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Scaffolding the Flipped Classroom to Enhance Students' Learning Process

ABSTRACT

After multiple trials to determine the most effective flipped classroom design for our bachelor course, Philosophy of Science, we established a setup with compulsory flipped workgroups at the core, while online knowledge videos and optional joint classes offer preparatory support. This article documents our attempts to improve scaffolding offered in the optional joint classes by structuring them according to the Question Driven Discovery model. Regarding the effectiveness of the offered scaffolding, the findings are mixed: students did not perceive the joint classes as highly activating or yielding positive learning effects, and most preferred to prepare for flipped workgroups independently. However, substantial differences were noted in learning activities and outcomes between attendees and non-attendees, as well as in their valuation of the supportive and activating function of the joint classes. These results confirm earlier findings which show that, to capitalize on the potential activating effect of the flipped classroom during the bachelor phase, instructors need to strike the right balance between structure and flexibility. As early career students' capacity to self-regulate is limited, we recommend future research focuses on how to design assignments and assessment in such a way that students are required to engage in scaffolding learning activities, even if they are non-compulsory.

KEYWORDS

flipped classroom, scaffolding, blended learning, activating education, learner-centered approach, self-regulation

INTRODUCTION

For more than two decades (Lage, Platt, and Treglia 2000), the flipped classroom has been hailed as an effective educational design to activate students and enhance deeper learning. As such, it raised interest and eagerness to experiment with this pedagogical concept within the University of Amsterdam's educational innovation lab at the Institute for Interdisciplinary Studies. The starting point of the flipped classroom is that students process content information on lower learning levels outside the classroom, in self-study and via online education, so that there's more time available to interact during class. Thus, students can be optimally activated during the face-to-face contact hours which enhances the chance to attain higher-level learning (Abeysekera and Dawson 2015; Bergmann and Sams 2012; Braseby 2015). Meta-reviews suggest that at points, the activating potential of the flipped classroom is ambiguous (Akçayır and Akçayır 2018; O'Flaherty and Phillips 2015; Strelan, Osborn, and Palmer 2020a; Strelan, Osborn, and Palmer 2020b), but there's also strong empirical evidence that using the flipped approach increases students' performance. Whether students like the

flipped classroom and positively evaluate it is a different question though, as we experienced in our own experiments.

Encouraged by the innovation lab six years ago, we started with converting the conventional lectures in the Philosophy of Science course—a core course taken by all students of the bachelor of future planet studies, which is also located at the Institute for Interdisciplinary Studies. As in most of our courses, students have four contact hours, two of which are reserved for a non-compulsory lecture and the other two for a subsequent compulsory workgroup.

First, we let go of the so-called transmission model where the teacher is mainly "sending" knowledge to students (Biggs and Tang 2015), and changed the lectures into more interactive class meetings (see Table 1). We then found, as did Fisher and Assa-Eley (2013), that exercises demanding higher in-class performance are less preferred and that many students tend to shy away when they are expected to engage in preparatory activities (see Tromp 2022). This was the opposite of what we aimed to achieve.

Table 1. Overview of various flipped classroom designs

Years / Trials	Work forms (in order of appearance)	
	General Class Meetings (Optional, Non-Compulsory)	**Meetings in Subgroups (Compulsory)**
Before 1	Conventional lectures for all students	Small-scale, interactive workgroups
1	Interactive lectures for all students	Small-scale, interactive workgroups where preparatory assignments were discussed
2	Interactive masterclasses for all students where preparatory assignments (including exam questions) were discussed	Small-scale, interactive workgroups where core concepts addressed in the masterclass were further elaborated and preparatory assignments were discussed
3 & 4	No general class meetings, only online supporting materials, including knowledge videos	Small-scale, interactive workgroups where core concepts addressed in the knowledge videos were elaborated and preparatory assignments were discussed
5 & 6	Interactive joint classes in which students are actively involved in the exploration of core concepts and introduced to preparatory assignments (including exam questions)	Small-scale, interactive workgroups where core concepts explored in the joint class are further elaborated and preparatory assignment are discussed

In the following years, we focused on improving the course design to attract more students, for instance by including masterclasses where students were actively invited to put their (prepared) questions before external experts. All to no avail—we did not succeed in attracting more than a quarter of the students to join in the general class meetings regularly (Tromp 2022). These findings are in line with conclusions from related studies that a large proportion of the students are "flip resisters" who do not endorse the pre-learning aspects of the flipped classroom (McNally et al. 2017), and that more preparation required for the in-class discussion is related to lower student acceptance and less favorable perceptions (Doyle, Krupicka, and Vo 2013).

Another finding that is shared with comparable studies (Sointu et al. 2023; Velde et al. 2021), is that students, particularly in the early phase of their bachelor studies, are very apprehensive about speaking up in a large lecture room. During our trials we found that the workgroups form a safe environment for students to take an active attitude; that is the place where most of them are not

afraid to enter into discussion and develop enough confidence to actively participate in exercises. As such, they are the most suitable form of education to flip. When we moved the course from the first to the second year, students' participation in the (optional) general class meetings remained low, so we decided to leave them out altogether. Since students did not seem to appreciate them and found them redundant while the small-scale (compulsory) workgroups were highly valued, we decided to make the latter the backbone of the course and abandon the large-scale class meetings. We solely offered online knowledge videos to help students grasp the core concepts in the compulsory literature and enable them to make the preparatory assignments for the workgroup.

