DOI: 10.5324/njsteme.v7i1.3356

Teachers' self-motivation and sense of responsibility determine the use of active learning methods

K. Enberg, I.H. Steen, and S. Ellingsen,

Department of Biological Sciences, University of Bergen, Norway

ABSTRACT: Extended use of laboratory and field courses makes biology a discipline considering itself as a habitual practitioner of active learning strategies. We investigated how widely the faculty at the Department of Biological Sciences (BIO) at the University of Bergen (UiB, Norway) uses active learning methods. Thirty-six members of the teaching staff answered our web-based questionnaire, and we carried out in-depth interviews of 7 faculty members. Our results show that almost all BIO-teachers use at least some active learning methods, and plan to use them in their teaching in the near future. The teachers use active learning methods mostly because they want their students to achieve deeper learning, but also because they want to develop themselves as teachers. This self-motivation is obvious, as over 90% of the teachers identified self-motivation as the strongest incentive, while colleagues, the department, and the university were less important. A vast majority of the teachers also think that it is their own responsibility to adopt active learning methods, while fewer faculty members assume institutional responsibility from BIO. The major bottlenecks identified were large class size and difficulties related to evaluating and grading student performance when using active learning methods. The teachers would use more active learning methods if the availability of active learning rooms was increased. Our in-depth interviews suggest that the most suitable time window for adopting more student-active learning methods is either when new courses are established, or when teachers are taking over courses new to them. We therefore suggest that if educational institutes wish to increase the proportion of active teaching and learning methods, they should provide extra support in such transition periods.

Keywords: Survey, interview, student-active learning, biology education

DOI: 10.5324/njsteme.v7i1.3356

1 INTRODUCTION

The benefits of active learning methods in terms of student performance are well documented (Freeman et al. 2014). Active learning is a method in teaching where the student is directly involved in the learning process as opposed to passive listening, like often on traditional lectures (Bonwell and Eison, 1991). The intentions of adapting active learning strategies in science education is to improve the learning environment and to stimulate motivation, intellectual engagement and deeper learning among university students (e.g. Michael 2006; Connel GL et al. 2016; Freeman et al. 2014). To facilitate the adoption of active learning methods, many institutions invest in active learning rooms, classrooms designed for creating good learning environments and facilitating work in small groups, as opposed to the large auditoriums with fixed rows (Beichner 2014, Lee et al. 2018). However, some research suggest that the benefits of active learning methods are achievable even without such specifically designed rooms or without the use of expensive high-tech audio-visual systems (Roediger & Pyc 2012; Soneral & Wyse 2017). There is a clear increase in focus on active, student-centred learning methods, which can also be seen in the number of publications on "active learning" which went from less than 100 per year before 2003 to almost 1000 articles per year within 2019 (Web of Science).

Regardless of the positive development in adopting active learning methods supported by the trend in the pedagogics literature, the dominating teaching strategy in higher education in Norway is still traditional lecturing. As many as 90% of students report that traditional lectures are used "to a large extent", while 75% of educators report that introduction of new content predominantly is done by plenary lectures at campus (Meld. St. 16 (2016–2017). In this study we investigated the use of active learning methods among the educators at the Department of Biological Sciences (BIO) at the University of Bergen, and aimed at answering the following research questions:

1) What is the extent of using active learning methods?

2) Which factors influence the likelihood of educators choosing active learning approaches?

3) What are the potential bottlenecks for adopting active learning methods?

4) Which strategies educational institutes can utilize in order to increase the proportion of active learning and teaching methods?

This study was initiated during the course "Collegial Teaching and Learning in STEM Education" organized by the Centre for Excellence in Education BioCEED (https://bioceed.w.uib.no) funded by the Norwegian Research Council and hosted at BIO.

2 MATERIAL AND METHODS

2.1 The Department of Biological Sciences (BIO) at the University of Bergen (UiB)

The Department of Biological Sciences (BIO; www.uib.no/bio) is the largest department at the University of Bergen (UiB), a public university located in Bergen, Norway. At the time of this study, BIO employed 218 annual full-time equivalents distributed as 153 scientific, 47 technical and 18 administrative staff members, as well as 23 post docs and 43 PhD students (per January 2019). The annual uptake of first-year bachelor students was approximately 200, and the number of students that completed their master degree was approximately 50 per year. Annually, over 100 courses were taught ranging from large classes (100+ students) at the bachelor level to small- to medium-sized classes at MSc- and PhD-level.

2.2 Online Survey

We designed an on-line questionnaire comprising 12 questions (Table 1) in order to map the background, experience, and motivation for implementing active learning strategies in teaching activities within the BIO teaching staff. The type of answers expected varied from a simple number (for example the age of

the respondent), to multiple choice with definite, mutually exclusive answer (for example current position at BIO), to a Likert-type scale (For example 5 steps from strongly disagree to strongly agree).

Table 1. The questions and answer types of the online questionnaire.

