Implementing the flipped classrooms and Peer Instruction in a Swiss University of Applied Sciences

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Abstract

In this paper, we report observations and data from one year of coaching Swiss faculty members who started implementing Flipped classrooms associated with Peer Instruction (Mazur 1997) in various disciplines, in sciences as well as in humanities. We learned about Peer Instruction at the ICED Conference held in Bangkok in July 2012 and as a result we decided to promote Eric Mazur's innovative pedagogy in a Swiss University of Applied Sciences.

Introduction

In this paper, we show what impact an ICED (International Consortium for Educational Development) Conference held in Asia could have on the learning experience of students in a European country, in this case Switzerland. In July 2012, we attended the ICED Conference in Bangkok, where we learned about an interactive teaching method invented by Harvard Professor Eric Mazur, who gave the introductory keynote lecture, which was followed up with a workshop.. This first meeting with Eric Mazur's teaching philosophy gave rise to a partnership between Eric Mazur himself and Lausanne University as well as the University of Applied Sciences and Art of Western Switzerland, where the combined number of students is more than 30'000..

In this paper we discuss how we introduced the Flipped Classroom and Peer Instruction among faculty members at the Western University of Applied Sciences in Yverdon. In this study, we show how we measured the impact of Professor Mazur's three visits to Switzerland in one year and how these pedagogical events developed into the beginning of a shift in teaching philosophy among faculty members who attended his lectures and workshops and then were trained and instructed according to Mazur's teaching philosophy. Recent studies demonstrate that undergraduate students in classes with traditional stand-and-deliver lectures are 1.5 times more likely to fail than students in classes where more stimulating, interactive learning methods are used. (Scott Freeman, 2014). In order to increase the quality of teaching, Swiss universities have invested in promoting these active learning methods. Here we discuss how professors encouraged college students to engage deeply in their learning, using a collaborative method of teaching called Peer Instruction (Mazur, 1997). This method is focused on a student-centered approach involving flipping the classroom. In this short article, we show the results of implementing Mazur's method among faculty and more specifically of one year of flipping a classroom for two different groups of engineering students, one group learning civil engineering and the other one learning English as a foreign language.

Research has proven the efficiency of Peer Instruction in various disciplines, mainly in the sciences where it originated, but rarely in humanities and foreign languages. In this paper, we will focus on the process of implementing Peer Instruction with Swiss college students, presenting the students' feedback and results and the faculty's point of view on this matter.

We also discuss how we have implemented Peer Instruction among faculty. Students' ratings have already shown a higher level of satisfaction after one semester of the peer instruction teaching method. The method is taught with either the use of flashcards, clickers or over the Internet with an interactive website called Learning Catalytics, which allows teachers to draw up new questions or to use some of the 7000 questions already on the data base. Students can then answer the questions using a smartphone, a tablet or a computer.

Our observations indicate increased student mastery of conceptual reasoning accompanied by an increase in self-esteem. In addition, we also found a significant increase in satisfaction with the learning experience and significant improvement in final exam results. On the faculty's side, we observed a deeper engagement together with a higher level of satisfaction.

Method

We analysed data on quantitative and on qualitative levels. To do this, we surveyed both students and faculty members involved in this pedagogical innovation, using online questionnaires and we interviewed members of both groups.

Eric Mazur was invited three times in one year and his first visit to Switzerland regarding this project occurred in October 2012. Over two hundred people, mostly faculty members, attended his lecture entitled: 'confessions of a converted lecturer' held at Lausanne University. 30 university professors experienced a more practical approach in a two hour long workshop on how to use Mazur's teaching method in a classroom. Following this introductory conference, instructional designers and educational developers offered to provide faculty with personal advice and resources in order to help them start implementing Peer Instruction in their classrooms. Around thirty faculty members showed interest and twelve started to implement actively Peer instruction in their classrooms while the remaining opted for a quiet self-paced implementation without seeking pedagogical supervision.

Mazur's second visit occurred in March 2013, when he gave a second advanced workshop following up on the first one, which was a prerequisite; 30 faculty attended this 3 hour intensive workshop based on how to conceive ConcepTests, i.e. questions based on students' misconceptions and mistakes and posed to students to practise interactively peer instruction during class sessions. During his third visit in November 2013, he gave both a lecture on: 'Assessment the silent killer of education' and a workshop on how to construct collaborative teaching. 150 people attended his lecture and 40 teachers attended his workshop. Among the approximately 60 teachers who started to implement Peer Instruction in their classrooms after Mazur's third visit, twelve have been accompanied more closely from October 2012 to today. In this paper we discuss how they were trained to shift their regular teaching towards a flipped teaching approach using Peer Instruction. We also show how this has impacted on students' learning experience, their levels of satisfaction and results.

