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ACTIVITY-BASED TEACHING FOR UNITEC NEW ZEALAND CONSTRUCTION STUDENTS

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In 1993, Betts and Liow called for a shift from traditional 'chalk and talk' teaching methods to 'active learning' for construction students. However, this study appears to be the first to provide an active learning classroom for construction students. We set out to find evidence for a direct link between this specific teaching practice and student learning. A participant observation methodology was used to study classroom changes for one compulsory module of a first year construction course. Stage one of the study concentrated on devising new teaching strategies informed by recent research into the learning-styles of New Zealand construction students. Although the instructor was willing to try new teaching strategies, he did not have any experience of activities-based learning, and he questioned the efficacy of such changes. Stages two through four concentrated on development of data types, collection of data and analysis of data concerning the use of activities-based teaching strategies. The student and instructor feedback was positive concerning student engagement both in the classroom and in relation to the final assessment. In addition, the link between of the activities-based teaching and student learning was evident in a marked improvement in grades in relation to those from the previous class.

Keywords: Activity-based learning, construction students, New Zealand, peer learning

1. INTRODUCTION

In 1993, Betts and Liow[1] called for a shift from traditional 'chalk and talk' teaching methods to 'active learning' for construction students. This request for change was based on the findings of a study that showed differences in learning expectations between lecturers and students. They found that academics were focused on the present, but students were focused on the future and thus failed to engage with course materials. They argued that students would focus on the present if they were provided with an active learning environment. To date this call for change appears to have been largely unheeded in construction education.

The purpose of this study is twofold. Firstly, the research aims to provide an 'active-learning' classroom where 'students actively participate in the learning experience rather than sit as passive listeners'[2]. If Betts and Liow are correct, then construction students are not suited to a passive learning environment and need activities-based teaching to provide them with strategies for engagement with course material.

In addition, Lammers and Murphy[2] suggest that research is needed 'to clarify the link between instructional technique and student learning'. The second aim of this study is to provide evidence that there is indeed an observable link. The research assumption is that an activities-based classroom is more suitable for construction students who prefer tactile learning[3] and thus, the learning outcomes will reflect increased engagement with the course content.

The structure of the paper is slightly different from the expected format. A multi-layered and multi-stage research design is easier to report as four separate stages. The paper will first provide a literature review focused on student engagement and an activities-based classroom. The methodology section provides details of the mix-methods methodology used. A description of four stages of the research includes an outline of the development of measurement criteria, data collected along with analysis of the data. The final section concludes with the implications of the findings.

2. CONCEPTUAL FRAMEWORK

Some researchers suggest that teaching strategies should move to a more student-centred approach[4]. A move beyond the traditional 'teacher in control' method of curriculum delivery is gaining acceptance as the positive evidence of a more 'student-centred'

approach increases. These approaches are based on a constructivist view of learning which suggests that each person 'constructs' their own learning process based on previous experience, usually in collaboration with others. Learning activities that are based on 'real life' experience are claimed to help students transform information or fact into personal knowledge which can then be applied in a variety of situations[5].

Models for the student-centred classroom have been developed specifically for construction students. Hall[6] discusses the problems of learning from the perspective of motivation of USA construction students. She writes that every class is 'comprised of both self-motivated students and students who appear to be lacking in motivation'. According to Hall, motivation is not just an individual attribute, but part of the interaction between learner and teacher; the student has the 'problem' and the teacher has the 'solution'. Thus student motivation can be 'managed' by the teacher. One of the best ways, she suggests, for managing motivation is to develop teaching techniques and strategies directed at motivating students.

One stream of research has focused on self-directed problem solving[7]. Auchey, Mills and Beliveau[8] suggest that 'self-directed problem solving' in a classroom provides construction students in the USA with experience, practices and skills. The claim that solving problems affords motivation is supported by research in the UK. Student-centred Learning in Construction Education (SLICE) has developed a number of teaching resources. For example, one CD provides a virtual tour of a house that has 'rising damp'. As the camera moves through the house, the degree of damage increases so that students are able to see the implications for their solutions to the damp problem[9].