Question	**Answer type**
Age	Number
Gender	Multiple choice
Current position at BIO	Multiple choice
Teaching group	Multiple choice
How many years have you been teaching at BIO?	Number
How many credits do you teach per year?	Number
Which level do you teach?	Multiple choice
How big proportion of your teaching consists of lecturing?	6-step Likert-type scale (0-100%)
Approximately how much of your current teaching activity takes place in	Multiple options, 6-step Likert-type scale (0-100%)
Which of the following active learning methods have you used within the last two years?	List of 22 active learning methods, with 4-step Likert-type scale (from "unknow to me" to "used often"), and an open "Other, not listed above" question. Note that the respondents were not provided with any explanations about the different methods, but their answers were based on their own understanding of the different methods.
Are you planning to use active learning methods within the next 12 months?	Multiple choice (yes, no, do not know). Active learning rooms with optimized technical solutions are introduced in many universities to support the implementation of active learning methods. At the time of this study, UiB had one such room, where 6 groups of 6 students have their own table with internet connection and electrical power outlets, large screen and a whiteboard.
If you have used active learning methods, who or what motivated you to do it?	List of 9 alternatives ranging from self-motivation to University, with 5-step Likert-type scale (from "strongly disagree" to "strongly agree"), and an open "Other, not listed above" question.
I use active learning methods because	List of 10 statements, with 5-step Likert-type scale (from "strongly disagree" to "strongly agree"), and an open "Other, not listed above" question.
I have learned about active learning methods	List of 3 statements, with 5-step Likert-type scale (from "strongly disagree" to "strongly agree"), and an open "Other, not listed above" question.
Bottlenecks	List of 10 statements, with 5-step Likert-type scale (from "strongly disagree" to "strongly agree"), and an open "Other, not listed above" question.
I would use more active learning methods if	List of 4 statements, with 5-step Likert-type scale (from "strongly disagree" to "strongly agree"), and an open "Other, not listed above" question.
Who has the responsibility for active learning being taken in use at BIO?	List of 8 alternatives ranging from teacher him-/herself to University, with 5-step Likert-type scale (from "strongly disagree" to "strongly agree"), and an open "Other, not listed above" question.

The survey questions were based on expectations arising from both existing knowledge of the teaching staff and courses at BIO, as well as existing literature on active learning. The teaching activities at BIO are organized into six different teaching-groups: Evolution and Ecology; Microbiology; Fish Health; Fisheries and Marine Biology; Environmental and Aquaculture Biology; Molecular Biology. The six

leaders of these teaching groups were asked to evaluate the questions, and, based on this pre-evaluation, the survey was modified accordingly. The final survey (https://skjemaker.app.uib.no/view.php?id=6046955) was presented to BIO faculty at a faculty teaching retreat on December 4th 2018, where 44 of the teaching staff were participating. During the retreat, time was reserved for the teachers to reply to the questionnaire online. Invitation to the survey was also sent by e-mail to all the teaching staff at BIO (with about 90 recipients). One reminder about the survey was sent to the teaching staff, and on December 10th the online survey was closed for responses.

2.3 Interviews

In order to get a deeper understanding about the teachers' views and attitudes on active learning we carried out in-depth interviews on a selection of teaching staff. We asked the teaching-group leaders to suggest two interview candidates from their respective groups: one with interest and/or experience in using active learning methods, and one with less interest and/or experience in applying such methods. Seven candidates were invited for a 30-minute long personal in-depth interview. Each interview was both directly transcribed and audio-recorded (for controlling the transcription afterwards). Two of us where interviewing, while one was transcribing. The questions used as starting point for the interviews were: 1: Can you describe how you plan and choose the methods for your teaching?; 2: Can you please define the term "Active learning"?; 3: Do you think teaching being performed in the field or lab courses automatically can be defined as "Active learning"?; 4: Have you used/visited the "active learning" room at UiB? What is your impression about that room?; 5: Do you have good and/or bad experiences during teaching (using active learning methods) you would like to share? The interviewees were allowed to take the time needed to answer the questions, but the pre-defined 30-minute slot was enough time for all of them. After the interviews, we made verbatim transcripts of each interview, and these texts were studied and summarized (see Results section 3.6).

3 RESULTS

3.1 The respondents

In total 36 BIO teachers filled the online questionnaire. Of these 16 were females and 20 males, and Figure 1 summarizes their positions. In total BIO teaching staff reported teaching on average 16.4 credits per year (SD 7 credits). Those teaching portions of several different courses pointed out the difficulties in estimating the exact number of credits for a shared course. For 52% of the respondents, over half of their teaching consists of lecturing, while for 13% all of their teaching is purely lectures. In this study we considered "laboratory" and "field" more as learning environments rather than learning methods, and they were therefore included as a separate category rather than listed as learning methods. Teaching at the field is not necessarily as common as often assumed for biology: 36% of the respondents never teach in the field, and only 16% of the teachers have more than 25% of their teaching in the field. Likewise, 44% of the respondents have not included using a laboratory in their teaching, and about 11% of the teachers have majority (>50%) of their teaching activities in the laboratory. Consequently, class room was the most common teaching location: 16% of the respondents have all their teaching in a class room, while 35% have the majority (>50%) of their teaching activities in a class room. Only 8% of the respondents do not teach in a classroom. The active learning room is not yet much used (it only became available during late 2018 fall semester): 52% of the respondents have no teaching in the active learning room, while only 14% have the majority (>50%) of their teaching activities in the active learning room.