Completely relying on students' willingness and capacity for self-study to prepare for interactive workgroups turned out to be not viable, however. These findings correspond with recent meta-studies (Alten et al. 2019; Bredow et al. 2021), which show that blended learning designs should never lead to less contact hours. The need for sufficient contact hours may help to explain why, paradoxically, students soon called for the return of traditional lectures. Low attendance and valuation of lectures by students is not an exception but a general trend (Massingham and Herrington 2006; Top Hat 2021), but we are not convinced that returning to a situation of passive "consumption" of lectures would be an effective response. We are more inclined to think, as Velde et al. (2021) and Sointu et al. (2023) suggest, that in order to help students make the move from being passive to active learners, sufficient guidance is required. If the flipped classroom is to actually enhance students' self-regulation, it is important to provide them with clear instruction and guidance. Thus, Velde et al. (2021) and Sointu et al. (2023) call for research that can shed more light on how these factors influence the learning experience. We decided to answer this call, and provide students support to "get going" and actually engage in learning activities. After five trials with the flipped classroom within our course, we have established a set-up where optional joint classes help students prepare for active participation in the compulsory flipped workgroups.

In the following section, we explain the theoretical rationale behind the decision to offer joint classes to prepare for the flipped workgroups and our efforts to improve their supportive function. Next, the research questions, formulated to study the effects of this enhanced support, and the methods used to answer the research questions are presented. After presenting the results, discussing the main findings, and noting the strengths and limitations, we conclude with the most important findings and recommendations for further research.

THEORETICAL BACKGROUND
Scaffolding: A fundamental element in the theory of learning
A well-known concept in the theory of cognitive development and learning is scaffolding (Vygotsky 1978). The term refers to the support a teacher offers students to guide them through their learning process. Support can be provided for content and learning strategies as well as for motivational processes. Scaffolding can fulfill instructional functions, such as simplification (breaking up complex tasks into sets of simpler operations), marking critical features (pointing out what factors are central to the task), and demonstration (showing an "idealised" expert version of what the learners need to learn). It can also fulfill motivational functions, such as recruitment (getting the learner interested in a task), direction maintenance (encouraging the learner to stay focused on the task) and frustration control (dampen the feeling of defeat or change specific activities before frustration becomes debilitating) (Wood, Bruner, and Ross 1976). Initially, students need help to achieve what they cannot yet achieve on their own, and that the scaffolding can gradually be removed as they learn and become more competent.

Instructor scaffolding for interaction, i.e. strategies to promote learner-instructor and learner-learner interaction, is said to play a critical role in increasing students' intellectual and behavioral engagement, and is positively associated with learners' perceived connectedness and self-regulated learning (Awidi and Paynter 2019; Cho and Cho 2014; Cho and Kim 2013). This is exactly what we aim to achieve in the joint class, where together with the students we explore concepts and do exercises which help prepare them for the necessary self-study.

Estes, Ingram, and Liu (2014) suggest that resistance to flipped teaching could be diminished by choosing a learner-centered approach and transparent teaching practices. They found that when a theoretical perspective informs the flipped classroom design, students feel they participated more actively and attentively in class activities and achieved better grades in their specific course—even when they have less positive attitudes towards pre-class activities. This inspired us to look for a didactic model that meets these requirements and can help improve the scaffolding offered in the joint classes.

Putting theory into practice via Question Driven Discovery

As our flipped classroom is blended and online knowledge videos form part of the scaffolding, we turned our eye to didactic models for students that are at least partly designed for online learners. One model that proved especially fitting was the Question Driven Discovery model, developed by the Open University of the Netherlands (Boom 2011)—a recognized innovative institute that offers higher distance education in a broad range of disciplines. Its projects are open to a wide audience. Most classes are virtual, take place online; face-to-face meetings are only organized occasionally.

For the past decade, the Open University's distance learning educational model is explicitly aimed at activating students and offering them as much flexibility as possible (College van Bestuur Open University 2021). Realizing that students—and particularly their distance learners—also need structure in order to study successfully (Dulfer et al. 2023; Selkrig et al. 2023), the Open University designed several standard models to support them in their self-study. The Question Driven Discovery (QDD) model can be regarded as one of those models that can help handle the tension between the desire for sufficient flexibility and the need for structure.

Besides being an interesting didactic model for a blended course such as ours, an additional reason to select the QDD is that it is particularly well-suited for courses that take certain central questions as points of departure. The model requires the course to be set up in such a way that enables students to find answers to these questions and to provide the necessary content and materials to do so. This is congruent with what we do in our course: we invite students to join us in an investigative journey where we try to formulate answers to some key issues within the philosophy of science. Each week, one question serves as the central focus, for instance: What is "the" scientific method?; How can we distinguish scientific knowledge from pseudoscience? And: Reality—is it given, or do we make it ourselves?

The structure of the QDD model implies a rather strict format, a step-wise approach with clearly recognizable phases: exploration, orientation, further investigation/study, integration, and reflection.

