When innovation meets load balancing

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Abstract

In this discussion note, we look into the problem of measuring and limiting the student workload. When an education shifts from a classical learning approach towards innovative and activated learning, then the possibility of over activating students occurs, as well as the problem of students hiding in e.g. project groups. At the same time, the classical study time measuring techniques are not designed to respond to this challenge.

Keywords: study workload, activating students, curriculum design

Introduction

The most *time efficient* method for teaching students is the following: drop them in an auditorium and start talking. The student-lector ratio will never be higher. The most efficient way of learning, for a student, would be to find an individual expert teacher, sit down next to him and start learning. The learning curve will never be steeper.

In practice, we must organize our educational system somewhere between these two poles. There are numerous experiments and education techniques, and most schools offer a mix of these to their students. The alternation of teaching techniques should help the students to focus, but they also provide us with a complicated challenge: *how can we make students to divide their workload evenly over these techniques?*

We illustrate these challenges by use of study workload measurements at the De Nayer Institute [7].

What we mean by “workload” and “activating”

In this text, we will use two terms that can be interpreted in different ways. For the sake of clarity, we define them first:

- *Activating method*: in this text, a student is activated by a teaching method or educational technique if it motivates him to spend more of his (private) time to the education, outside the college.

- *Student workload*: the amount of time that a student spends on his education. This must be seen as a *positive* term, which is *proportional to the amount of knowledge or competence that he acquires*.

So if an educational technique *activates* a student into a *higher workload*, we suppose that he will have absorbed or taken up more of the course objectives[1].

Measuring student workload

The ECTS (European Credit Transfer and Accumulation System) systems organizes an education as an accumulation of credits. Each of these credits represents an actual unity of workload. E.g. in Belgium, a credits stands for 25 to 30 hours of work. A Bachelor education consists of 180 credits, spread over three years. The workload numbers are averages, they differ between students.

The classical approach

Simple mathematics tells us that an average student will work 750 up to 900 hours per semester[2]. In a classical approach, this effort is divided into three stages:

1. *handing over* knowledge: 250-300 hours of presence in classroom/laboratory/…;

2. *processing* content: 250-300 hours to process the material;

3. *acquiring/studying*:250-300 hours preparing for exams.

The time that students spend on their study can only be measured by asking them about their workload. In the K.U.Leuven Association, different tools were developed in order to do so:

- one can inquire students *many* times over *small portions* of the semester; for this purpose the online Kronos system was developed [1];

- one can estimate *few times* over *large intervals*; a similar web based system called Metis [1];

[1] Obviously, study efficiency is also important.
[2] 180 credits * 25 hours / 6 semesters = 750 hours per semester

- one can ask students for a relative estimation by comparing parts of the curriculum; the Metis system has a module for this type of assessment [1]

- one can study the three stages with isolated measurements after every stage, using the former systems

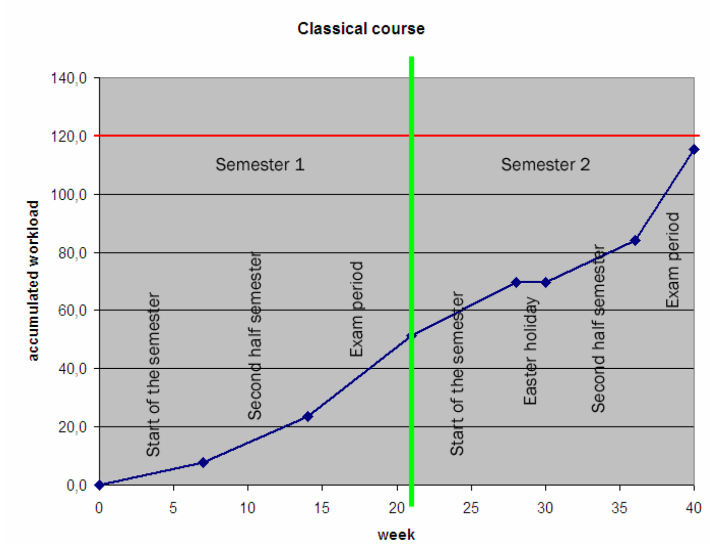

Figure 1. The three phases shown for a classical course

A problem arises if the education is organized in a different way. The classical measurement methods compute the average workload e.g. often assuming that different parts of the semester have a high statistical resemblance[3].

Hence, innovative teaching techniques require innovative measuring techniques.

Innovative teaching

When a school steps into the world of innovative teaching techniques, the former does not hold anymore. The study workload will no longer be spread evenly over the three stages – this is often the specific goal of innovation - and measuring becomes difficult. If we can not measure the workload, then we can not adapt the curriculum in a fair way.