Hake[10] argues that motivation follows from engagement, and engaging students in interactive and self-feedback curriculum is the most effective method for teaching and learning complex theory. His research data for introductory physics students in the USA measures conceptual understanding and is only one of many studies that support the call for active students in active classrooms. He concludes that activity related to the material being presented is the important factor, and that a variety of activities have proven successful.

Another stream of researchers studying student-centred learning has found that construction students prefer to have active classrooms[9,11]. Prince[12] has defined active learning as 'any instructional method that engages students in the learning process' that takes place in the classroom. Active learning has two points of distinction from the traditional 'transmission model' of teaching and learning. First, active-learning is in direct opposition to the traditional 'active lecturer and passive students' scenario. Second, activity-based learning is considered a collaborative effort between students rather than being the 'solitary activity' postulated in traditional educational theory[12].

Betts and Liow[1] were early proponents of active classrooms for construction education. Their research to determine the best teaching methods for the Building discipline is based on questionnaire data from both teachers and students in Singapore. Betts and Liow asked participants to rank a list of educational objectives in order of importance. They found that lecturers focused on the present learning objectives and students focused on the future outcomes. Betts and Liow suggest that these results are the expected outcome of a passive learning environment and lack of student engagement. Therefore, instructors need to change their behaviour, and thus their skill set, so that classrooms become 'active'. To ensure that this happens, the authors advise that lecturers also become facilitators[13] in active learning classrooms to engage construction students with the course content.

The views of Betts and Liow are reinforced by the findings of Panko et al., which show that many of those entering the construction and building industry have a preference for tactile learning[3]. A passive learning environment, where students are required to sit still in a classroom, is difficult for tactile learners[14]. In Kolb's learning cycle model, tactile learners prefer tasks they can directly experience, perform, or that involves manipulating teaching materials[15]. In addition, students with a preferred tactile learning style need to be active and take frequent breaks.

All of these factors reinforce the need for teaching models based on strategies that provide active-learning opportunities for construction students.

3. METHODOLOGY

A mixed-method methodology was used to collect data directly and indirectly. The ability to collect data using a variety of methods is an important benefit of the mixed-method paradigm[16]. The primary methodology was participant/observation because of the necessity to track changes in physical behavior[17]. Data were also collected using focus-groups and face-to-face semi-structured interviews[18].

The location of the study was a tiered lecture theatre at Unitec, New Zealand. The study participants were the instructor and a group of 34 construction students working through a compulsory module requiring 12 classroom contact hours. Each classroom session was three hours in length with a half-hour break.

Participant/observation data were collected in the form of field notes based on behaviour sampling with a period recording to create a standardised observation unit[17]. The activities in the lecture theatre were observed for nine contact hours by one of the research team. The research design called for an evaluation of

the changes in teaching practice. During the last session data were obtained from the students via focus groups. In addition the observer conducted a face-to-face interview with the instructor[19] after the classroom sessions were completed, but before the final assignment had been submitted or marked.

4. FOUR STAGES OF THE STUDY

In this section we plan to adapt the usual order of reporting research. This multi-layered and multi-stage research design is easier to report if the collection of data and analysis are combined and presented as four stages of the study.

4.1. Stage One: Designing New Teaching Strategies

The instructor was mentored by educationalists versed in theories of teaching practice and student engagement[12,20-24]. The lecturer decided that the key to change was a classroom environment based on the general principles of 'active-learning'[25]. The variety of definitions of active learning actually helped the lecturer to choose elements for change that suited the subject and the limited time of the study. A number of teaching strategies were to be implemented.

He decided that three types of 'activity' could be introduced into the classroom. The research on small group work with construction students is not extensive. However, in his study of USA construction students Choudhury[26] found that peer teaching and learning in the classroom is responsible for 'more frequent generation of ideas and solutions than individualistic learning'. In addition there are extensive reports on the successful use of this teaching method in related disciplines[23]. Small groups were also considered to be a way of shortening lecture times and providing tactile opportunities for the students[27].