In our case, the first steps of the model: exploration and orientation, are addressed in the weekly joint classes. We start with an introduction to that week's course objectives and central question. From a scaffolding perspective, these questions can be regarded as efforts to raise students' curiosity, and thus motivationally recruit them for the course. Then, in interaction with the students, we explore core concepts from the textbook. Furthermore, students are given indicative suggestions

of how to go about reading the additional assigned philosophy articles by sketching the background of those philosophers and the relation to the main question and most important concepts. Last but not least, the joint classes guide students into the preparatory assignment for the subsequent workgroup by doing one or two class exercises that entail parts of the assignment. This can be viewed as a combination of motivational and instructional scaffolding: by raising their interest, breaking the assignment into smaller parts, and marking critical features, we simultaneously encourage students to start reading and guide them in the right direction.

The subsequent steps of further investigation/study and integration are partly done in self-study and are the main components of the compulsory workgroups. They also form part of the assessment, which in our course entails a take home exam consisting of two parts: the first part is released after the first two weeks and needs to be completed in week three, the second part is released after the last meetings in week seven and needs to be handed in one week later. In the workgroups, the teachers engage the students in exercises that address the assignment they made in preparation, and challenge them to apply what they have learned. Simplification, direction maintenance, and frustration control, to some extent, are the main scaffolding functions. The teachers are provided with some thoroughly prepared interactive work forms to further develop students' understanding of the core concepts and principles and help them to integrate the findings so as to find answers to the main questions. The last step of the QDD model, reflection, is also partly induced in the workgroup and needs to be completed by the students themselves in the take home exam. The latter two steps can be regarded as scaffolding activities aimed at showing students the way towards the "ideal" answers.

To cater to online learners' diverse abilities, the QDD model offers e-workbooks, i.e. online instructions with built-in guidance on various levels to help students find answers to the central questions. The scaffolding offered by the e-workbooks varies from hardly any guidance at the most basic level to thoroughly prepared didactic dialogues on the most refined level. The former is adequate for students who already have sufficient background knowledge to answer the main question straight away. The latter is for those students who need to be guided, step by step, through a variety of sub-questions before finally getting to the main question.

Amongst our students, the diversity in background is not that large and we have more on-campus education, so there is no need to strictly follow the QDD format regarding the offered online guidance. Nevertheless, our set-up leaves ample room for students to decide how much use they want to make of the offered scaffolding. They can choose whether they want to start with some guidance or prefer to prepare each week's central topics on their own. If they opt for self-study, they have to read the mandatory literature and make the preparatory assignments for the workgroup all by themselves. If they prefer some scaffolding, they make use of the guiding reading questions and the online knowledge videos to help them acquire the necessary insights. The maximum amount of guidance can be attained by participating in the joint classes, where both motivational scaffolding is offered to "get them going," and instructional scaffolding in the form of supportive exercises to "get to grips" with the content. If they do not want to come to campus and participate live, they can watch the recordings of the joint class afterwards and use the accompanying PowerPoint presentation to prepare for the workgroup.

Now that the scaffolding function of the joint classes and what we did to further improve them is clarified, we can move to the next section where we describe how we set up our research into the effects of this enhanced scaffolding.

METHODS
Research design

Our research follows the principles of a design cycle (see Figure 1 and Bruchatz, Fischer, and Stelzer 2018), which forms an effective method to test the effects of certain interventions intended to help solve a problematic situation. After an initial problem analysis, a solution is designed. This solution is first tested on a small-scale or in a virtual situation in order to bring into view both the desired and possible unwanted (side) effects. Depending on the results from the test phase, the intervention can be adjusted (or, in the worst case, be abandoned) before it is implemented on a larger scale or in a real-life situation.

Figure 1. The Research cycle of the design method (Tromp 2018)
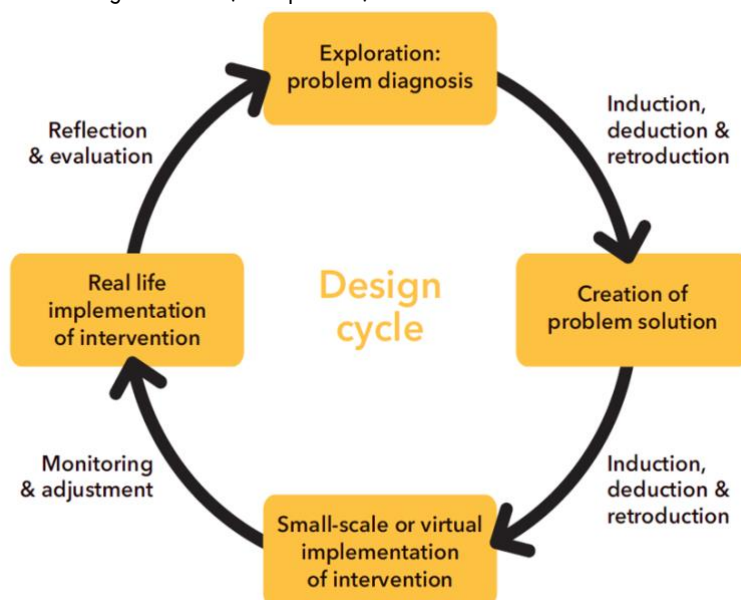
The design method adopts an iterative approach to continuously improve on interventions that seem worth pursuing. In our case the first interventions focused on the flipped classroom, while later it shifted towards its scaffolding function. The most important findings of the earlier research rounds are presented in the introduction (see also Tromp 2022). All we need to add here is that in the previous research round, the interventions consisted of reintroduction of a general meeting in the form of a joint class and improvement of the structure of the electronic learning environment (see Table 2). Both interventions were intended to offer more support in students' learning process.