DOI: 10.5324/njsteme.v7i1.3356

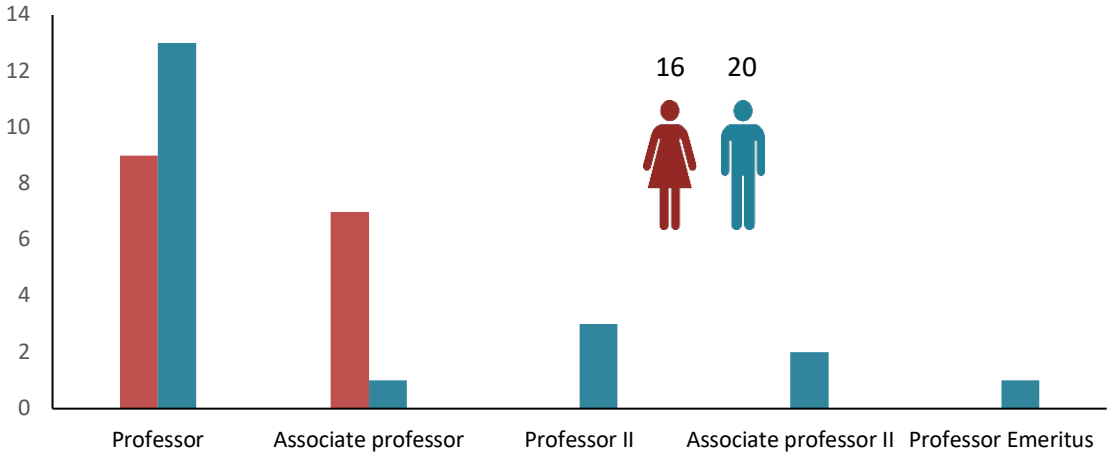

Figure 3.1.1. The number of respondents of the online questionnaire by type of position and by gender. Associate professor II and professor II are adjunct positions with usually 20% commitment.

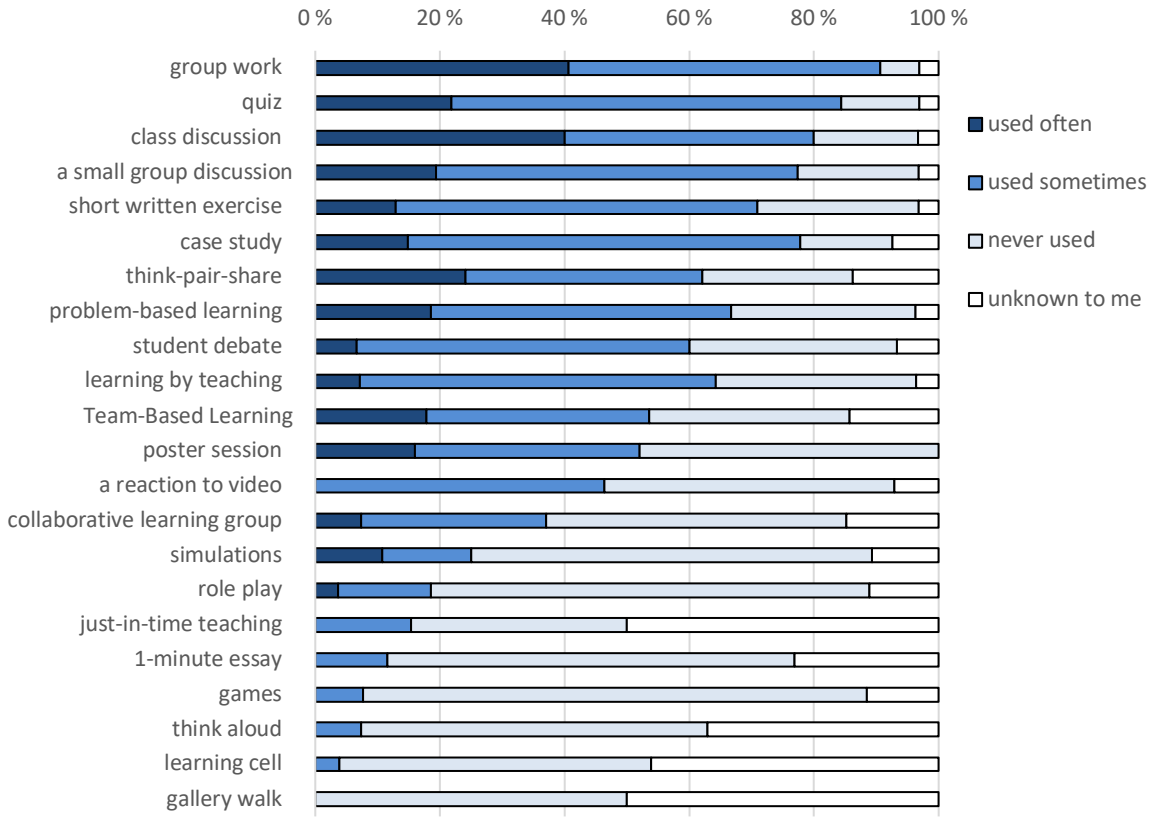

Fig. 3.1.2. How often do the respondents use the listed active learning methods?

