Socratic Flipped Classroom – What Types of Questions and Tasks Promote Learning?

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Abstract: Socratic questioning stresses the importance of questioning for learning. Flipped Classroom pedagogy generates a need for effective questions and tasks in order to promote active learning. This paper describes a project aimed at finding out how different kinds of questions and tasks support students' learning in a flipped classroom context. In this study, during the flipped courses, both the questions and tasks were distributed together with video recordings. Answers and solutions were presented and discussed in seminars, with approximately 10 participating students in each seminar. Information Systems students from three flipped classroom courses at three different levels were interviewed in focus groups about their perceptions of how different kinds of questions and tasks supported their learning process. The selected courses were organized differently, with various kinds of questions and tasks. Course one included open questions that were answered and presented at the seminar. Students also solved a task and presented the solution to the group. Course two included open questions and a task. Answers and solutions were discussed at the seminars where students also reviewed each other's answers and solutions. Course three included online single- and multiple choice questions with real-time feedback. Answers were discussed at the seminar, with the focus on any misconceptions. In this paper we categorized the questions in accordance with Wilson (2016) as factual, convergent, divergent, evaluative, or a combination of these. In all, we found that any comprehensible question that initiates a dialogue, preferably with a set of Socratic questions, is perceived as promoting learning. This is why seminars that allow such questions and discussion are effective. We found no differences between the different kinds of Socratic questions. They were seen to promote learning so long as they made students reflect and problematize the questions. To conclude, we found that questions and tasks promote learning when they are answered and solved in a process that is characterized by comprehensibility, variation, repetition and activity.

Key words: Flipped classroom, questions, tasks, Socratic questioning.

1. Introduction

In higher education, the flipped classroom is sometimes presented as being completely different from traditional university teaching (Bishop & Verleger, 2013; McCarthy & Anderson, 2000). As such, it is an active learning approach that seeks to allocate more time to teacher and student interaction than would be the case in traditional teaching (Kvam, 2000; Prince, 2004). Researchers have found that students and teachers perceive the flipped classroom approach as a positive experience (e.g. Galway et al, 2014; O'Flaherty & Philips, 2015). Other studies have indicated that it can also improve student performance (e.g. Mason et al, 2013; O'Flaherty & Philips, 2015).

The flipped classroom method is often related to eLearning, which is a natural assumption since ICT is often used to record, distribute and consume learning content. Whilst ICT is simply a medium, it does provide opportunities to take a pedagogical approach based on the idea of active learning (Avdic & Åkerlund, 2015). ICT is of course not a pedagogical approach in itself; it can, however, strengthen certain aspects of learning, such as the flipped classroom. Like all pedagogical approaches, the flipped classroom can only succeed if it is exercised in an effective way. Indeed, there are several factors that can affect the effectiveness of a flipped course. Regardless of the quality and content of the digital recordings that are normally used, the types of questions and tasks assigned,

along with the digital presentation itself, are of crucial importance. These questions and tasks are the triggers of the learning process.

Questioning is central in all kinds of education. Above all, it is used to promote learning and to assess performance. Teachers ask students all kinds of questions for various purposes. When the learning purpose is descriptive, these questions are accordingly descriptive. When students are expected to demonstrate analytical and evaluative skills, they are more refined in order to reflect a specific kind of knowledge and skills.

In this paper, our aim is to investigate how students perceive different kinds of questions from a learning perspective.

2. Theory

As far back as the ancient Greeks, there has been an interest in how to question in order to learn. Socratic questioning stresses the importance of questioning in learning, which is why it is still relevant to any discussion of how to learn today. Socratic questioning is different from questioning *per se* in that it is systematic, disciplined, and deep. Usually, it focuses on fundamental concepts, principles, theories, issues or problems. This is very much in line with teaching in higher education that promotes analytical and critical skills as the highest form of learning (Law of higher education, 1992).

According to Socratic questioning, a question is not just a question and an answer. It is a dialogue that can be used by a teacher to answer a question in order to search for further relevant answers and reflections.