Table 2. Overview of the interventions of the last two research rounds

Interventions prior iteration	Interventions latest iteration
Scaffolding offered via weekly introductory, explorative joint classes.	Internal, substantial scaffolding offered via weekly introductory, explorative joint classes structured according to the guidelines of the Question Driven Discovery model. → Focus of present research report
Scaffolding offered via an improved online educational learning environment (Canvas), providing all blended learning-materials.	External, organizational scaffolding offered by planning the joint classes next to parallel courses.

In our latest research round, the interventions were again two-fold and aimed to further enhance offered support. The first intervention consisted of an effort to improve the internal scaffolding offered by the joint classes through structuring them according to the QDD model, in the way that has just been described. The second intervention implied external, organizational scaffolding by alignment of the joint classes' schedule with parallel courses. This latter intervention did not have any noticeable effect, i.e. it did not lead to an increase in attendance. Therefore, it will not further be discussed here; we will focus instead on the offered internal scaffolding.

Research questions

The main research question (RQ) related to our intervention is whether enhancing the scaffolding function of the joint class by structuring them according to the principles of the QDD model helps to capitalize on the potential effects of the flipped classroom. These potential effects of the offered scaffolding can be split into two sub-questions:

RQ1: Does it help to increase students' understanding of the course content?
RQ2: Does it lead to a more active study attitude under students?

Operationalisation of the effects related to RQ1 are: students' self-reports about learning outcomes in the survey and their achievements in the form of final grades.

Operationalisations of the effects related to RQ2 are: students' self-reports about the amount of activities undertaken during the course, perceived activation, and their actual study activities online.

We used a broad array of methods to find answers on the research questions. Quantitative methods ranged from registering the attendance and conducting a survey, to comparing final grades and using the learning analytics provided by the digital educational learning environment. In addition, we collected qualitative data via round table talks and an online inventory about students' preferred course set-up. Below, we explain what each used method entailed precisely, and which data were analysed to find answers to our research questions.

Registering attendance

To keep track of the number of students who participated in the six joint classes, we asked them to register their attendance (by student number only). Students were also asked to indicate the

amount of joint classes they attended in the survey (see below). Splitting up the forms, we studied the scores of those who joined regularly separately from those who hardly ever joined or not at all, enabling us to compare potential differences between "attendees" (defined as: those students who joined in three or more joint classes) and "non-attendees" (i.e. joining in less than three joint classes).

Survey

For the survey, we used the questionnaire that students at the University of Amsterdam (UvA) are asked to fill out after every course. This questionnaire contains standard items about various aspects of the course, including the learning outcomes, digital learning environment, teaching methods, and assessment. It also informs about students' attendance, their prior interest in the topic, their opinion about the (level and quality of the) course, effort put into the course, and how much they learned. There is also an option to comment about the strengths of the course and offer suggestions for improvement.

The decision to make use of the existing questionnaire was prompted by the fear that holding a separate survey would lead to a sharp reduction in respondents. It is hard enough to get a sufficiently high response rate for the regular questionnaire; putting two before students would run the risk that neither the standard questionnaire nor the additional survey would yield reliable outcomes. The downside to this pragmatic decision is that the standard questionnaire is processed and analysed by UvA's executive office, meaning we couldn't tailor the survey to our own needs.

Nonetheless, by selecting relevant items and taking up some additional items, we were able to adjust the questionnaire so that it could fulfil our specific research needs. Considering the operationalisations for RQ1, the learning outcomes, i.e. whether students feel they learned about fundamental theories and principles, and how to apply these, were most interesting. Considering the operationalisations for RQ2, particularly relevant items pertained to students' opinions about the set-up and structure of the course, whether they felt activated and encouraged to work regularly, and whether they experienced the work forms as activating and the meetings as supportive for their learning process.

In addition, we had the chance to take up some additional items in the questionnaire related to the motivational and instructional scaffolding and activating functions of the joint class. These items offered insights into whether the joint classes made students curious and motivated to study, helped students study regularly, reduce procrastination and barriers to start working on assignments, and led to a more active attitude. We also took up a few questions about the social function of the joint class.

As usual, students were asked to give their response on a 5-point Likert scale, ranging from 1= "thoroughly disagree" to 5= "thoroughly agree." For each item, the mean of the scores, the median and the standard deviation were calculated. Of the total group of 94 participants, 66 students filled out the survey, 49 of whom granted permission to use their data in this research.

Learning analytics

The digital educational learning environment that our course makes use of, Canvas, provides learning analytics which offer insights into students' weekly online activities in the form of page views, participation in discussions, and whether students submit their assignments (in time). From this range of learning analytics, we considered the amount of page views for the folders with the course materials to help answer RQ2. This selection enabled us to find out to what extent students actively made use of the knowledge videos and additional materials that are provided online. Besides that, we were also able to check how many times the recordings of the joint classes had been watched as well

as how often the slides uploaded afterwards were accessed, which can be regarded as additional indicators of the extent to which students were actively engaged with the course.