3.2 Active learning methods in use at BIO

More than 90 % of the respondents use group work sometimes or often in their teaching, making this the most popular active learning method used at BIO (*Fig. 3.1.).* Quiz (84% used sometimes or often) and class discussion (80% used sometimes or often) were also common methods. However, there are many active learning methods either not used or not familiar to the teaching staff at BIO. There seems to be a general positive attitude towards active learning methods, as 91% of the respondents are planning to use such learning methods within the next 12 months.

DOI: 10.5324/njsteme.v7i1.3356

3.3 Motivation

Almost all respondents use active learning methods at least partly because they help students to achieve deeper learning (*Fig. 3.3.1.*). The teachers are motivated to use active learning methods also because they make students engage more, and because research shows that they lead to better learning. Only a minority was using active learning methods to improve their CV or their students' grades.

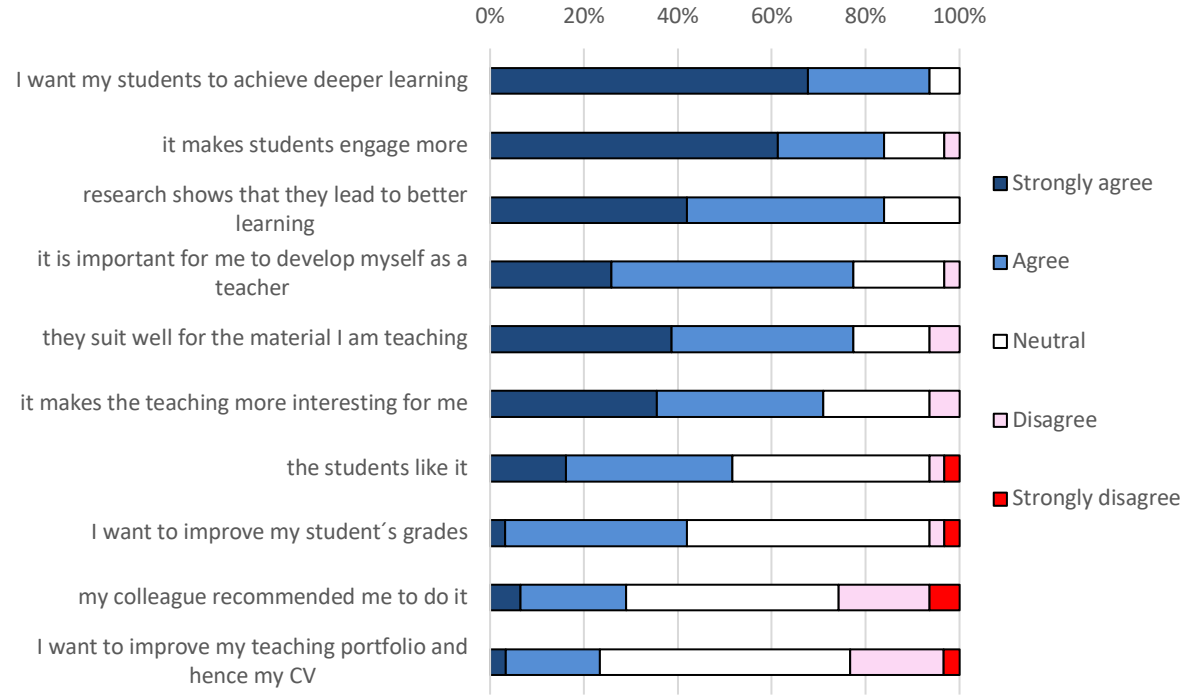

Fig. 3.3.1. Why are BIO-teachers using active learning methods?

The most important motivational factor for using active learning methods was self-motivation (*Fig. 3.3.2)*. Colleagues and BioCEED were also motivating for two thirds of the respondents. However, very few experienced that the UiB or the Faculty of Mathematics and Natural Sciences had motivated them to use active learning methods. Interestingly, the research group the respondents belong to was found to be a more important motivational factor than the teaching-group, even though the latter is the organisational unit responsible for teaching.

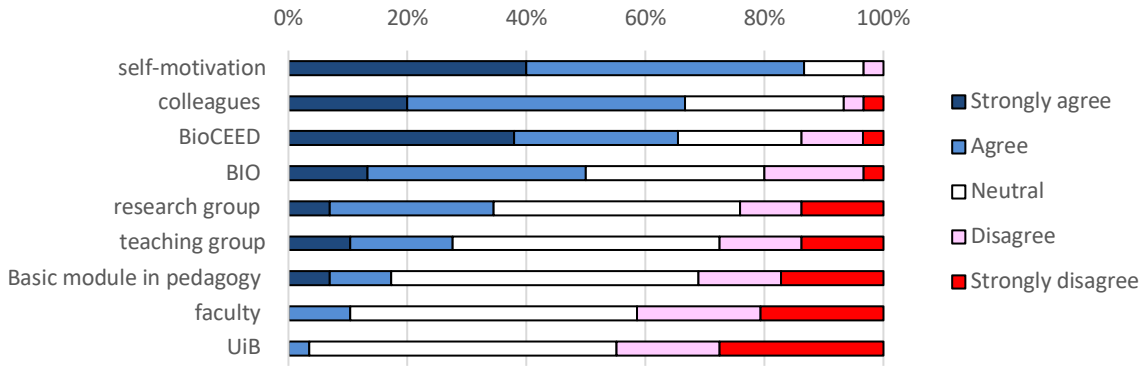

Fig. 3.3.2. If the teacher has used active learning methods, who or what motivated her/him to do it?