The ECTS idea states that a teacher offers a course to a student and that some fixed amount of workload is attached to this course. Opposed to this idea, previous research [6] showed that for many students it works the other way around: *a student offers an amount of his time to his educational program* [3]. The lectures must compete for this time. So it is very important that innovative courses do not cannibalize other courses, nor that they would be pushed out the market by demanding (ex cathedra) courses.

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[3] E.g. a relative estimation based on the Thurnstone method implies that different courses have a similar variance of workload between students.

The passive student

The need for innovative education techniques starts with the premise *that a student is non-active by nature*. The educator hopes that once activated, the student follows the inertia principle and thus, that he will acquire both the competences and the content that are offered by the teacher.

But we must be careful about theses premises.

A student is just human

Workload studies and simple intuition teach us that students are not different from ordinary human beings: *they work towards deadlines*.

> *For example, the course of Figure 1 lays no requirements upon the students during the Easter holiday. Consequently, no effort is made there.*

This means that in a classical, ex cathedra context students already can be activated just by imposing multiple deadlines during the semester. Also, every deadline will drain study workload from other – at that moment low priority – courses.

Time mathematics

There are 7 days in a week, each holding 24 hours; 20 weeks in a semester. The workload of a student is physically limited by these numbers.

> *For example, an institution organizes 13 weeks in which 25 hours of class are held. Supposes that a student reserves 250-300 hours for exams, then there are 'only' 175 to 300 hours left for activation. He must spend this effort in about 15 weeks and often less (some weeks to start the semester up, some time for feedback). This means that an activated student needs to spend 15 to 20 hours a week extra.*

If innovative courses require no classical exam, then the associated workload is spread out over the ±15 weeks. The effort can go up to more than 30 hours weekly. This is more time than an average student can spend. As a result, the number of courses without exams should be limited to 1/3 of the study points at the most.

> *Indeed, the 175 to 300 hours of the former example correspond to 7 à 10 ECTS points, if we choose to assign all this workload. If this maximum is reached, then student will have to process and study the* <u>*all*</u> *the other courses at the very end of the semester.*

The myth

As a conclusion, very simple reasoning teaches us that the inactive student probably is a myth. He is simply opportunistic and spends no effort unless it is really necessary.

Notice that this leaves us with a paradox: in a timeframe where development of social skills and personal competences are considered to be very important, a student must be motivated to take on a hobby or a social engagement. School must enter the competition with these activities, which makes activating extra difficult.

Activation techniques

We can distinguish three types of activation techniques:

1. stepping in the field of student interest, *e.g. by use of contemporary technology*

2. lowering the barriers between the student and the study content, e.g. *learning anytime, anywhere*

3. shifting from knowledge to competences, *which requires activating and innovative methods when practical but general competences are taught*

Step into the field of interest

Although we all know that the one who uses the word “contemporary” is always the old person, contemporary technology can lower the doorstep towards the content of a course.

(a) Focus on sexy technology, *e.g. using weblogs, wiki, chat or youtube*.

There are methods to make the content *look better*. A student can be motivated to collect information in a wiki, correspond about it with chat and present it using multimedia. If a teacher tries to lure the student into studying, then two workload issues must be guarded. First, students can become over enthusiastic and end up with unbounded workload. They might put so much effort in the tool, that they forget to study the content. Secondly, with weblog and wiki technology, it is hard to assign the performed work(load) to a specific student, since often it is a joint effort.

(b) Problem based learning, *e.g. starting from real world applications, knowledge construction*

These methods try to offer the student a smaller amount of knowledge, but a profound insight. Some students will follow the defined path, but others might not see the problem to start with. This results in a large variance between the study loads that will be measured. Since study workload is mostly reported as the *mean* of a group, this difference might even be invisible to the teacher.

Table 1. Normalized variance of workload

	Normalized variance
Classical course	3,75
Practical course	1,00
Project course	12,39

For example, Table 1 show a normalized variance of a workload measurement of three types of courses: a classical course, a practical course and a very big project. The variance of the practical course is low, because it offers very clear deadlines to students, combined with a high level of guidance. For the classical course, students must choose there own pace. The project case has the largest variance, possibly because of the difference between students who just meet requirements and students who get enthusiastic.

(c) Teaching around projects, *e.g. mini enterprises at schools*

As stated before, students tend to work towards deadlines, which results in the problem of high workload peaks. For measuring the workload, projects are ideal when organized in a proper, separated way. A semester can then be divided into periods of project length, which one can measure. Also, the workload of a project is very well outlined in the mind of a student, which makes the estimation error smaller.