Round table talks

In order to get more in-depth insights into students' valuation of the function of the joint class, we wanted to organize some focus groups. In our previous round, students were not eager to join in such meetings (n = 2). Therefore, we decided to accept the offer of the programme coordinator to include the focus groups in two round table talks with students that were planned shortly after the end of our course. Besides attracting more participants, an additional benefit would be that there was less danger of getting socially desirable answers as the programme coordinator was not involved in the course and neither responsible for the design and content, nor for the grading.

In the two round table talks an arbitrary sample from the students took part in a group conversation about the joint class—as part of other topics about the programme (n = 8 + 11 = 19, all of which granted permission to use the outcomes in the research). The intention was to ask participants to write down two strong and two weak points of the joint classes, inform about the perceived value of these meetings, their motivation to attend and whether they would attend more often if recordings would not be made available. When we received the notes of the meetings, we found that this intention had not entirely been realized (see Results).

Online inventory

In the last joint class of the course, we organized an online inventory about the preferred course set-up. Students were asked to go to a Miro board and drag around digital post-its with various work forms and place them in an order that they thought would work best for them. The post-its contained the following labels:

- General classes (i.e. for the whole group, e.g. lectures, masterclasses, joint classes)
- Self-study (i.e. working on your own, e.g. reading literature, watching online videos or recordings, making preparatory assignments)
- Meetings in subgroups, in our case: work groups
- Other work form, namely. . .

The results were used to find out whether the chosen set-up works for students, or that perhaps a different design is considered more supportive. Of the 14 students that participated in the last joint class, 11 granted permission to use their answers in the research.

Below, the results of the quantitative and qualitative methods are presented, where the insights gained from the latter are mainly used as additional sources in the analysis, to make the picture complete.

RESULTS

Regarding the question of whether the instructional scaffolding offered in the joint classes helped increase students' understanding of the course content, we can, at most, conclude from the survey that it seems to have somewhat increased students' understanding of the material and curiosity about the literature and lowered the barrier to start reading (see the items on the supportive function in Table 3 with the scores of 3.2, 3.0 and 3.0 respectively, which is a slight improvement compared to the year before).

Table 3. Descriptive statistics for RQ1

Items on the supportive function of the joint classes	Average	Median	Deviation
The weekly joint classes helped me to better understand the subject matter (n=36)	3.2	3.0	1.0
The joint classes made me curious as regards the literature that was on the list (n=33)	3.0	3.0	0.8
The joint classes lowered the barrier to start reading the literature (n=35)	3.0	3.0	1.2
Items on the supportive function of the joint classes	**Average**	**Median**	**Deviation**
I learned about fundamental principles and theories during this course (n=49)	4.1	4.0	0.7
I learned about scientific theories and developments during this course (n=47)	3.6	4.0	0.9
I learned to apply fundamental principles and theories that were taught during the course (n=48)	3.2	3.0	1.1

The fact that almost half of the respondents refrained from scoring the relevant statements concerning the supportive function of the joint classes (around 33 out of the 49 respondents), leaves us with some questions about the reliability of these results. If we look at the items on the learning outcomes, which inform what students learned from the course in general, both the number of respondents and the scores are remarkably higher (47–49 respondents, with scores between 3.2 and 4.1).

Whereas the self-reports do not allow us to claim a substantial effect, we do see a considerable differences in final grades: on average the students who participated three times or more in the joint classes score 7.8 on a 10-point scale whereas the mean for those who participated two times or less is 7.3 (and the year before they scored 8.1 whereas the mean for the others was 7.2).

Our second expectation, i.e. that the motivational scaffolding offered in the joint classes boost an active stance in students, was not confirmed in the survey. Just like last year, the survey scores did not present convincing support that the joint classes enhance an active attitude towards students' studies and regular study behavior. Neither did the scores give reason to believe that the joint classes increase students' motivation or their enthusiasm to make the preparatory assignments or help to prevent procrastination (see items on the activating function in Table 4—all scores ranging between 2.5 and 2.9). Introduction of the QDD model did not seem to have made any difference in this regard; the scores on these items were the same as last year.

Again, we see that many respondents refrain from scoring the most relevant items for our research, while three related questions about the quality of the overall course were answered by all and were scored markedly higher (with scores ranging from 3.6 to 3.9, see the middle row in Table 4).

The only positive survey results with regard to the joint classes stemmed from its social function (see the last row in Table 4): students appreciated the contact with their peers (3.6 this year; 3.8 last year) and with the principal teacher (3.4 this year; 3.6 last year), and this increased their involvement with their study.

Table 4. Descriptive statistics for RQ2

| Items on the activating function of the joint classes	Average	Median	Deviation
The weekly joint classes enhanced my enthusiasm to work on the Preparatory Assignments (n=34)	2.8	3.0	0.9
The joint classes lowered the barrier to start making the Preparatory Assignments (n=34)	2.9	3.0	0.8
The joint classes enhanced a more active study attitude in me (n=35)	2.8	3.0	0.9
The joint classes stimulated me to study (more) regularly (n=33)	2.7	3.0	0.9
The joint classes helped to prevent that I would procrastinate (n=34)	2.5	2.5	0.9
Items on the quality of the course	**Average**	**Median**	**Deviation**
The course was clearly structured (n=49)	3.6	4.0	0.9
I was encouraged to work regularly during this course (n=49)	3.9	4.0	1.0
I was encouraged to participate actively during this course (n=49)	3.8	4.0	0.9
Items on the social function of the joint classes	**Average**	**Median**	**Deviation**
I enjoyed meeting my peers during the joint classes–this way I feel more involved in my studies (n=32)	3.6	4.0	1.0
I enjoyed also meeting the coordinating teacher–this way I feel more involved in my studies (n=33)	3.4	4.0	1.0

The data from Canvas' learning analytics showed that, on average, the students who participated in three joint classes or more had almost three times as many page views as the overall average (126 views over and against an overall average of 45 views).