DOI: 10.5324/njsteme.v7i1.3356

3.4 Responsibility

Active learning methods are preferable for achieving deeper learning, but who has the responsibility for them to be taken into use? A vast majority (94%) of the respondents consider it to be the teacher herself/himself that has this responsibility (*Fig. 3.4.1.*). However, it is also seen as a departmental responsibility: 74% of the respondents agree that BIO has this responsibility. As could be expected, only about 20% of the respondents think that the research group is responsible.

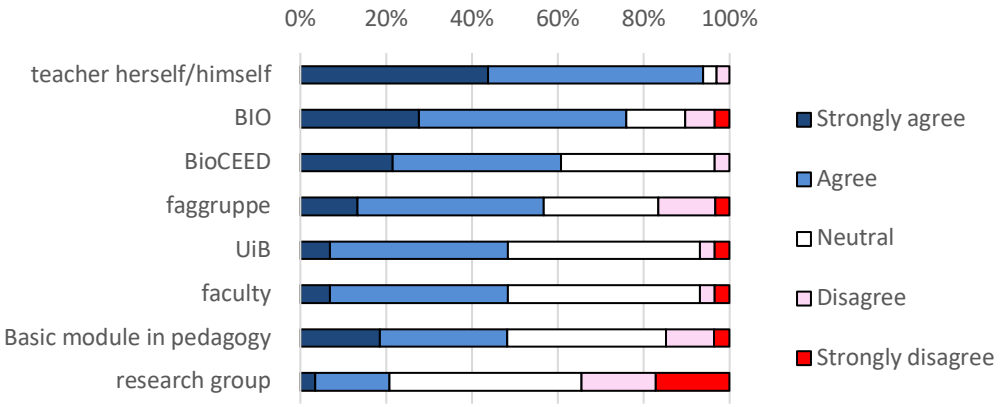

Fig. 3.4.1. Who has the responsibility for active learning being taken in use at BIO?

A majority (83%) of the respondents had learned about active learning methods themselves, 44% at a BioCEED teaching course, and 35% in a specialized university pedagogics course (*Fig. 3.4.2.*).

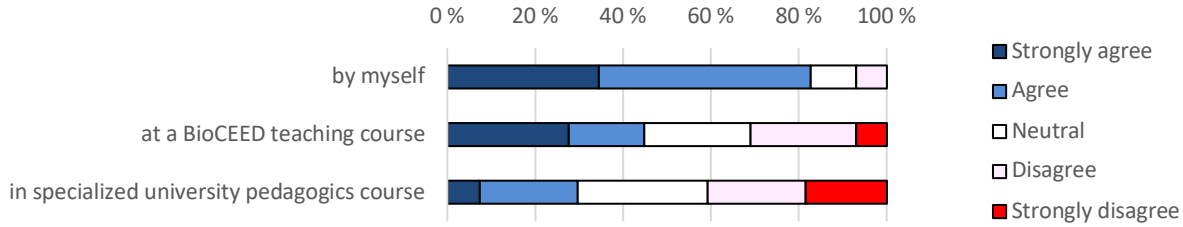

Fig. 3.4.2. I have learned about active learning methods…

3.5 Bottlenecks and solutions

A small majority (52%) replied that the large number of students in their class is a bottleneck for their use of active learning methods (*Fig. 3.5.1)*. Evaluating and grading is also seen as difficult when using active learning methods by 45% of the respondents. Only 35% of the respondents experience the traditional lecture room setup as a limiting factor, although 26% agree that too few active learning rooms is limiting their use of active learning methods. 45% of the respondents experience too little support from the administration in issues related to active learning. Against our expectations, only 13% of the respondents feel that it takes too much time to plan active learning activities, but 23% agree that using active learning methods limits the amount of material they can cover in their course.