A second innovation was to have an instance of 'field work' for each session. The field work would give students an additional opportunity to practice peer learning and to experience 'real life' situations [20]. The field trip component would also provide a way to combine course content and activities through students reporting group findings.

The third teaching strategy was undertaken to increase student interactions with each other and the instructor. The instructor planned designated question and answer periods within each session[28]. This simple tactic of engaging students with course content was expected to provide students with an opportunity to interact with 'the expert' as this appears to be a preferred learning style for construction students[3].

Although the instructor was willing to try new teaching strategies, he did not have any experience of activities-based teaching in the classroom and he questioned the efficacy of such changes.

4.2. Stage Two: Developing the Measurement Tools

An important task for the participant/observer was to devise a way to record the classroom activities for both the lecturer and students. The measurement instrument arises from observation in ethnographic type studies[17]. In developing the scale for measurement, the literature on student engagement helped to provide the two opposite categories of passive and active. The 'interactive' category was developed from the observation of classroom activities.

Table 1. Outline of Observable Student Behaviours

Behaviour	Passive	Interactive	Active
listening	no verbal interaction with lecturer	only speak when spoken to	students asking questions
answering	only when asked by lecturer	volunteering answer to lecturer's questions	students volunteering both questions and answers
reporting	one person on request of instructor	one person volunteering	other group members adding to reporters' volunteered report
small groups	students interacting with each other	students interacting with each other and materials	students interacting with each other, materials and other groups

The teaching strategies chosen for incorporation into the study were taken as the baseline for 'activities' and the behaviours of both the students and the instructor were assessed accordingly. Table 1 outlines the types of student behaviour and activities that were observed over nine hours.

The noise levels for week one were not noted at the time, but added retrospectively based on the observed behaviours. Table 2 shows the data collected through observation during week one using the factors discussed. Data were also collected for weeks two and three using the same template.

Table 2. Observations for Week One

Time	Instructor activity	Students' behaviour	Noise level
8:30	instructing	passive listening	1
8:45	lecturing	passive listening	1
9:00	lecturing	passive listening	1
9:15	questioning	passive answering	1
9:30-10:00	n/a	field work	n/a
10:00-10:15	break	break	n/a
10:15	lecturing	passive listening	1
10:30	instructing	passive small groups	1
10:45	facilitating	passive reporting	1
11:00	lecturing	passive listening	1
11:15-11:30	break	break	n/a
11:30	lecturing	passive listening	1
11:45	questioning	passive answering	1
12:00	lecturing	passive listening	1
12:15	instructing	passive listening	1

The observations of the teaching activities of lecturing, questioning and facilitating were refined based on classroom observations. It was noted that some of the 'talking' time was not related to course content, but to 'housekeeping' information such as lists of course materials, assignments etc. Therefore, an additional category, instructing, was added. Lecturing in this study means course content.

The use of the level of 'noise' in the classroom as a proxy for student engagement arose from a comment by the lecturer during the second session. When the students had formed into their six small groups, the instructor said, "I can't hear any noise, if you guys are working there should be noise." The ability to triangulate data, that is have two sources which provide the same data, added rigor to this study[18]. The field notes focused on three factors; teacher activity, student activity, and overall noise level. Noise level was graded in a three point scale; 1=teacher only talking, 2=some student verbalisation, and 3=majority of students appear verbally engaged in the classroom activity. The field notes reported on the major activity for twelve 15-minute intervals[19].

4.3. Stage Three: Creating an Activities-Based Classroom

Phase three was the attempted implementation of the selected teaching strategies, allowing for the unalterable elements: set course content, designated classroom, pre-determined assessment which had been incorporated into the course in the previous year.

As noted in the conceptual section, construction students have a preference for an activities-based learning environment. The instructor chose new teaching strategies that incorporated peer learning as a replacement for traditional lecturer time for three reasons. This decision was based on the view that course content could be presented in 'mini' lecture format and that student discussion of the application of the building concepts would support student understanding[10]. In addition, small groups provided mobility and the opportunity to use other tactile learning activities such as drawing. Small groups were also designed to allow peer-learning within the classroom[4].