The learning analytics also revealed that not all students visit the dedicated folders for the joint classes, which contain information about the objectives for each week and an explanation of what explorative activities will be employed to take the first steps in reaching these objectives. Only three quarters of the group viewed the folder for the first joint class, and the amount of students viewing the folders for the subsequent joint classes gradually decreased during the course (see Figure 2).

While the vast majority of students attended the first joint class on campus (81 of the 94), some chose to watch the recording of the second joint class online. After the second week, the numbers of the views of the recordings quickly dropped. (Let it be noted that the views are not linked to data about the students, so we cannot infer from the amount of views how many students watched the recordings; some students might have watched a recording more than once.) Around half of the students made use of the PowerPoint presentations accompanying the joint classes, which are afterwards uploaded on Canvas.

The amount of students viewing the folders for the workgroups was higher from the start than those for the joint classes and remained at a constant level until almost the final week. The folders for the workgroups inform the students about the activities that will be employed in these compulsory meetings, and contain indications of what needs to be read in preparation of each workgroup. The mandatory literature can also be found in these folders.

Figure 2. Views of the provided online materials for the joint classes and workgroups
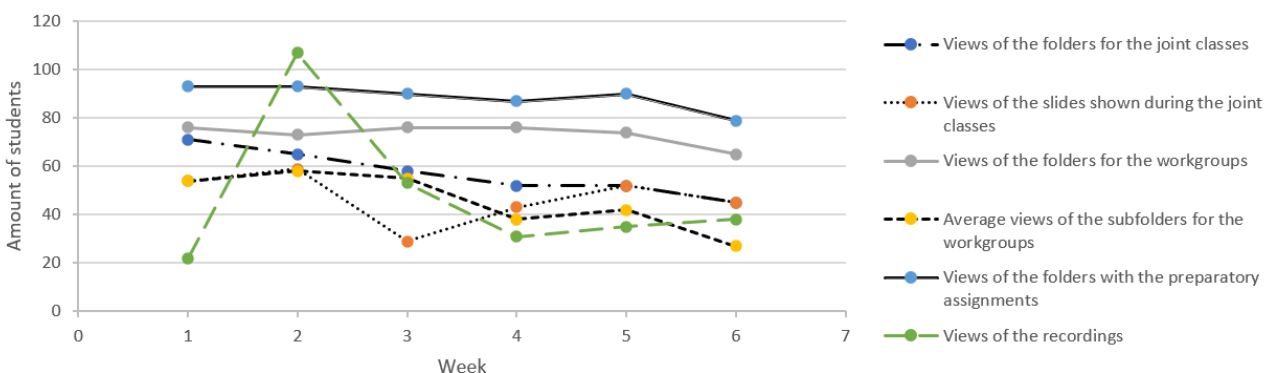
The amount of students viewing the subfolders for the workgroups showed more variation. It was overall lower than the views of the main folder, indicating that only a certain percentage of the students made use of the additional online material—including topical knowledge videos—to increase their understanding of the course content. The use of these knowledge videos was comparable to the use of the slides in the joint class. What is mostly viewed are the folders for the mandatory preparatory assignments that students have to make to participate in the workgroups. Like the views of the folders for the workgroups, the views of the folders for the preparatory assignments remain at a constant level, with exception of the last week.
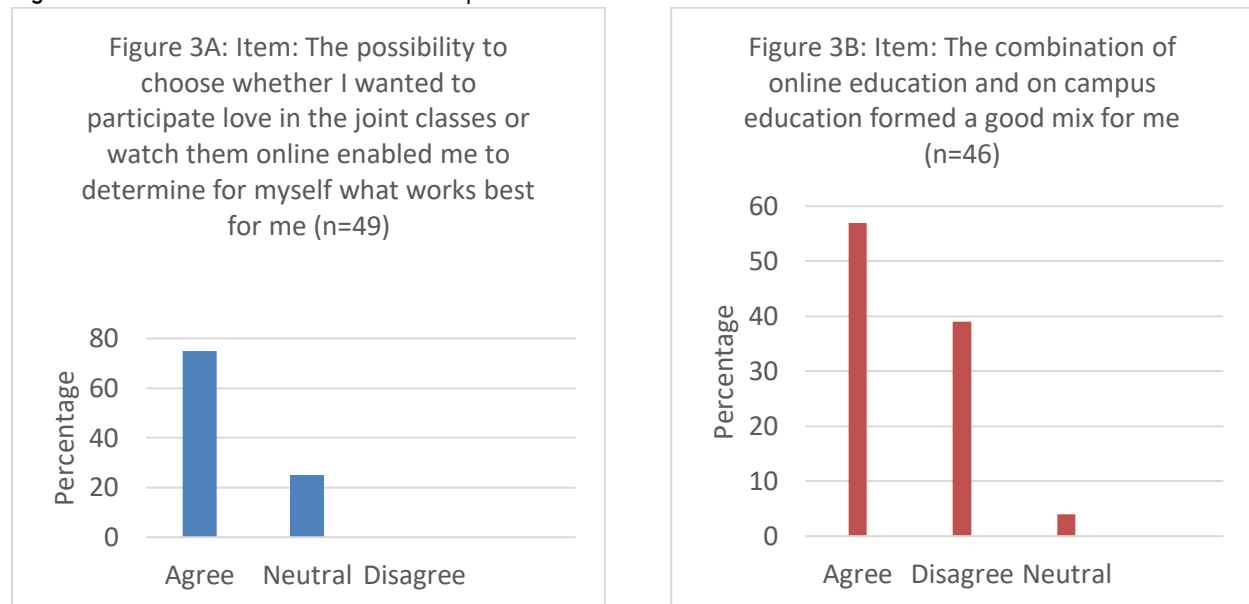
The outcomes from the round table talks painted a more positive picture than those of the survey, which may have been the result of the different types of questions that became the topic of discussion. Rather than talking about whether the joint classes have a supportive function and an activating effect, the conversation drifted more towards how students actually used the offered learning materials. The participants explicitly indicated that they valued the fact that they can choose whether or not to attend the joint class or watch the recordings and expressed appreciation for the availability of PowerPoint presentations online. For many of them, these slides were very helpful and supportive in the preparation for the flipped workgroup and the exam. The same can be said about the knowledge videos that were offered. Just as with the recordings, students liked that they could watch the slides and videos any time they like, at a pace they liked, for as long as they liked, and as many times as they liked.