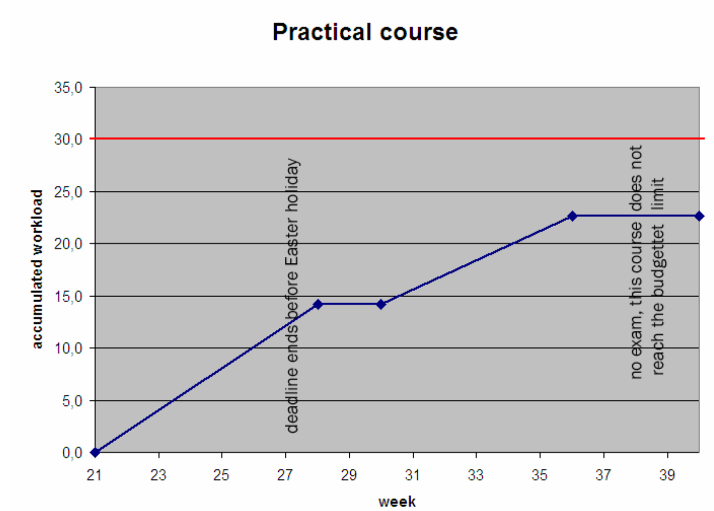

Figure 2. A practical course with regular deadlines

Notice that if project deadlines coincide, students will tend to assign a smaller overall workload to these deadlines than when there is a clear separation. Projects also confront us with the paradox of *subjective* workload appreciation versus the *objective* amount. Indeed, the high workload peak leaves the student with the impression of a high workload, whereas the absence of an additional examination often results in a total workload that is smaller than budgeted.

For example, Figure 2 shows an example of a small, practical course with regular deadlines. The absence of exam(s) reduces the total amount of workload, however students do not notice it.

The risk exists that a student will react by choosing a less profound way of learning [4].

Lowering the barriers between the student and the study content

What a student learns not only depends on the workload, it also depends on the *effectiveness* of the effort. If we can lower the threshold between the student and the content, if we can remove the overhead, then this effectiveness might improve. *Playing is learning, so let us turn learning into playing.* Study workload then loses its 'load' aspect.

From the point of view of workload, the student chooses his own pace – he must still cross the lowered threshold. As a result, some threats must be kept an eye on. First, there is the tendency for students to stay on safe, known grounds. In self tuition packages, there is the temptation to remain in chapters that a student already masters and which will give him positive feedback, rather than being confronted with his weaker points. Secondly, the student might end with a lower speed, since there is no human being close upon his heels. The workload then goes up, proportional to the loss of efficiency.

Finally, it is hard to measure the difference between real playing and real working.

This can be illustrated by a paradox that was noticed for students in an Informatics education. Despite the fact that they spend many hours behind computers, acquiring essential skills, they report only a very low study time when compared with similar students in different educations. As if they do not consider their hobby as a learning experience.

Shift to competence learning, peer instruction, learning in groups

A third group of techniques translates the study objectives from knowledge to competences. There is a lot to say about this option, but we restrict us here to the topic of workload.

In our daily practice, we see three issues surface. First of all, competence learning is well done in dialog with fellow students, in groups. But working in groups, does that *divide* the workload by the number of participants or *multiply* it by the number of group members? If the former is true, then *the teacher must accept that not every member of the group will acquire the full set of offered competences*. In the latter case, the workload will increase a lot, since students need a lot of time to repeat the same operations. Good organization is essential.

We also see that for competence learning a classical exam is very difficult to organize, which means that the workload is smaller by nature. Also a large amount of time – up to 25% of class time – must be spent on evaluation and feedback. Therefore, the course offers less knowledge/competence in its allocated time; good organization can solve this issue.

For example, we reformed a practical course in a laboratory setting at the De Nayer Institute towards a 100% competence based course. In order to offer sufficient feedback to the students, on average one of four sessions had to be turned into a feedback session. The study workload was not reduced, since students were pushed into a more profound preparation of the course. The knowledge part of the content was assumed to be acquired before the start of the session and the augmented feedback sessions left less room for individual escapism.

Conclusion

Innovative education has an important impact on student workload and thus on the effectiveness of a courses. But very little is known about this impact. It is very difficult to measure it, because the existing tools for assessment of workload are suited for the classical learning schema: *hand on - process - study*.

Program designers and teachers must take many issues into account:

- students can be over-activated and spend too much workload
- students can hide behind technology and spend a lot of workload with little effectiveness
- students that work in groups can multiply their workload or hide behind the work of others
- students only have a limited amount of time to divide between the elements of their education
- therefore, deadlines activate students towards certain courses, but they can drain workload from other courses
- student workload is best controlled by separating an activating course into well defined projects with non-coinciding deadlines
- students are human

For the educational institution, it is essential to monitor the process and the balance between classical and innovational courses.

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