All in all, two lectures and three workshops given by professor Mazur took place in 13 months. In between, individual counseling and advice has been given to 12 teachers trained by Professor Mazur. 40 other faculty members report having started to implement Peer Instruction on an occasional basis.

Findings

To measure faculty members' interest in Peer Instruction, teachers attending Eric Mazur's conferences and workshops were sent online questionnaires. 92 % of the teachers polled said they had learned material which they could tranfer into their teaching practice and all of them, 100 percent, said they enjoyed being taught Peer Instruction by its inventor. 73% said they would try to implement Mazur's method and asked for further support and advice. However, only a fourth, that is to say 25%, asked for supervision and met an educational developer in order to start teaching a flipped classroom with Peer Instruction. We tried to understand the reasons to explain such a high level of drop off and it seems that a high existing workload and the fear of being overwhelmed with more extra work are to blame here.

We interviewed all the professors who had asked for supervision, and we observed a high level of motivation and engagement in this approach. All of them expressed their conviction about the pertinence of this pedagogical approach their and interest in it. Here are a few comments: *'I'm convinced by the coherence of this approach', ' I will share with my colleagues'*. However, some of them also expressed some doubts about the outcomes: *'We can't compare average Swiss students with Harvard students and it may be difficult to obtain the same positive results', or 'Although I find this method very inspiring, I haven't the time and resources to implement it in my teaching, I would need support from my school to do so'*.

To measure our students' learning experience and satisfaction, we have analyzed more closely students' results and feedback in two different subjects: hydrogeology and English as a foreign language. Undeniably, research shows that students' feedback is relevant to their learning experience and satisfaction (Marsh, 1997; Wolff & Marsh, 2007) and hence provides a tool for measuring certain aspects of teaching quality.

Firstly, we compared the results of two different classrooms engaged in the learning of hydrogeology with the same teacher and the same final exam. One classroom was taught through the flipped classroom model using Peer Instruction (Class B) while the other classroom was taught with traditional stand-and-deliver lectures, i.e. teaching based on class transfer of information and assimilation of concepts and learning at home (Class A). An instructional designer trained in Mazur's teaching technique and philosophy accompanied and gave support to a young teacher of hydrogeology throughout the academic year to allow for this comparison. The results are striking when we compare indicators such as percentages having passed the exams and scores at exams. All indicators show better results with the flipped teaching approach associated with Peer Instruction.

	Class A N=8	**Class B N= 13**
Average on a scale of 1 to 6	4.2	5.1
% >4, passed exams	63%	100%
% key concepts assimilated	50%	100%
% of students able to solve a complex problem in a different context	25%	85%

The students' feedback expresses a high level of motivation for this subject and many comments point out the highly appreciated interactive way of teaching in classroom B. In addition to those remarkable results, we measure a high level of enthusiasm on both teacher's and students' sides. Among others, here's a comment showing high levels of satisfaction from the students:*'Excellent course, nothing to be changed!', 'Our teacher shows interest in each of us, no one is left behind, she makes sure everybody is on the same page', or 'excellent teacher, excellent professor'*. By changing teachers' roles, flipping the classroom gives more time to teachers during class sessions and allows teachers to get to know their students better and hence help them individually. (Bergmann & Sams).

Now let's turn to another analysis of a flipped course taught with wikis and Peer Instruction. This second analysis focuses on the class of 14 B2 EFL engineering students at Yverdon