DOI: 10.5324/njsteme.v7i1.3356

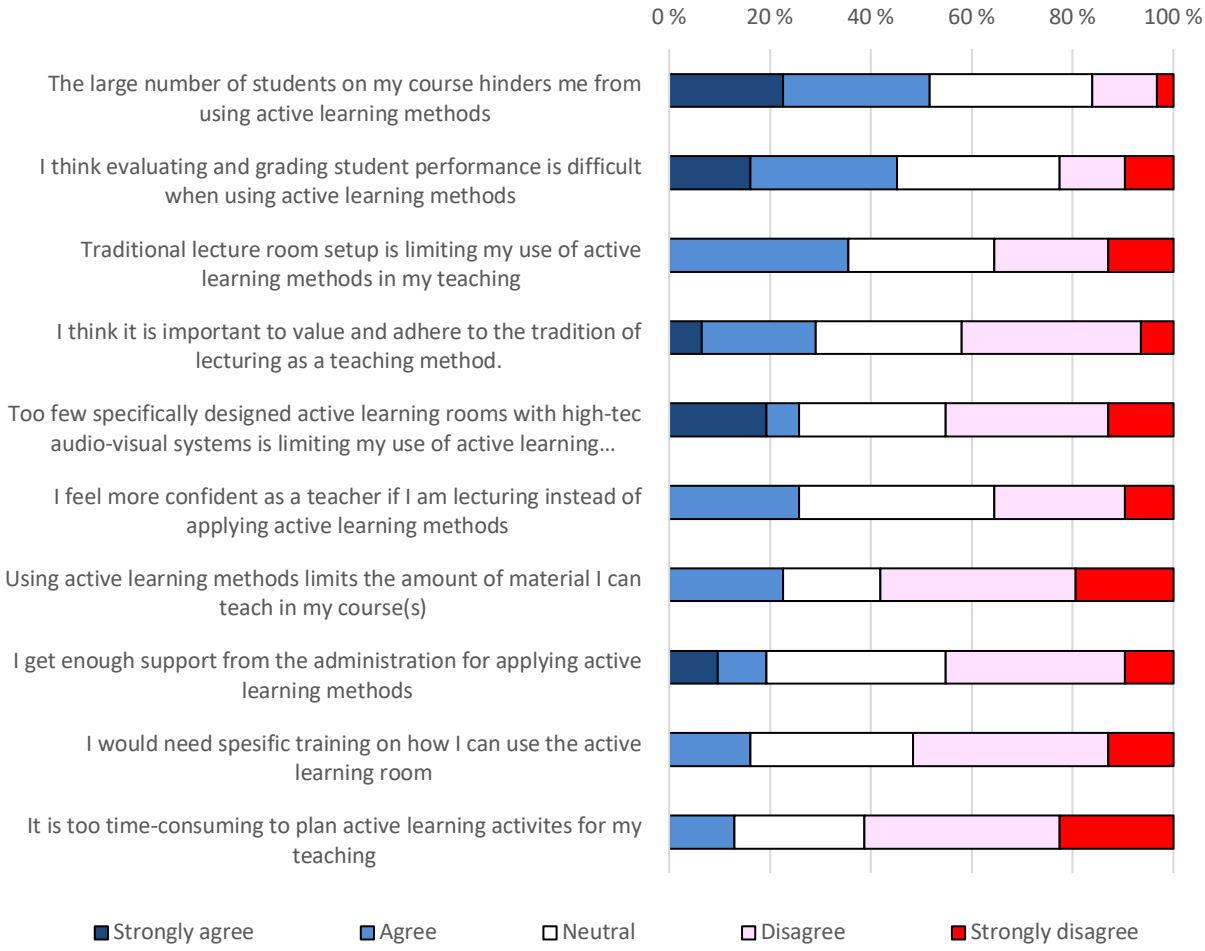

Fig. 3.5.1. Bottlenecks for using more active learning methods.

If the number of active learning rooms was increased, the majority (51%) of the respondents would use active learning methods more (*Fig. 3.5.2*). Getting an introduction to the technology related to the use of active learning rooms would also help (41% respondents agree). However, only 30% of the respondents agree that more pedagogical training would increase their use of active learning methods.

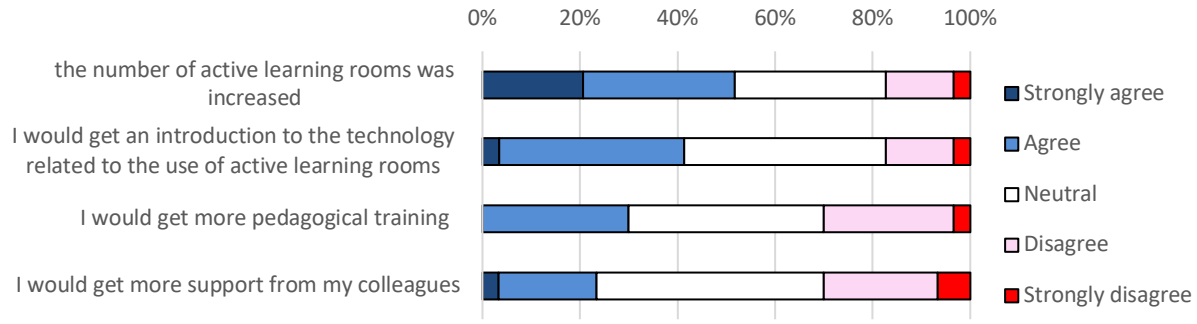

Fig. 3.5.2. The BIO-teachers would use more active learning methods if…

3.6 In-depth interviews

The interviews revealed that all the educators had used or were planning to use some sort of active learning tools in their teaching. Most frequently used (6 out of 7 interviewees) were quizzes as part

of student assessments and/or as feedback to the teacher. One faculty member had developed teaching consisting of mainly active learning strategies over a long period. Two faculty members had transformed courses from being totally lecture-based to include mostly active learning methods when being given the responsibility for a course new to them. A third faculty member, teaching an introductory-level course, had also introduced group work in a class of 160 students. However, notably, all but one (who taught only practical and laboratory work) used some sort of lecturing in their teaching. Two of the interviewees emphasized the value of lecturing as a good or excellent teaching and learning method, depending on the lectures being well structured or the lecturer having a talent for inspiring students.