Van Aswegen et al (2011) exemplified six ways of posing questions in a Socratic manner.

1. Getting students to **clarify their thinking**
   'Why do you say that?', 'Could you explain further?'
2. **Challenging** students about assumptions
   'Is this always the case?', 'Why do you think that this assumption holds here?'
3. **Evidence** as a basis for argument
   'Why do you say that?', 'Is there reason to doubt this evidence?'
4. **Alternative** viewpoints and perspectives
   'What is the counter-argument?', 'Can/did anyone see this another way?'
5. **Implications and consequences**
   'But if... happened, what else would result?', 'How does...affect...?'
6. **Question the question**
   'Why do you think I asked that question?', 'Why was that question important?', 'Which of your questions turned out to be the most useful?'
   (Van Aswegen et al, 2011)

Questions can focus on different aspects of knowledge domain, such as concepts or theories. Questions can also take different forms, even if they focus on the same kind of knowledge type, e.g. concepts or theories of a knowledge domain. Wilson (2016) put forward five types of questions in which different kinds of thinking and knowledge are targeted.

1. **Factual**. The answer can be found in the literature. Answers are right or wrong.
   'What kinds of software tests are there?'
2. **Convergent**. Students are asked to justify their answer when the justification can be found in the literature or in the light of evidence offered or the inferences made.
   'Considering a hierarchy of goals, which goals are conflicting?'
3. **Divergent**. Includes valuing, organization, or characterization.
   'If an organization is planning to implement an ERP system, how can they proceed if none of the ERP system candidates do not fulfil their main requirements?'
4. **Evaluative**. Sophisticated cognitive and/or emotional (affective) judgement.
   'What kind of research strategy is most relevant when carrying out a literature study, and what are the consequences of the alternatives?'

5. **Combinations**. Any combination of the above.

Above, we have presented two categorizations of questioning that pose different challenges for students. As a teacher you need to make assumptions about which types of questions and tasks are most effective in a learning situation. But how do we know how this is perceived by the students? This question is the motivation for this paper.

3. Method

This paper takes a case study approach, using focus group interviews for data collection. Our three cases are courses in Informatics at Dalarna University in Sweden. The courses all ran in the academic year 2015 to 2016. The cases are presented in more detail in the Results section below.

Focus group interviews were carried out in groups that each comprised between five and eight students. Each interview lasted about an hour. The interviews were recorded and transcribed with the permission of the participants.

The aim of the interviews was to allow the students to reflect upon the questions and tasks they had to answer/perform during their particular Informatics course. We selected examples of questions and tasks (see below) and presented them to the students for reflection on how they found them to be effective from a learning perspective.

The questions asked during the interviews were about:

- how different kinds of questions and tasks mattered from a learning perspective.
- how the students thought and acted when they were looking for answers.
- which questions were less effective and more effective
- how the videos, recordings and textbooks were used to answer questions
- the role of the seminar with regard to discussions, seminar tasks, and presentations for answering questions or solving tasks.

We analyzed the material both inductively and deductively. During the inductive analysis, we looked for what the students perceived as effective for learning without considering the categories in the Theory section. After that, we compared our findings with the theoretical categories. We then organized our findings accordingly.

4. Results

In this section we present our three cases and findings from the focus group interviews with students from three flipped classroom courses. The courses are part of a three-year Bachelor program in Systems Science.

4.1 Course one

The first course, Research Methods, runs in year one. Learning outcomes focus on an understanding of and ability to use and motivate strategies, data collection and data analysis. The course consists of laboratory work, seminars, video lectures, and one individual and one group assignment. Five video lectures cover the main topics. The lectures and seminars are based on the main textbook: "Researching information systems and computing" (Oates, 2006). The flipped classroom approach is carried out through the videos, textbook and seminars. The course study guide presents the students with a number of questions (normally 10 to 12) that they are supposed to answer individually in writing and submit the day before each seminar. Seminars last for two hours and are divided into two parts. First, the students take turns to explain their answers to the questions (see Table 1). Secondly, they get a report that is relevant for the seminar topic, together with four questions (see Table 2). The answers to these questions can be found in the report and are presented using PowerPoint to the rest of the group. The process is depicted in Figure 1 below.

