Furnishing Active Learning Classrooms for Blended Synchronous Learning

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Abstract: Technology enhanced learning has been a rapidly expanding field in the 21st century, while most university classrooms and lecture halls look the same as they did one hundred years ago. A new classroom concept that seem to have potential to renew education is the so called Active learning classrooms (ALCs). The fundamental idea for ALCs is to furnish for active group learning with technology enhancement such as computers, digital screens, whiteboards and Internet connection.

Today higher education settings are not only technology blended, but also blended in other ways. In the standard definition of blended learning the blend consists of traditional face-to-face education and technology enhanced online sessions. A subclass of blended learning is blended synchronous learning (BSL), a blend where on-campus students work together with distance students in common synchronous teaching and learning activities. The BSL concept should also build on active and collaborative learning in groups with participants from both the described student groups. The aim of the study was to analyse and discuss how active group learning in BSL settings are depending on the ALC furnishing and the technology.

The study for this chapter was conducted with a case study approach with two active learning classrooms as the investigated case units. Nine teachers and three persons from the service staff focus group were interviewed. Answers from the semi-structured interviews were analysed by use of the qualitative data analysis tool Atlas.ti. The more technical parts of the evaluation were analysed with the Technology Acceptance Model as a theoretical framework.

A result from the analysis was that there was not only one BSL model but two. The first one is more dependent on furnishing than on technology enhancement and the recommendation is here to choose a low-cost and low-tech 'light version'. Regarding the second BSL model with a synchronous mix of on-campus and distance students the recommendation is to go for high-tech equipment and rich-media communication and communication tools. Finally, it seems difficult to reach any consensus regarding the spatial design, and the recommendation, for both BSL models, is a flexible design with movable furniture and enhanced communication and collaboration technology.

Keywords: Active Learning Classrooms, ALC, Blended synchronous learning, Higher education, Technology acceptance model

Introduction

After a century of rapid technological advancements and a rich discussion on how education can be made more active, most educators agree on that also the classrooms need to be redesigned. Student centred teaching and learning activities are better carried out in virtual and actual class rooms that supports collaboration and active learning. Technology enhancement and blended learning are two popular concepts that must be considered in the
design of today’s active learning classrooms (Fisher 2010; Baepler, Walker & Driessen, 2014). There have been substantial investments in information and communication technology (ICT) in higher education during the last decade, with more or less successful outcomes (Cook & Triola, 2014; Fischer et al, 2014; Kirkwood & Price, 2014; Flavin, 2017).

Blended learning has been a rapidly expanding phenomenon in the 21st century, and almost all universities are today using some variation of blended learning with a blend of face-to-face activities and ICT enabled online activities (Garrison & Kanuka, 2004; Watson, 2008). Different models for blended learning have been implemented and tested (Valiathan, 2002), where the online blend can be given asynchronously (Welsh et al, 2003) as well as synchronously (Bower et al., 2015). If an effective blending of synchronous and asynchronous features can be created there will be good probabilities to support students’ peer interaction and collaboration (Hrastinski, 2010). As pointed out in the study by Garner and Rouser (2016) the recommendation is a balance between traditional face-to-face activities and technology enhanced online activities that supports the actual course aims.

This chapter has a focus on blended learning with a high frequency of synchronous activities and how active learning classrooms (ALCs) should be furnished to facilitate for university teachers. Nine teachers from different departments at the Mid Sweden University have been interviewed about their experiences of technology enhanced teaching in two ALCs. Analysed teaching and learning sessions have been carried out during three semesters in two ALCS that have a design inspired by the ALC model that has been developed at the University of Michigan (Baepler, Walker & Driessen, 2014). The aim of this study was to analyse and discuss how active learning classrooms should be furnished to support blended synchronous learning.

Method and data collection
The overall research strategy was a case study approach with two active learning classrooms as the investigated case units. A case study could be defined as a structured and systematic investigation of real world phenomena (Yin, 1989), where the selected case units can consist of entities that are explored more in depth with data collected from different sources (Creswell, 2009). Case studies should have a focus on one, or just a few instances of a selected phenomenon with a focus on an in-depth analysis and description of the instance(s) (Remenyi, 2012).

Nine university teachers and three persons from the service unit were interviewed about their use of the ALCs during three semesters. Answers from the semi-structured interviews have been thematically analysed with the qualitative data analysis tool Atlas.ti. The evaluation of the ALC technology was conducted with the Technology Acceptance Model as a theoretical framework and complemented with an analysis of the service unit’s error logs. All involved persons have participated on a voluntary basis and informants have been kept as anonymous as possible.