Among the interviewed faculty, there was an awareness that field courses and laboratory courses can not necessarily be defined as active learning methods, but that it is dependent on how such exercises are assembled. In general, the interviewed faculty members were not able to very clearly define what active learning is, but rather expressed what it is not or what are passive learning methods. All but one faculty member were clear on that standard lecture-based teaching was a passive learning method, and they did not want to base all their teaching solely on lecturing.

Five of the interviewees were familiar with the active learning room at UiB. One expressed that it was not of interest to use this room for teaching, since standard classroom fulfilled the needs for the teaching given. For another teacher, the room was known, but not relevant to use in teaching, because their teaching consisted only of practical work. The remaining faculty expressed a high interest for using the room.

4 DISCUSSION

In this study we wanted to answer four specific research questions (listed in section 1). Here we discuss first the limitations of our study, and then proceed to discussing the results in the light of our predetermined research questions.

One of the limitations of our study is the relatively small sample size of 36 faculty members. However, they represent 40% of the total number of about 90 teachers at the BIO, and this response rate roughly corresponds to the response rate of the bioCEED survey of major tertiary-level biology education in Norway carried out in 2015 (Hole et al. 2015), where average response rate was 48% (range 22-63% among different institutes). Our survey was presented at a BIO teachers' retreat, and even though these retreats are considered compulsory to all the members of the teaching staff, it might be that particularly those most interested in developing themselves and their teaching were participating and responding to the survey. Also, a survey on active learning methods announced on e-mail might not be inviting to someone who is little interested in pedagogy and the scholarship of teaching and learning. Both of these aspects might be biasing our results towards teachers more interested in pedagogy and developing themselves and their teaching. Finally, our questionnaire have some potential weaknesses and some the questions might have appeared ambiguous, which might have lead to differences in interpretation of some of the questions. Nevertheless, we believe that even with these limitations, our study provides a realistic view of the use of active learning methods at BIO around the time these questionnaires and interviews were conducted.

The extent of using active learning methods varied among the respondents, and traditional lecturing was the most common teaching approach. However, there was a clear awareness of the value of implementing active learning strategies, and a majority of the educators demonstrated a motivation and trust in "active learning" being able to achieve student engagement and deeper learning. However, the knowledge of different tools and the degree of implementation varied among the faculty. Simple methods like "group work" and "quiz" were widely used, whereas more advanced methods were less known and utilized. The proportion of teaching taking place on the field was somewhat lower than expected: over one third of the teachers never teach on a field course. This result seems to provide

support for the suggestion that fieldwork in biology education is in general declining (Moore 2001, Smith 2004, Greene 2005).

Exposure to student-active learning is associated with increased level of student-centred conceptions about teaching and greater appreciation of active learning (Jacobs et al. 2015). At BIO, an increased focus on the use of active learning strategies has been introduced through the Centre of Excellence in Education, BioCEED, and 61% of the BIO-teachers considered BioCEED having the responsibility for active learning being taken in use at BIO. Nevertheless, when asked about the motivations to introduce new teaching strategies, it was self-motivation that was given as the most important factor among BIO educators. The influence from BIO, the Faculty and central University was considered less important. It might seem that our results highlighting the importance of self-motivation and individual responsibility seemingly contradict earlier research on higher education that has shown that change in university teaching culture happens through conversations among significant local networks of colleagues (Roxå & Mårtensson 2009, Roxå, Mårtensson & Alveteg 2011). However, our interpretation is that local networks of colleagues are important in introducing new ideas (such as new learning and teaching methods), whereas the final steps of initiation and implementation will often be individual. Self-motivation is obviously a valuable asset at any work-place (Lunenburg 2011), and evidently plays a large role in how faculty at BIO plan their teaching.

Somewhat surprisingly, only 13% of the educators answered that is was too time-consuming to plan active learning activities for their teaching. However, a large proportion of the faculty expressed the lack of specifically designed active learning rooms as one important bottleneck limiting their use of active learning methods, and would use more active learning methods if the availability of such rooms was improved. Our results also support earlier findings that the teacher's lack of technological knowledge can impede teaching in active learning rooms (Ungar et al. 2018). Over 40% of the teachers in our survey replied that their use of the active learning room would increase if they would get an introduction to the technology available in the room. Thus lack of technological knowledge creates insecurity that hinders the teachers from using the active learning room. If the educational institutions have ambitions to increase the utilizations of active learning methods, they should therefore invest in both creating more active learning rooms and providing introductory courses to the use of active learning room technology.

Even if the increased availability of active learning rooms and competence on the technologies used in such rooms were identified as factors promoting the use of active learning methods, only 35% of the respondents considered the traditional lecture room setup as a bottleneck for their use of active learning methods. This is an important result, as it signals that the educators understand that the core of active learning lies not in the architecture, but rather in the teaching philosophy – if there is a will, there is a way. The 'low-tech' approach to active learning has been earlier discussed by e.g. Roediger & Pyc (2012) and Soneral & Wyse (2017).