University of Applied Sciences in Switzerland. This category of students expresses an average to a low level of motivation for humanities and foreign languages in general. However, foreign language courses are compulsory and carry significant weight in the requirements for a successful completion of the study program. There are two weekly sessions of 90 minutes dedicated to EFL teaching. The English teacher started to flip his classroom giving home assignments prior to the language class, and students had to read and write on specific topics and hand in their work one day before class meeting. The English teacher prepared ConcepTests based on students' misconception of English grammar and concepts and posed the questions at the next meeting. Interestingly, the teacher noticed that he would never have prepared the same questions, had it been up to him to decide on the teaching subjects. Flipping his classroom made him aware that his understanding of students' weaknesses and misconceptions had changed and that he then addressed the right concepts to his students. Homework was not graded, but the effort in doing them was, giving students a bonus at the end of the year.
As a result, we observed an exceptionally high rate of satisfaction among students. If we look more closely at the students' feedback and results, we can see that students find no discrepancy between the course objectives and what they achieved in the course. It's a very interesting result, as we usually observe a gap in respect to that special point. The highest score of 100% satisfaction concerns the method used to teach, and for personal satisfaction. Students express their happiness in their comments, which focus on how 'entertaining, fun and motivating' was the way the course was taught. They also express a feeling of a high level of learning, understanding and personal involvement.
To sum up, 100 percent of the students who sent in their feedback on the course expressed full satisfaction with the course, on how they reached their objectives, about the way their efforts were graded, the way they were evaluated and the way the course was taught. The rate of failure was extremely low as none failed, except for a student who left school before the end of the academic year. We assumed that he made his decision to leave the engineering school for personal reasons. In a ranking of over two hundred courses, this special course was ranked first for the first time in twelve years. Moreover, students expressed a better involvement in the given learning activities while 50% gained the final bonus given for achieving all the expected tasks prior to class teaching. In a few words, better satisfaction and better results. However, we reported a 61% of participation in the evaluation, which is too low a percentage to reflect an objective feedback. In classes where there are fewer than 30 students, we supposedly should have at least 80% of participation to reflect an objective situation (Centra, 1993). Nevertheless, as students expressed themselves directly during class sessions and afterwards by email, we assumed that the obtained results in the feedbacks show a generalized trend among all students.

Our findings confirm that active learning increases scores dramatically in small classes. (Scott Freeman, 2014)
Interestingly, we observed increased enthusiasm and motivation on both sides, from teachers and students.

Discussion

What exactly do we mean when we refer to flipped teaching or to the flipped classroom? Even if Professor Mazur has never claimed he invented the flipped classroom, he introduced the concept of flipping his classroom in his Peer Instruction manual (Mazur 1997): "the key point is to get students to do part of the work ahead of the lecture" (p.22)…"I require students

to read the text book and my lecture notes before coming to class" and my "lectures elaborate on the reading, address potential difficulties, deepen understanding, build confidence, and add additional examples" (p. 10). The concept of flipping the classroom could be summed up as follows. Firstly, transfer of knowledge occurs outside the classroom, as the students receive the material to study prior to the course. Thereafter, the assimilation of knowledge and new concepts take place afterwards in the classroom. According to Jonathan Bergmann (Bergmann & Sams), a high school chemistry teacher most people thank for having invented the flipped classroom although he does not lay claim to this, it's more a mindset than a teaching method and Bergmann even prefers to talk about flipped learning rather than flipped teaching. He mentions five key unifying themes of flipped learning: transferring the ownership of learning to students, personalizing learning for all students, giving teachers time to explore deeper learning opportunities with their students, making learning and not teaching the center of the classroom and maximizing the face to face time in the classroom. The commonly accepted definition of what a flipped classroom is the following: 'In most Flipped Classrooms, there is an active and intentional transfer of some of the information delivery to outside of the classroom with the goal of freeing up time to make better use of the face-to-face interaction in school. This can look very different from classroom to classroom and we recognize no two Flipped Classrooms look exactly the same, just as no two traditional classrooms look alike. The Flipped Classroom is a pedagogy-first approach that strives to meet the needs of the learners in our individual schools and communities. It is much more an ideology than it is a specific methodology…there is no prescribed set of rules to follow or model to fit…Practitioners of the various flipped classroom models are constantly tweaking, changing, rejecting, adding to, and generally trying to improve the model through direct experience with how effective it is for kids."(Brian E. Bennett et al., 2011)
In other words, Flipped teaching is rather a mindset than a teaching strategy and may vary considerably depending on the context, yet we observe a growing number of faculty implementing flipped teaching not only in STEM (Science, Technology, Engineering and Maths) but in various disciplines, such as history, languages, social studies, and not only in colleges and universities but at all levels, in elementary school and middle school (Bretzmann, 2014). Moreover, flipped teaching is not necessarily associated with technology and can be implemented with reading assignments or pre-class writing tasks. Part-time flipping can be another option and involves flipping only portions of the classroom. Both teachers whose flipping class we observed previously opted for part-time teaching. As professionals, they knew what was best for their students and reported that technology was not always the best way to instruct and share ideas. Moreover, both reported being scared and considering it a daunting task to flip their class 100 percent, due to a lack of technological skill and a lack of time to create flipped lessons. Part-time flipping allowed them to flip at their own pace, finding ways to incorporate new technology as they saw fit.