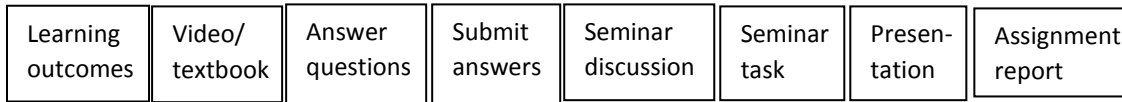| Learning outcomes	Video/ textbook	Answer questions	Submit answers	Seminar discussion	Seminar task	Presen-tation	Assignment report

Figure 1 Course one – the flipped process.

Below are examples of questions that students are supposed to answer before the seminar.

Table 1 Questions.

1. Survey
   a. What is a Survey strategy?
   b. How can you plan and design a Survey?
   c. How can you evaluate a Survey strategy?
2. Is there something in the study material that relates to such strategies that needs to be discussed and explained?

Table 2 Seminar questions.

1. What motives are presented for the selected strategy?
2. How is the selected strategy described?
3. How is the strategy used in the study?
4. How are the limitations of the strategy described?

4.2 Course two

The second course, Change Analysis, runs during year two. Learning outcomes are related to the skills and abilities needed to conduct a change analysis and the students' ability to evaluate different analyses so as to propose changes needed to the studied case. The main learning activities in the course are six mandatory seminars and project work, whereby the students perform a change analysis at a company or organization. Answering the seminar questions and the project work are group activities. For each seminar there are pre-recorded lectures and recommended reading. The seminar questions are disseminated to the students one week before the seminar and the students submit their answers and solutions to the questions before the seminar. They are also expected to look at and comment on another groups' answers before the seminar. For the seminar questions, they are given a case description of the fictional company used for their analysis. The first four seminars focus on a specific part of a change analysis (such as problem analysis or goal analysis), and the last two seminars focus on methodological questions and information literacy.

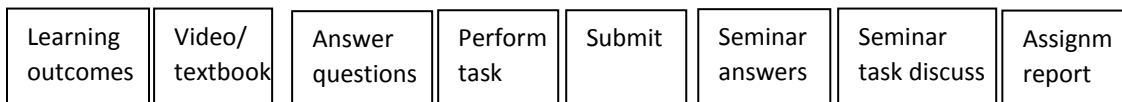| Learning outcomes	Video/ textbook	Answer questions	Perform task	Submit	Seminar answers	Seminar task discuss	Assignm report

Figure 2 Course two - the flipped process.

Examples of questions that students were supposed to answer in writing and submit before the seminar. The examples are from the seminar on business analysis.

Table 3 Questions that are supposed to be answered before the seminar.

Task A: Study an alternative way to describe processes in an organization and answer the following questions: 1) What are the advantages and disadvantages of different notations? 2) What are the implications of different graph techniques that model different concepts?

Task B: Describe some general rules for the way that action graphs should be drawn. 1) What should you consider? 2) What should you avoid?

Task C: There are two ways of looking at a business: from a process-oriented and function-oriented approach. A process-oriented approach is often seen as a better option. What arguments are used to support a process-oriented approach or a function-oriented approach?

Task D: What have you experienced as difficult or complicated in business analysis? What would you like to discuss in the seminar?

Task E: Make a process graph for the Datadalens cottage rental service (the fictional company that we used as a case).