Data were analysed in an inductive-deductive way with the two found models for blended synchronous learning as main categories. In the second analysis step found themes have been grouped into sub-categories in the main categories. Categories were created as 'codes' in the qualitative data analysis tool Atlas.ti, when audio files were analysed and compared to observations, field notes and error report logs. The data analysis was carried out in a number of distinct steps inspired by the methodology for qualitative data analysis that have been described by Bryman and Burgess (1994) and Braun and Clarke (2006).
**Blended synchronous learning**

Today, almost all universities use some version of blended learning where traditional face-to-face teaching is blended technology enhanced online learning (Garrison & Kanuka, 2004; Watson, 2008). A wide variety of blended learning models have been designed and evaluated (Valiathan, 2002). The technology enhanced part of blended learning can be given either asynchronously as described by (Welsh et al., 2003), or as synchronous activities. A common design of blended synchronous learning is to have on-campus students and distance students participating together in the same activities. Students are supposed to interact and collaborate with the use of rich media tools, but this blend is not without problems and there are sometimes barriers between the two groups (Popov, 2009). The recommendation is to consider the divide between the two different groups and to design for equivalent learning opportunities (Turoff, 2000).

Blended synchronous learning with a blend of on-campus and distance learners has to be orchestrated with the use of Internet connected rich-media technologies such as video conferencing systems and virtual learning environments. Important is to choose tools and technology that meet students' communicative needs and to design for active learning (Bower et al., 2015). The importance of teacher-student and student-student interactions in learning processes should not be underestimated. Technology enhancement only is unlikely to be the most effective teaching and learning strategy (Rhem, 2012; Chen & Yao, 2016). The study by So and Brush (2008) found that learners with high perceptions of collaboration and interaction in their course participation also perceived high social presence. The sometimes neglected emotional support could be a way to reduce students' sense of distance in blended learning environments. The recommendation is to design for socio-affective interaction (So & Brush, 2008).

If carefully designed, blended synchronous learning has the potential to open up higher education with access for new target groups such as students who are working, taking care of children, or students with disabilities (Pope, 2010). The overall objective should be to create a more inclusive and equitable learning environment to persons who are geographically isolated or cannot physically participate (Norberg, 2012; Cunningham, 2014). Finally, all students should have the opportunity to interact and collaborate with each other with active learning spaces on-campus as well as online.

**The Technology Acceptance Model**

New technology is rarely accepted automatically with users’ perceived usefulness and user-friendliness as critical factors. If a system lacks usefulness, it will simply never be used and if features are too difficult to use the user attitude will be negative. A well-known and widely used model for evaluating new technology and information systems is the technology acceptance model (TAM). The model has been developed iteratively with the three main versions that are described below.

In the very first version (TAM 1) that was constructed and presented by Davis, Bagozzi and Warshaw (1989), critical factors for end users’ actual use of a system had been investigated and presented. Main factors affecting the user attitude and users’ intention to use a system in TAM 1 were perceived usefulness and perceived ease of use. TAM is a model based on the earlier Theory of Reasoned Action, which is a more general concept for explaining human attitudes and behaviour. A difference between the Theory of Reasoned Action and the TAM model is that TAM aligns the user's intention to use a system to a systems' perceived
usefulness and the systems' perceived ease of use.

Perceived usefulness, is in the TAM model defined as "the degree to which a person believes that using a particular system would enhance his or her job performance". This was found to have a strong influence on the intention to use a system (Davis, Bagozzi & Warshaw, 1989). However, perceived ease of use, in TAM defined as "the degree to which a person believes that using a particular system would be free from effort", also matters. To summarise, a user that perceives a concrete usefulness of a system, often strives to complete the use even if this involves challenges and usability issues. However, a technology or a system with a high perceived ease of use, have much higher probabilities for a genuine user acceptance. (Davis, Bagozzi & Warshaw, 1989)

TAM 1 was extended to TAM 2 with the additional concept of the user's subjective norm, which also has its origin the Theory of Reasoned Action. The image or the reputation of an artefact might have an impact the user's social status, regardless of the artefact's actual usefulness (Venkatesh & Davis, 2000). TAM 2 also involves factors as voluntariness and experience that are related to the behavioural intention to use an artefact. Social norms often play a decisive role in the inception phase, but in the longer run it is the end users’ own experience and evaluation that influences the actual use of an artefact. The study by Venkatesh and Davis (2000) found this relationship both for mandatory and voluntarily use of an information system.

