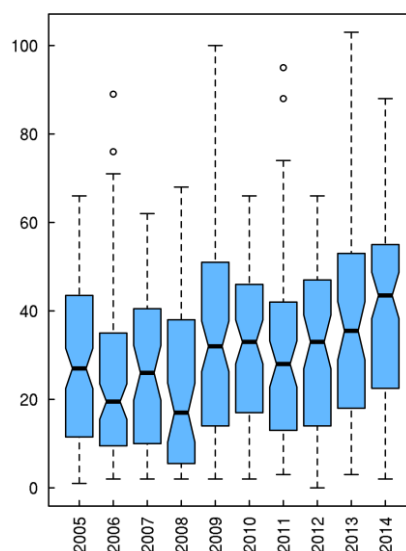


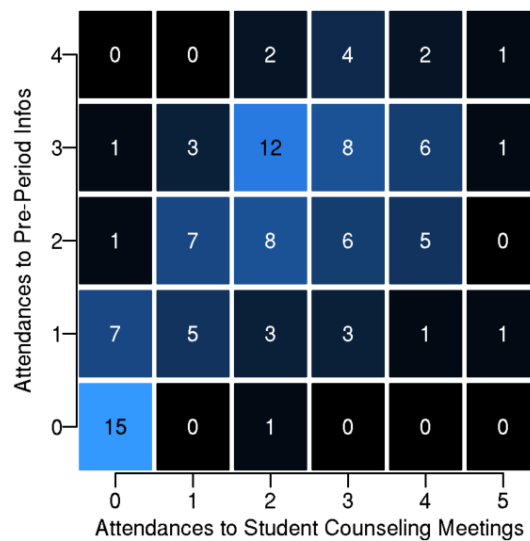
Figure 1 Boxplots of amount of achieved ECTS by study year for CS and IT freshmen between study years 2005 and 2014. During the treatment process (2011–2014), there has been a steady increase in the median achieved amount of ECTS (the thick black line). For the year 2014 the median also deviates significantly from all of the years before the treatment process.

During the treatment period 2011 – 2014, the median amount of the received ECTS credits has steadily increased, and for the year 2014, the median is finally significantly higher than all of the years preceding

the treatment. The median values for each year are listed in the rightmost column of Table 1, where the effect is also visible.

## 6.2 Connection between Attendance to Educational Guidance and the Achieved Amount of Study Points

For the study year 2014–2015, CS and IT freshmen's attendance to pre-period information events and student counseling group meetings were measured using RFID tags. The amount of attendances to these events is presented in Figure 2. Students were a little more likely to participate to period info events than student counseling group meetings. Attendance to these events was highly correlated, as one might expect (Spearman correlation 0.605, N=103). A rather large group of students, 15 out of the 103 that were registered to the student counselling course in ViLLE, never participated to any of the events.



*Figure 2 The amount of attendances per student to period info events and student counselling meetings. There is a clear correlation between the attendances to the two events (Spearman correlation 0.605, N=103). Almost all of the students failed to appear at least once for both event types, while 15 out of 103 registered students never attended any of the events.*

Furthermore, the attendance counts for study year 2014–2015 were compared to the amounts of study points that the freshmen achieved during their first study year (see Figure 3). There is a clear connection between the amount of attendances to the educational guidance events and the amount of achieved ECTS. The higher the student's total amount of attendances is, the higher the amount of achieved ECTS is. In fact, the effect is so strong that those who do not attend to any of the aforementioned educational guidance events achieve less than half of the study points in comparison to the regularly attending students achieve.



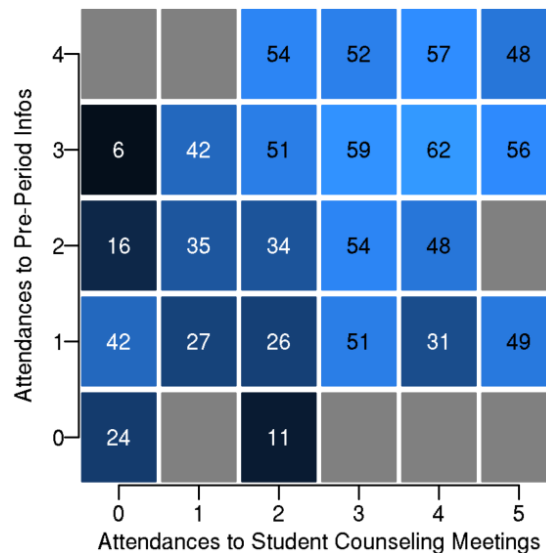


Figure 3 Average amount of achieved study points (ECTS), grouped by the number of attendances to the pre-period information events and student counseling group meetings. The figure shows how those who attend often achieve far greater amounts of ECTS than those who miss the pre-period info events.

Due to the high correlation and the effect, we calculated a linear model between the event attendances and the study points:

$$ECTS = 7.113 * (\text{number of period info attendances}) + 26.251.$$

The given model has Adjusted R squared of 0.1566 and p-value < 0.00003. The R-squared is quite high considering that it only relies on attendances to four voluntary events. We also tested the model which includes both of the events as predictors. This yielded another model with Adjusted R-squared of 0.2276:

$$ECTS = -0.6341 * x - 3.3667 * y + 3.3834 * x * y + 31.1214.$$

In the model, x and y are the number of attendances to the period info and student group counseling events, respectively. These two models can be described as follows: while attendance to the two different types of events is highly correlated, and attendance to these events predicts positively about the amount of achieved study points, attending to only one type of event is a clearly negative trait.

## 7 CONCLUSIONS

It seems that the changes made in student counselling methodology were highly effective for improving student performance, when measured with the number of study credits gained. Still, although there was a trend towards better performance starting at 2011 and going through 2012 and 2013, the effect was statistically significant only at 2014 when the changes were completed. Still, the trend towards better performance in 2012 and 2013 indicates, that individual changes may have a positive effect on their own, even if the adaptation of the full methodology is needed for statistically significant effects.

### 7.1 About Student Activity

Activation of the unmotivated and otherwise inactive students is clearly the largest of remaining goals. While the methods presented in this study have clearly been proven effective for both motivation and observation, they still fail to activate the most passive of all students. That said, the presented methods do provide the means for identifying the passive students early on, and provide students counsellors a chance to provide guidance for the students who are most likely to underperform in their studies. Collecting event attendances and reacting early on to repeated absences might provide a way to further improve the students credit scores [1].

## 7.2 About Students' Attendance to Events

The predictive models for the amount of ECTS credits that were derived in the results section raise a question about the consistence of the attendance. The predictive models suggest that while event attendance is a positive trait, inconsistent event attendance is a negative trait. It should be further examined how this should be interpreted for larger sets of events and event types across different types of courses.

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