4.3 Course three

The third course, Maintenance and Testing of IT Systems, runs during year three. Learning outcomes focus on the acquisition of knowledge and understanding of systems maintenance and the testing of IT systems. The course comprises three parts, which are examined in three different ways. The first part focuses on systems maintenance and consists of four seminars, which are examined through seminar participation and by writing an assignment report. The second part focuses on the testing of IT systems and consists of four video lectures based on the main (Swedish) textbook "Test and quality assurance of IT-system" (Eriksson, 2008), and an online quiz, followed by a seminar and a laboratory task. The latter is examined by a laboratory assignment report. The third part is a project examined by a project report and viva. Flipped classroom pedagogy is used in the second part of the course. Neither the quiz nor the seminar are mandatory; however, in order to attend the seminar students have to complete and submit the quiz, with 35 multiple choice and yes/no questions, beforehand. The questions are based on the four video lectures, which contain information that the student will need in order to complete the laboratory assignment report. The quiz is available online on the Fronter LMS. The students can have one attempt at the quiz, for which there is no time limit. The purpose of the quiz is to detect the areas that the students have not understood or have misunderstood from the video lectures. These areas can then be discussed during the seminar In order to fill the knowledge gap and prepare students for the laboratory assignment that follows. The class is divided into groups of 10 to 15 students during each seminar which is somewhat more than the other two courses. Throughout the seminar the students are presented with the overall result of each question in the form of diagrams (not individual results). The seminar participants focus on the discussion of those questions for which incorrect answers have been given. Figure 3 below illustrates this process.

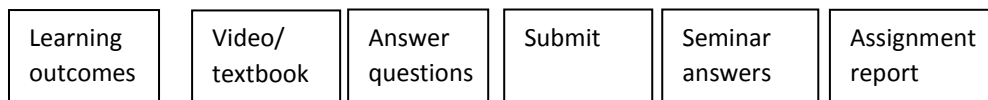| Learning outcomes | Video/ textbook | Answer questions | Submit | Seminar answers | Assignment report |

Figure 3 Course three - the flipped process.

Factual questions are used in the quiz that the students are required to answer and submit before the seminar. Two examples of quiz questions are:

1. Testing tools are only used in automated tests.
   a. Yes
   b. No
2. Examples of tests that take place during systems maintenance are (multiple choice question):
   a. delivery tests
   b. regression tests
   c. planning tests

During the seminar the questions with wrong answers are discussed and the participants can clarify the answers. The Socratic aspect was planned to be implemented during the seminar, where we expected a discussion/dialogue to take place about the answers that were not correct.

5. Findings and analysis

5.1 Course 1

Overall, the students said that the questions and tasks should be comprehensible and not too complicated. Even if a question was quite simple and could be answered just by finding the answer in the textbook or in the recording, the search for the answer, or the search for the meaning of a concept, made the students more aware of the context of the question. Furthermore, the discussion at the seminar brought more meaning to the specific knowledge domain. Students found it frustrating when they were not sure what was actually meant by a certain question. One student stated: "You shouldn't have to use half the time to try to understand what a question is about". The question about how to plan and design (Table 1, question 1b) was favored by several students because it made them understand a context rather than just a fact or a concept. It also made them read more of the section about the studied concept in order to answer the question. When the students submitted their answers, relatively few of them answered question 2 about what needed to be discussed or explained. They claimed that the reason for this was that they knew they could discuss this at the seminar. Some students were also rather afraid to reveal their ignorance.

During the first part of the seminar, when the students presented their answers to the questions they had prepared, the teacher asked Socratic follow-up questions, such as "Can you explain what is the main purpose by triangulation and give an example?". One Socratic way to promote discussion, which was mentioned in the interviews, was 'Alternative viewpoint'. This was directed to the rest of the group after a question was answered by a student. 'Clarify thinking' was also almost mandatory when something in the answer was not clear. All kinds of Socratic questions were used, except for the sixth question. Even when the original question was factual, convergent, divergent or evaluative, the seminar follow-up question could be any of the Socratic questions.

As for the questions that were supposed to be answered and presented during the seminar (see Table 2 above), almost all students were positive. They had to answer questions and present their answers to the others, all in 45 minutes. Because they didn't have much time, they had to be very efficient. Most of the students, although not all, found this to be a positive challenge. Comments included: "It was really rewarding to do something yourself". "The first time it was scary. After a while I looked forward to the presentation". When first faced with this challenge, the students thought it would be impossible to find answers and make a presentation in 45 minutes; however, when they saw that it was indeed possible, they were stimulated by the challenge.