To conclude, TAM 2 could be summarised as an extension of the perceived usefulness in TAM 1, while the TAM 3 model could be summarised as an extension of the perceived ease of use. A fundamental idea in TAM 3 the focus on the user's relation to information and communication technologies and that the user's computer skills matters. New factors in TAM 3 that are related to this are computer anxiety, computer playfulness and computer self-efficacy. TAM 3 also have added factors such as perception of external control, perceived enjoyment and objective usability. (Venkatesh & Bala, 2008)

**ALCs and the two investigated case units**

A recent trend in higher education is to replace traditional and lecture-based sessions with more student centred learning and teaching activities that involve interactive, group based collaboration. There are positive reports from studies on ALCs highlighting that both instructors and students find them to be engaging environments (Vercellotti, 2017). The ALC concept seems to have a potential to facilitate student centred activities and to reshape traditional educational structures (Charles & Whittaker, 2015).

Several universities have replaced parts of their traditional learning spaces with ALCs. An interesting example of a successful redesign is the ALCS that are in use at the University of Minnesota (Baepler et al., 2014). Two fundamental design concepts in these ALCs are the round-tables to support student collaboration and interaction, and the idea of the teacher acting as a learning coach instead of taking the traditional lecturer role. (Cotner et al, 2013). The ALCs at the University of Minnesota appears to be successful and appreciated by students that have completed their courses with good learning outcomes (Baepler et al., 2014).

The two investigated ALCs at the Mid Sweden University have a design that is inspired by the implemented ALC concept at the University of Minnesota. There are resizable round-tables with six chairs that all have their own computer, their own whiteboard and a screen that can be shared. Each ALC have six tables, a projector, microphones, loudspeakers and a
centralised teacher desk. The teacher desk contains a control panel where lights, volume, computers, the projectors can be adjusted for the actual teaching and learning session. Each ALC also have a sound reducing carpet to avoid group discussions to disturb other group discussions.

Findings and discussions

In the first data driven inductive analysis the surprising main finding was that the university uses two different models for blended synchronous learning. Since the differences in teaching and learning between the Blended synchronous learning model 1 (BSLM 1) and Blended synchronous learning model 2 (BSLM 2), these models were main categories for structuring other found themes to sub-categories in the second data analysis. The common sub-categories that are presented below are technology, rich media tools and acoustics, furnishing and teaching and learning activities. All sub-categories should be discussed by how they are interdepending on other sub-categories, while the two models for blended synchronous learning better are discussed separately.

**Blended synchronous learning model 1**

A model that was started and is widely used as a standard blend at the Department of education. The blend in this model is to have 'on-campus weeks' where all students attend synchronous face-to-face sessions at the university mixed with 'off-campus weeks' where students work mainly in an asynchronous mode in the Moodle virtual learning environment. On-campus weeks can then be orchestrated with a minimum of rich media tools. The emphasis can then be on group work and face-to-face discussions and as expressed by Teacher 1 "I’ve never had any blended groups since I’m afraid that technology wouldn’t work". Findings in the sub-categories of BSLM 1 were as described below:

**Technology**

If there are no blend of on-campus students and distance students technology can be kept simpler and less complex. It is sufficient if audio and video transmission works within the ALC, with the Internet connection as an extra resource for retrieving information. What both BSL models have had as a common problem was the high frequency of hardware issues during the first semester. The error log contains a lot of vaguely defined problems labelled as 'projector problem', 'computer screen issue', 'computer problem' or 'technical problem. One interviewed teacher remembered that "Initially it was problematic to get the computers and the screens started". During the semester of ALC use the service staff found the common denominator, the cabling.

The initial cabling system was purchased for a low cost, but with a bad functionality that caused a lot of errors. Another penny-wise decision that ended up to be pound-foolish when costs of technicians and janitors are included. With a new cabling system the ALC hardware has worked in a much more stable way, and what teachers mainly brought up for semester 2 and semester 3 were software problems. Most teachers find the technical complexity to be high in the ALCs and several teachers were checking that everything works up to 45 minutes in advance before a teaching and learning activity. Several teachers also find the control panel at the teacher desk to be non-intuitive, with problems to switch between the various monitors.