So contrary to what we are led to believe if we only look at the outcomes of the survey items relating to the joint class, the results from the round table talks indicate that, viewed from this broader perspective, they did stimulate the students to study regularly. Overall, the participants of the round table talks were quite positive about the blended set-up of the course, including the various forms of support offered online. The inventory of the preferred set-up in the last joint class of the course supports these findings; the majority of the respondents indicated that the current set-up worked well for them.

These findings also correspond with the outcomes of the survey items that did not directly relate to the joint class, but more to the overall design of the course. Seventy five percent of the respondents of the survey agreed that the opportunity to choose to either participate on campus in the joint classes or watch them online enabled them to determine for themselves what work form was best for them in this course. Nobody disagreed with this claim (see Figure 3A). An open remark confirmed what was said in the round table talks: "the variance in the background knowledge of students is high, so it is good that you have a lot of room to determine for yourself what use you make of the offered materials and work forms." This variance may relate to the familiarity with the topics;

some students had an introduction to philosophy of science in high school, while for others it is a new topic and one that entails yet a completely different kind of thinking than the other courses in their already highly varied interdisciplinary programme. Students can make use of the offered scaffolding according to their own needs. The variance can also be related to the inherent interest in the topic: the survey showed an equal division on prior interest, ranging from highly interested to not at all interested. Some may be sensitive to the motivational scaffolding, while others cannot be reached. Additional reasons why students appreciated that they could choose which work forms they used may relate to external factors, such as the fact that work obligations or the distance to the university made it impossible to join in the class meetings.

Figure 3. Satisfaction with the blended set-up of the course

Figure 3A: Item: The possibility to choose whether I wanted to participate love in the joint classes or watch them online enabled me to determine for myself what works best for me (n=49)

Figure 3B: Item: The combination of online education and on campus education formed a good mix for me (n=46)

It's worth noting that 25% percent of the respondents do not explicitly agree or disagree, but report feeling neutral about whether the freedom to choose enables them to determine for themselves what works best for them (see Figure 3A). Most of them do value the blended set-up of the course (see Figure 3B), and particularly the possibility to (re)view the recording of the joint class at a moment that was most convenient for them. With an average of 4.2, the score on whether they found this an attractive set-up is highest of all (n=33).

DISCUSSION

For several items of the survey, especially the ones related to the core topic of our research questions, the response rate was low while the standard deviation was rather large. The abstention can possibly be explained by the fact that students who only occasionally attended the joint classes didn't feel justified to score these items. Whatever the cause, with a rate just around thirty percent (the required minimum in the standard student evaluation form), the outcomes can, at most, be viewed as just reliable enough. Fortunately, the combination of using quantitative and qualitative methods enabled us to draw up a nuanced answer on the question whether the structured scaffolding offered by the joint classes had any of the desired effects.

The survey results do not offer direct support for the claim that the joint classes enhance an active study attitude among students or support them in their self-study, but the reactions yielded in

the round table talks point in a more positive direction. Since the round table talks had only a limited number of participants, the collected data should mainly be viewed as additional insights; yet they do provide interesting information, as highlighted by the fact that we also see a substantial difference in the learning outcomes of those who attend regularly and those who don't.[1] This could be viewed as an indication that the instructional scaffolding offered in the joint classes does indeed have a positive effect, as we would expect based on Vygotsky's learning theory (1978; Wood, Bruner, and Ross 1976).

Additional support can be inferred from the only explicit positive survey results regarding the joint classes, which relate to its social function. From the fact that students indicated that they appreciated the contact with their peers and teacher, and the related increase in their class involvement, we can infer that instructor scaffolding for interaction, i.e. strategies to promote learner-instructor and learner-learner interaction, is positively associated with learners' perceived connectedness. And that it indeed seems to play an important, if not crucial, role in increasing students' intellectual and behavioral engagement, as earlier research has suggested (Awidi and Paynter 2019; Cho and Cho 2014; Cho and Kim 2013).