To summarize, the students considered the following aspects to be important from a learning point of view: comprehensible questions and tasks, variation in the material's format, repetition of the information in various forms, active ways to process information, and the presentation of the answer to the question to the others. We used factual, convergent, divergent and evaluative questions. During both parts of the seminar, including the presentation, discussions included Socratic questions.

5.2 Course 2

Overall, the students liked questions that required them to actively look for answers from different sources and where they had to make sense of different concepts. For example, Task C in table 3 required the students to find out the meaning of two concepts and compare them with each other. Comparing these types of questions to more factual questions that can easily be found in the texts, the students felt that questions where they had to investigate something were more beneficial for their deep learning than factual questions that were easily forgotten. However, they felt that factual questions and more investigative or practical questions could be combined to further stimulate their learning: "The questions can be combined, you can have 'small' questions, words, concepts, that later activate you when you have to apply them". Furthermore, the factual questions were discussed during the seminars to increase the students' understanding of different concepts. For example, if the students were asked to list what should be avoided in a specific graph technique, follow-up questions should ask for any reasons why something should be avoided, the implications of ignoring the rules and so on.

One problem identified by the students was that some of the questions in this course used words that they did not know the meaning of. These were words that we, as teachers, took for granted. When the questions were not clearly formulated and understood by the students, it led to frustration. This was also apparent in the groups'

answers during the seminars, where poorly formulated questions more often had answers that where wrong, or only partially correct.

A reoccurring question in all seminars was that we asked the groups to state what they had found most difficult, and what they wanted to discuss during the seminar (see Task D, table 3). Not all groups answered the question for all the seminars; however, the ones that we interviewed felt that the question had an important function. Having the ability to decide what to discuss was an opportunity to "get something more, or better explained in the seminar instead of having to try and figure it out from the textbooks". The reason that not all groups answered the question was thought to be that they did not want to look stupid in front of their peers.

A question that was included in the first four seminars was related to the modelling of graphs based on a case description (see Task E, table 3). In this question the groups had to apply what they had learned in a more practical activity. These types of questions were appreciated by the students: "In these types of questions, the things you have asked earlier reoccur. You talk about it, in the recorded lectures for example, and you think 'okay, this is easy' and then you have to do it yourself and you notice how difficult it is. You have to start to think about what you are doing". Hence, the students felt that it was difficult to grasp the complexity of things by just seeing or hearing someone else talk about it. They had to apply it themselves in order for the "thought process" to start. After the students had presented their graphs there were more discussions and follow-up Socratic questions (both from the teachers and the other student groups), where different solutions, motivations for a specific solution, and so on, were presented. Thus, the students had to re-think their original answers, and thei initial assumptions, leading to further improvements in their learning.

5.3 Course 3

Overall, the students preferred questions that were clearly formulated. They liked the quizzes, because they were presented with various possible answers, which helped to clarify the questions. When comparing this format with one that involved writing answers to questions, one student stated: "If you are to write your own answers you do not know if you have understood the question". Another student thought that having options to answers contributed to learning: "You learn even from the answers available".

The fact that the students had to answer the questions in the quiz motivated them to listen to the video lectures. Several students agreed that it helps with the motivation to learn if they understand the purpose of listening to the video lecture. It also helps if the subject is interesting. Another aspect that affects their learning and what they do before a seminar is how the seminar is structured. If the students are supposed to be active in the seminar it motivates preparation. It was also found that the way in which they are supposed to participate also affects preparation. The learning that takes place in the seminar is helped by discussions. According to one student: "It is always good to discuss". On the other hand, one student stated: "It is easy to just take a more passive role and just go with the flow with what others discuss during the seminar".

The types of questions in the quiz can influence the learning process. One student thought that: "Yes/no questions do not contribute to more knowledge". Multiple choice questions, which offer the possibility of several correct choices, were also seen to be good for learning. As one student put it: "You have to think a little harder".