Training in university pedagogics has a range of positive impacts on both the teachers and their students (Gibbs & Coffey 2004), and 30% of the respondents of our survey think more pedagogical training would make them use more active learning methods. In Norway there is currently strong focus in teaching qualifications when employing new associate professors or professors, and 50% of the time budget of the associate professors and professors is devoted to teaching. If a new professor or associate professor has not already gone through a formal university pedagogy education of at least 20 ECTS, the university offers basic module (10 ECTS) and advanced modules in university pedagogy. Consequently, all relatively new associate professors and professors should have gone through a formal university pedagogy education of 20 ECTS. In our survey 45% the respondents had learned about active learning at a teaching course organised by the Centre of Excellence in Education, BioCEED, and 29% in specialized university pedagogic course. However, 83% of the respondents reported learning about active learning methods by themselves, so it is clear that in addition to courses, individual learning also plays an important role in the process of competence development and the transformation towards more student-centred teaching and learning.

Given the faculty's apparent willingness to implement new teaching strategies, a high gain could be hypothesized if the identified bottlenecks can be overcome. Based on our in-depth interviews, we suggest that the timing of introducing new teaching methods is of great importance. Particularly suitable

points in time are when new courses are established, or when a new person takes over an existing course. Both of these stand out as excellent opportunities to introduce changes to the way courses are taught. The educational institutions should take advantage of these windows of opportunity to stimulate implementation of active learning through administrational and collegial support.

5 REFERENCES

Avsec, S. and M. Jagiello-Kowalczyk (2018). "Pre-Service Teachers' Attitudes Towards Technology, Engagement in Active Learning, and Creativity as Predictors of Ability to Innovate." International Journal of Engineering Education 34(3): 1049-1059.

Beichner, R. J. (2014). "History and Evolution of Active Learning Spaces." New Directions for Teaching and Learning 2014(137): 9-16.

Bonwell, C and Eison, J (1991). "Active Learning: Creating Excitement in the Classroom." ASHE-ERIC Higher Education Report No. 1. The George Washington University, School of Education and Human Development.

Connel, GL., et al. (2016). "Increasing the Use of Student-Centered Pedagogies from Moderate to High Improves Student Learning and Attitudes about Biology." CBE – Life Science Education 15 (ar3), 1-15.

Freeman S. et al. (2014). "Active learning increases student performance in science, engineering, and mathematics." PNAS 111 (23): 8410-8415.

Gibbs, G. and M. Coffey (2004). "The Impact Of Training Of University Teachers on their Teaching Skills, their Approach to Teaching and the Approach to Learning of their Students." Active Learning in Higher Education 5(1): 87-100.

Greene H W (2005) Organisms in nature as a central focus for biology. Trends in Ecology and Evolution, 20(7) 23–27.

Hole, T.N., Jeno, L.M., Holtermann, K., Raaheim, A., Velle, G., Simonelli, AL., & Vandvik, V. (2016). bioCEED Survey 2015. Retrieved from University of Bergen, BORA – Bergen Open Research Archive: http://hdl.handle.net/1956/11952.

Jacobs, J. C. G., et al. (2015). "Impact of institute and person variables on teachers' conceptions of learning and teaching." Medical Teacher 37(8): 738-746.

Lee, D., et al. (2018). "From swimming pool to collaborative learning studio: Pedagogy, space, and technology in a large active learning classroom." Educational Technology Research and Development 66(1): 95-127.

Lunenburg, F.C. (2011). "Self-Efficacy in the Workplace: Implications for Motivation and Performance". International Journal of Management, Business, and Administration 14(1): 1-6.

Meld. St. 16 (2016–2017): https://www.regjeringen.no/no/dokumenter/meld.-st.-16-20162017/id2536007/

Michael, J. (2006). "Where's the evidence that active learning works?" Adv in Physiology Edu 30(4): 159-167.

Moore P G (Ed) (2001) Developing and sharing best practice in marine-related fieldwork. University Marine Biological Station, Millport. Occasional publication 8.

Roediger, HL and Pyc, MA. (2012). Inexpensive techniques to improve education: Applying cognitive psychology to enhance educational practice. Journal of Applied Research in Memory and Cognition, 1(4), 242-248.

Roxå, T. and Mårtensson, K., 2009. "Significant conversations and significant networks–exploring the backstage of the teaching arena." Studies in Higher Education, 34(5), 547-559.

Roxå, T., Mårtensson, K. and Alveteg, M., 2011. "Understanding and influencing teaching and learning cultures at university: A network approach." Higher Education, 62(1), 99-111.

Smith D (2004) Issues and trends in higher education biology fieldwork. Journal of Biological Education 39(1) 6-10.

Soneral, P. A. G., et al. (2017). "A SCALE-UP Mock-Up: Comparison of Student Learning Gains in High- and Low-Tech Active-Learning Environments." CBE—Life Sciences Education 16(1): ar12.

Ungar, O. A., et al. (2018). "Faculty Use of the Active Learning Classroom: Barriers and Facilitators." Journal of Information Technology Education: Research 17: 485-504.