(my comment: I don't think their has been enough mention of what technology is required)

In this study, we have discussed the transfer of information out of two classrooms, one of hydrogeology and one of English as a foreign language, associated with the Eric Mazur interactive method of Peer Instruction (Mazur, 1997)

The above-discussed method of flipped teaching provides schools with a context to use 2.0 technologies in learning environments. Indeed, students can practice the use of wikis for their learning experience and can also have the opportunity to extend and practice previously acquired skills such as using youtube, discovering new perspectives in educational settings allowing co-construction of knowledge and communication prior to the class and also during

class sessions and even afterwards. Moreover, as students are aware of how their written production will be read by other students, kept online and possibly graded by their professor, they become more seriously involved in the activity prior to the classroom meeting. Practising interactivity in the classroom with Peer Instruction has proven to be very efficient and well adaptedto the context. Above all, we observed that what is particularly impactful in a collaborative approach of learning is that students adapt their discourse, language and explanations to convince their peers. Being able to explain a subject to a fellow student requires a high level of comprehension and capitalizes on a high level of retention. These elements increase not only intrinsic motivation but also the quality of the collaborative product and thus produce a high level of satisfaction. Furthermore, as a result the objectives of the courses under discussion were fully attained and the students' learning experience was optimized.

Furthermore, teachers report a very high level of personal investment in the preparation of their teaching. Although faculty mentions the difficulty in finding appropriate and relevant ConcepTests based on the misconceptions and mistakes brought to light through pre-class assignments, they report a very high level of motivation when doing this. However, it has been observed that a high level of motivation and energy required from a professor willing to use wikis for collaborative student work prior to the teaching and peer instruction should be accompanied with instructional designer's coaching and support.

Practical implications

In our study, we observed that, despite a high level of motivation of faculty members at the beginning of the process of implementation, only 25% of the faculty involved in the workshops started to shift their teaching towards the flipped classroom. However, this resulted in a very high level of satisfaction not only for the teachers but also for the students. From the teachers' point of view, what has been proven to be difficult concerns certain aspects of the assignments, which could be improved. Indeed, they occasionally experienced difficulty in creating ConcepTests, which weren't as relevant as expected. The difficulty lies in finding the right question in what Vygotsky called the zone of proximal development: "The zone of proximal development defines functions that have not matured yet, but are in a process of maturing, that will mature tomorrow, that are currently in an embryonic state; these functions could be called the buds of development, the flowers of development, rather than the fruits of development, that is, what is only just maturing" (Smith, Dockrell, & Tomlinson, 1997)

Nevertheless, the results of one year of teaching flipped classrooms and Peer Instruction are very encouraging. Indeed, this interactive method based on collaborative work has proved to be effective in teaching not only in sciences but also in foreign languages. Teaching through a student-centered approach involving flipping the original classroom by moving information transfer out through technological support and moving application of learning into the classroom is rather uncommon in Switzerland. Our observations indicated an increase in student mastery of both use of English and critical thinking and writing accompanied with an increase in self-esteem. Even if the model might be improved, teaching common language practice exercises with pre-class written responses using wikis as a support for the collaborative tasks proves to be motivating and enhances satisfaction at the same time. Our observations show that this method helps students learn more from pre-class homework and increases students' intrinsic motivation. Moreover, students report a higher engagement in

discussions with their peers. Previous research has demonstrated the effectiveness of peer instruction for sciences and humanities, with the exception of foreign languages. In contrast, this study proves that Peer Instruction associated with the use of wikis enhances effectiveness in collaborative pre-class work when compared to more traditional teaching methods. Thus, students' ratings have shown a significant higher level of satisfaction after one semester of following the peer instruction teaching method while teachers are highly motivated to pursue the experience despite the amount of work involved.
The field of education is facing dramatic changes and disruptive innovation due to technology and professional development will be necessary to move faculty towards implementing innovative ideas in their classrooms. Flipping teaching might be a way to face up to unavoidable new educational challenges.

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