Looking at the data from the learning analytics, we realize this engagement cannot be taken for granted. It shows that most of the students only do what is necessary, i.e. visit the folders for the preparatory assignments which tell them what they need to read and do, before they enter the workgroup. But no more than three quarters of the students view the folders for the joint classes and the workgroups, with that number dropping steadily throughout the course, particularly for the former. The same can be said about the recording views. The students who regularly attend the joint classes seem to put a lot more time and effort in the course, and visit the folders with online materials almost thrice as much as the ones who don't. This could be interpreted as a positive effect of the recruitment function and motivational scaffolding offered in the joint class (Vygotsky 1978; Wood, Bruner, and Ross 1976). It may also form part of the explanation why those students who regularly attend complete the course with substantially higher grades.

While we did not find any conclusive significant effects, we do have reason to assume that the instructional and motivational scaffolding offered in the joint classes does help increase students' learning outcomes and, to some extent, does enhance a more active study attitude. Support for the hypothesis that this effect is further enhanced by choosing a learner-centered and transparent teaching approach such as the QDD model, as Estes, Ingram, and Liu (2014) purport, was not found though. Neither did we find any support for their assertion that it helps to reduce the resistance to flipped teaching.

Then again, it seems fair to claim, as many other researchers do (Bendermacher, Wolfhagen, and Dolmans 2017; Benton and Cashin 2014; Heffernan 2022; Kirschner and Van Merriënboer 2013; Marsh 2007), that it can be doubted whether students themselves are always the best judges of whether and how they are learning. Even students themselves seem unsure to what extent they have the skills to decide how to learn, considering the fact that 25% percent reported feeling neutral about whether the freedom to choose enables them to determine for themselves which of the offered work forms work best for them. Particularly for those who are not inherently interested in the content, it can be questioned whether we should leave it up to them to decide whether or not to make use of the additional motivational and instructional scaffolding that is offered in the joint classes.

STRENGTHS AND LIMITATIONS

This study is part of a long-term study and executed in a real-life setting, giving it many strengths. It forms part of a continuous cycle in which efforts to improve on our education have been carefully evaluated and studied for its effects, on the basis of which new improvements have been

implemented. The methodology consists of methods and tools that form part of the regular educational practice, thus helping to capture the real, actual behaviour of students and enhancing the ecological validity of our research. The choice for such a set-up, though, brought with it some limitations. As UvA's students' survey service does not impart data to other parties, it was impossible for us to use more refined statistical methods or perform analyses beyond the standard ones provided. And while there is a benefit in the researcher—who is also the coordinating teacher—not being directly involved in the round table talks, having it led by another party meant that there was no possibility to maintain topic focus Then again, this appeared to have a beneficial effect, in that it brought about insights about the broader context that we otherwise might have missed. All this is the result of the trade-off between experimental control versus studying real-life behaviour.

CONCLUSION

This study suggests that students clearly value the flexibility offered in our course. They appreciate the blend of offline and online supportive learning materials, and particularly the freedom to use them according to their own needs. They embrace the online knowledge videos, slides, and recordings of the joint class, and use these instructional scaffoldings in a manner that suits their personal needs. Regarding the offline facility of the joint class, they mostly value its social function. The chosen set-up accommodates for the diversity of student interests and backgrounds, and as such can form part of the development of a successful learning strategy.

By contrast, we observed that our students did not make optimal use of the offered structure, even though this obviously enhances their studies and learning outcomes. Only a small portion fully engaged in the developed blended design, and participated on campus in the optional preparatory joint class, alongside the offered online materials, before entering the compulsory flipped workgroups. This is congruent with the strategies followed by students elsewhere, in whatever form of higher education they may be involved: students often embrace the flexibility but regularly resist the offered scaffolding (Dulfer et al. 2023; Selkrig et al. 2023).

While we think we have indeed arrived at an optimal design to benefit most from the educational potential of the flipped classroom concept in the bachelor phase, there is still more to do. One way to proceed could be making all classes compulsory, just like in high school. Since students' participation on campus seems to have further decreased rather than increased after the pandemic, this would definitely be worth considering. However, from a flexibility perspective, this may not be desirable (Dulfer et al. 2023). Another option is to examine what would be the effects of making the subsequent steps in the QDD model mandatory assignments that students have to take up in a portfolio, which will then be assessed at the end of the course, either orally or during a written exam on campus. Since the wide-spread introduction of Generative AI tools, instructors have had to reconsider the standard forms of assessment anyway; this is the route we recommend to attain the optimal balance between structure and flexibility. Based on Saetra (2022), who asserts Generative AI can perform certain scaffolding functions extremely well, we propose future research explores how it can be utilized to structure students' learning processes while considering their personal needs and circumstances, thereby simultaneously enhancing their motivation as well.

NOTES
1. We checked whether the difference in grades could be attributed to the fact that only the more intrinsically motivated students attend the (non-compulsory) class meetings, by calculating students' overall average grades. We found that this assumption is correct for the

participants of the prior year, but that the averages for the current group are not substantially higher.

ETHICS
This research complied with the national Code of Ethics for Research in the Social and Behavioural Sciences involving Human Participants (NECSB 2018).

COMPETING INTEREST
The author has no relevant financial or non-financial interests to disclose.

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