The rationale for expanding of use of verbal questions and answers during lecturing was to break up the lectures into small segments and to provide a platform for student activity[20]. Any activity that engaged students as individuals or in groups was perceived to be positive within this study. Thus students' reporting on the data collection from their field trips was another instructional technique to provide students with activity that focused on course content[25].

Instructor behaviour

At the beginning of the project the instructor described his teaching as that of lecturing students while the students sat and listened. During week one only marginal change was evident from the usual 'talk and chalk' classroom. By the third week, the time the instructor spent facilitating rather than lecturing was dramatically increased. Facilitating rather than lecturing implies more engagement with and between students[1].

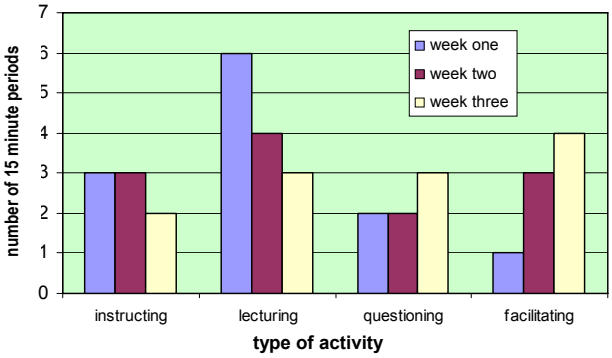

Chart 1. Instructor's Activities for Three Weeks

The instructor had no experience of using practical group work as a component of his teaching. Thus he had to learn new skills to provide an activities-based classroom[1]. Indeed, the skills and the knowledge of how to facilitate activities as simple as questions and answers should not be underrated[28]. In the event, it appears to have been easier to plan changes than to implement them, as noted in Table 2. Only one small group session took place during the first class.

Chart 1 shows that the time spent giving instructions did not change much over the three weeks, but the time spent lecturing decreased significantly. It can be assumed that the shift from lecturing to facilitating, both the small groups and reporting activities, is indicative of a more activities-based classroom. However, it was clear from observing the classroom behaviour of the instructor that providing an active environment for students does not follow a simple developmental model. The lack of experience in small group activities and the passive nature of some of the students' behaviour appear to have reinforced the transmission model of teaching.

Students' behaviour

While there was less lecturing and more student activity in the classroom each successive week, for some of the time in all weeks the students were passive as noted in Chart 2. If student classroom behaviour has been formed by years of transmission model experience[28], then behavioural changes may be difficult for them. In this study, even when the lecturer attempted to engage the students in question and answer sessions, students waited to be asked before speaking. There was a similar student response to the field work reporting to the class; reports were only given when asked for and students not reporting were silent. This may be the reason that the lecturer changed the 15-minute period designated for student

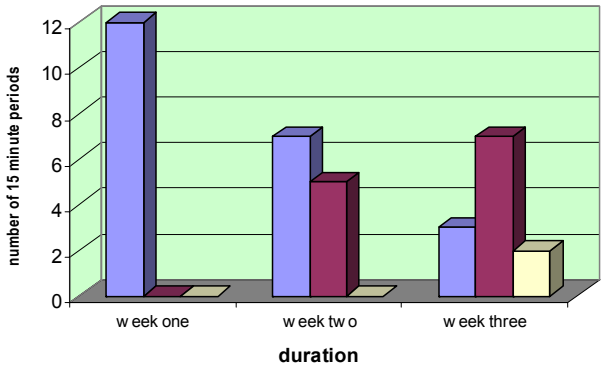

Chart 2. Construction Students' Behaviour for Three Weeks

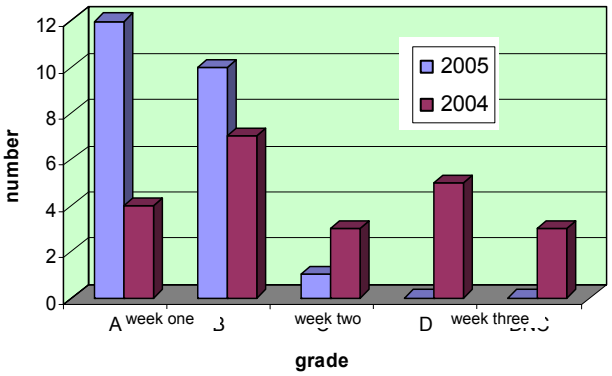

Chart 3. Comparison of Assessment Grades: 2004-2005

reporting on their field data into a mini lecture in week one. Overall during the first session the lecturer lectured and the students sat passively, apparently disengaged (many did not have even the basics of textbook or writing materials).