Knowing that they would complete the quiz after listening to the video lectures affected the way some of the students listened. One student stated: "I was looking for special sentences". According to another student: "I was memorizing words". Comparing a quiz like this with writing answers to given questions, one student said: "If I write my own answers I would try to understand the subject and the text more". Thus, the quiz resulted in surface learning rather than deep learning. In addition, the way the students prepare for quiz-type questions, by looking for facts in the video lectures, does not promote deep learning. One student stated: "… I forgot the facts shortly after the quiz". With this in mind, it was harder to engage the students in deeper discussions during the seminar that followed. It was also hard for the students to talk about the correct answers, because they expected someone else to provide these during the seminar. However, the quiz did help the students to gain an awareness of what they had understood from the video lectures. One student stated: "The quiz helped me to know that I was on the right track after all". The students also appreciated that they could see the result after the quiz was submitted: "That was the best."

To summarize, the students approached the quiz by looking for words and definitions, and memorizing these, while listening to the video lectures. The yes/no type of questions asked in the quiz were not perceived as helpful for learning; however, the multiple choice questions could be seen as a part of the learning process, itself. Thus, students' awareness about how they are going to participate in the seminar does affect how they go about preparing for the seminar.

6. Discussion and conclusion

All three courses applied different means to support flipped classroom learning. They all included recordings and questions that had to be answered before the seminars. Course 1 included task solving and the presentation of the solution during seminars. Course 2 included a task whereby the students had to analyze a case and present a solution graphically. Course 3 provided an online quiz with instant correction of the answers and a discussion of the answers at the seminar.

We found that a fundamental demand on a question is that it should be comprehensible and indicate a direction for where to look and how to search for the answer. Dubious or fuzzy questions are counterproductive and cause students to lose energy and motivation. This is regardless of whether the question is factual, convergent, divergent or evaluative.

The motivation to read, listen and reflect upon the initial questions depended on what happened in the seminar. Courses 1 and 2 included planned seminar discussions about the answers submitted, where all students had to take an active part. After a student had presented an answer the teacher usually either asked the student a 'clarifying' question or posed an 'alternative' question to the rest of the group about other viewpoints. Some answers led to 'implications' questions and others to 'challenge' or 'evidence' questions. The students perceived this discussion to promote learning as it provided repetition from different perspectives. In addition, the students had to process the information through presentations or a case analysis. We consider this method of learning to be 'evaluative'. Together, these learning methods generated a number of activities for each initial question. This flow of activities included a seminar discussion, with Socratic questions mostly posed by teachers but also by students. After the verbal processing the students also had to apply the knowledge gained. This mix of practical and theoretical activities was appreciated by the students, because of the variation and repetition aspects, and their perceived effect on learning.

The seminar in course 3 included students' presentations of the answers and an opportunity for them to discuss the answers, especially those that were incorrect. This discussion could eventually include most Socratic questions; unfortunately, the students were not prepared for these. So when comparing the three courses the third course with quizzes generated less discussions. We can only guess the reasons for this. One reason might be the size of the seminar groups and the room arrangements. When the students in course one and two sat around a table in smaller groups, the students in course three sat in a regular classroom behind each other and in larger groups than the other students. Another possible reason could be the fact that the students were not prepared for a discussion. We thought that the discussion might start by itself when we presented the results and the answers. But this didn't really happen. So in all we can't say that quizzes are less suitable for Socratic questioning before we have tested another seminar approach with fewer students and prepared questions covering different kinds of Socratic questions.

In all, we found that any comprehensible question that initiates a dialogue, preferably with a set of Socratic questions, is perceived as promoting learning. This is why seminars that allow such questions and discussion are effective. We did not find any difference between the different kinds of Socratic questions. As long as they made the students reflect and problematize the question, they promoted learning.

To conclude, we found that questions and tasks promote learning when they are answered and solved as part of a process that is characterized by comprehensibility, variation, repetition and activity.

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