**Rich media tools and acoustics**

After the initial cabling disturbance there are mainly software issues that are reported during
semester 2 and semester 3. The most problematic software seems to be the Adobe Connect system that sometimes has not worked at all. Also for BSLM 1 it is interesting with Adobe Connect features like session recording and ‘break out rooms’. Recording of a lecture or a seminar can be easily managed when the software works, but the audio and the video quality is reduced with lower resolution and poor quality for things like a video captured whiteboard. An improvement

There have also been issues reported for sessions using the Skype conference system which some teachers wish to replace with another rich media communication tool. On the other hand teachers' experiences is that the sound quality is good in Skype, "when it works". For audio transmission in the ALCs the loudspeakers seem to have been misplaced, and for most participants the sound comes from behind their heads. Like in digital games, sounds from behind can be perceived as unpleasant. What all teachers praise, is the sound reducing wall-to-wall carpet. In a session with six round-table discussions it is important that the groups do not disturb each other.

Furnishing

A great majority of the teachers pointed out that the ALC furnishing is very suitable for interactive group work, and as mentioned by Teacher 4 "With the ALC facilitates, it is easy to shift between the collective and the autonomous". Group activities at the ALC round-tables are often combined with short teacher presentation or 'mini-lectures' from the centralised teacher desk. Some teachers have felt confused with this centralisation when they in their presentations always have to turn their backs to some of the student groups. The centralised teacher desk is a concept borrowed from the ALC design at the University of Michigan, based on the idea of a teacher that during a lecture should shift positions to get face-to-face contact with all groups. Teacher 1 mentions the habit of "When the ALC is not that full, I have placed the students so that everyone faces the teacher". Some teachers have found it convenient to walk around during lectures, but others have found it inconvenient and disturbing. It has also been difficult to reach a consensus considering the initially centralised main screen that later was moved to a side wall. The same goes for the document camera has been moved the other way around to the teaching desk in the centre. Some teachers see this as an improvement, others claim that they liked the initial furnishing better. One person in the service staff summarised this as "It seems hard to please all the teachers with one fixed furnishing".

Teaching and learning activities

The interview answers contain a wide variety of creative teaching and learning activities and as mentioned by a Teacher 2 "I started out easy and has later developed my activities". Teacher 4 brought up that "It took some time to learn to know the room and to explore what is doable and what's not" and that "I've exposed myself for the rooms". Something that Teacher 4 shares with most other teachers is to build around a mix of short lectures or 'intros ' and group collaboration. They all think that this works better in an ALC than, as earlier, with a traditional lecture hall combined with 3-6 group rooms.

The ALCs open up a possibility to have all activities in the same room with a better focus and improved collaboration. An interesting idea mentioned by several teachers, is to use both the adjacent ALC rooms for larger student groups. Teacher 6 also mentioned that there is nothing in the ALC design that hinders any traditional teaching method, and for BSLM 1 it is mostly the furnishing that might hamper some kind of activities.
Blended synchronous learning model 2

The blended synchronous learning model 2 (BSLM 2) builds upon the idea of having on-campus students participating together in the same synchronous activities with distance students. Teachers and students should interact and collaborate via Internet with the use of rich media tools for communication and group work. A challenge with BSML 2 is how to break the group barriers and stimulate collaboration with participants from both groups. This is the standard mode for all courses at the programme for Informatics at the department of computer and system sciences at the Mid Sweden University. Findings in the sub-categories of BSLM 2 were as described below:

Technology

If technology is seen like an available extra feature in BSLM 1, it is here in BSLM 2 a fundamental condition for all teaching and learning activities. Without a high quality audio and video transfer the distance students will have far from equal conditions to participate in the synchronous activities. Teacher 6 that have a general embracing attitude towards technology and distance education have tried to teach in BSLM 1, but was not satisfied with the outcome. An obvious problem is how to transfer information written on the ALC whiteboards and as expressed by Teacher 1 "Whiteboards are as important as digital screens". Since the math teacher claimed that "The pen is still the most important tool", there must be a satisfying technical solution with decent readability for the distance students.

Teacher 4 who also works in BSLM 2 mode has chosen to run the blended synchronous activities from the university’s dedicated video conference rooms instead of using the ALCs. Working in BSLM 2 mode have been troublesome, but these teachers have a very good general impression of the helpdesk staff and as pointed out by Teacher 6: "The janitors have helped me when I've got stuck and they are generally helpful". To summarise, BSLM 2 is much more depending on technology and high quality audio and video transfer is a fundamental condition that must be fulfilled.

Rich media tools and acoustics

There were no teachers that found the virtual learning environment Moodle to be problematic. The general impression seems to be that this system is a bit square and uninspiring, but with a reliable robustness. More crucial are the video conferencing systems, but there are an internal project investigating alternatives to replace Adobe Connect. A plausible candidate is the Zoom system that soon will be tested in some courses. This might also be a way to increase the bandwidth to obtain better audio and video resolution. Furthermore, there are discussions on replacing Skype with the Discord software.

The sound reducing wall-to-wall carpet and the generally good acoustics are beneficial also for BSML 2. It would be relatively easy to update the ALC with some additional microphones and loudspeakers. Important is to assure that all distance students can hear all on-campus students and vice versa. There might also be a need for more cameras in the ALCs, but that is discussed as a furnishing issue in the next section.

Furnishing

The centralised teacher desk is obviously a problem and that distance students should watch images of the teacher’s back is certainly not a good solution. For a
BSLM 1 group it could be stimulating that the teacher shifts position to sometime face every group, but for a BSLM 2 group this would be confusing. A solution might be to have several teacher desks and more cameras giving the teachers more options. Another idea could be to make most of the furnishing movable and more flexible. There are movable whiteboards on wheels and instead of fixing the teacher desk in the middle, it might be equipped with wheels as well. Some of the interviewed service staff did not like the idea of making everything movable, but several teachers liked the idea.

Technology will certainly develop further and the vision that Teacher 6 had with "... all walls as extended whiteboards that also could be used as projection areas", might soon be possible to realise. The first generation of interactive 'smartboards' has been a costly and disappointing experience, but the next generation will hopefully work better. Teacher 5 also wanted to replace the fixed wall between the ALCs and to replace it with a 'mobile folding wall' that would facilitate to use both ALCs in the same teaching and learning session.

Teaching and learning activities

Teachers brought up many activities of the type that Teacher 1 called 'cross-group activities' where the student groups use whiteboards and screens to present their solutions for other groups. Several of them would probably work for a BSLM 2 session, but the one called 'The Vernissage' might not be possible for distance groups. A Vernissage is an activity where all groups should visit all other groups to look at their presentations, ask questions and discuss the presented ideas. This would definitely need more cameras, microphones and probably more sophisticated software as well.

Exactly how the ALCs need updating for BSLM 2 is hard to specify, but the recommendation is to investigate this further before building more ALCs. A high percentage of the interviewed teachers had used the ALCs for BSLM 1 activities and one idea was to build less complex 'low-tech ALCs'. For BSLM 2 groups the solution is probably a step in the other direction without making the ALCs to complex and without violating the TAM ide of a high ease of use. The focus must be on the teaching and learning activities and not on technology or mobbing furniture.

Conclusion

For the BSLM 1 model it seems relatively easy to achieve technology acceptance the perceived usefulness is met for several pedagogical models. When technology works the ALC design supports active and student centred group learning with rich discussions and interaction. Some explanations based on the TAM model, might be the TAM 2 extensions of voluntariness and the subjective norm. All teachers have chosen to use the ALCs by free will and to use the ALCs is according to their social norm and giving them a higher status. From the TAM 3 extension of perceived enjoyment, teachers have used the in a joyful manner after the many technical issues in the inception phase. Furthermore, teaching and learning activities in the BSLM 1 model do not necessarily have a need to use all technical features and several of the described pedagogical ideas can be carried out with a minimum of rich
media tools.

Considering the BSLM 2 model technology and the use of rich media tools are more crucial. With a group of distance students interacting with teachers and on-campus students the demands for audio and video communication are definitely higher. If distance students miss the social presence in group activities and discussions much of the BSLM 2 core ideas would fail. Basic design issues like the positioning of the teacher desk and the cameras need rethink and redesign in ALC version 2, and more robust software would improve teachers’ working situation in a BSLM 2 environment. There is a need for reliable high-tech equipment and robust rich-media communication tools to bridge the divide between the two different student groups.

Different teachers have different teaching and furnishing preferences, and it seems difficult to reach any consensus regarding furnishing and the spatial design. The recommendation, for both the BSL models, is a flexible design with more movable furniture, and enhanced communication and collaboration technology. Not all teachers have to use all technical features, but only with an overloaded variety of communication and collaboration tools available the same ALCs can be used for both BSL models.

References


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