Change can only happen if both the teacher and the learner are willing to participate in an active classroom. During the following two sessions these behaviours sometimes changed as noted in Chart 2. The students appear to have become more engaged with their learning, as the environment became more supportive of their preferred learning-styles. The classroom was more conducive to activities in week three because of the teaching strategies being implemented. These focused on three types of student activities; verbal questions and answers, students sharing personal experiences in small groups and with the whole class, as well as student verbal reporting on course related activities.

Noise level

Table 3 provides the 'average' observed (not measured with instruments) noise level for each of the 12 recorded 15-minute classroom periods.

Table 3. Noise Levels for Three Weeks of Observation

Week	08:30	08:45	09:00	09:15	10:15	10:30	10:45	11:00	11:30	11:45	12:00	12:15	Average
One	1	1	1	1	1	1	1	1	1	1	1	1	**1.0**
Two	1	1	1	1	2	1	2	2	2	1	2	1	**1.4**
Three	1	2	2	2	2	3	2	3	1	2	2	1	**1.9**

During week one, the low level of noise could be attributed to group forming behaviours[29]. On the other hand, it is also possible that the traditional expectations of classroom behaviour of the transmission model prevailed for both instructor and students during the first session. The average noise level did gradually increase from week one to week three: 1.0 to 1.4 then 1.9, based on observable student activity as noted in Chart 2. However, it must also be acknowledged that a subjective judgement of only one observer provided data for this proxy.

4.4. Stage Four: Testing for Links between Teaching and Learning

During the fourth course session, evaluation data were collected from a number of sources. Participant data from the students were obtained through focus group[16] Students responded positively to the active-learning components introduced by their lecturer. A typical response was, "Of all the classes I've ever sat through this is the most active, by far, we were getting involved". When students were asked for aspects of teaching they had liked least, some complained that they had not received enough activity-based teaching.

A second source of evaluation data came from an interview with the lecturer responsible for implementing the new teaching strategies. The lecturer was pleased with the changes in his teaching approach, and he felt that he had moved into a more engaging form of teaching without sacrificing the content of his course material. When questioned about the difficulties he encountered he said, "The hardest thing was changing my style. I will have to work on that throughout the year." The intellectual shift required to change teaching behaviour appears to be only a first step; the shift in teaching practice appears to take longer.

In addition, a proxy for the link between instruction techniques and student learning was assumed to be a comparison of the grades for the module assignment which had been used for the students in the previous year[18], as noted in Chart 3.

The student grades for 2005 are significantly higher; the majority of students completing the assessment earned an A grade. In 2004, eight students failed (D) or did not complete (DNC) the assessment, compared to none for this study. A similar number of students withdrew from the course in both years. In the judgement of the instructor, the student cohort in this study was similar, in terms of ability and experience, to the students of 2004. The teaching unit covers a standard set of material, so while the content remained the same, it must be assumed that the difference in student achievement lay in the way it was delivered.

Because of the potential for other differences between these two groups, it is impossible to conclude that the improved performance is entirely due to the new teaching strategies which created an activities-based learning environment. However, the claim by Choudhury[26] that working with peers is responsible for 'higher reasoning' cannot be disregarded. It is possible that the higher grades for the Unitec study are indeed attributable to the changes made in the way the course material was presented. The teaching strategies in this study did create more opportunities for students to actively engage with the course content, their peers and the instructor. Therefore it can be concluded that this study has provided evidence of an observable link between instructional technique and student learning[2].

5. CONCLUSION

While the transmission model of learning may still be prevalent, a growing number of scholars argue that the addition of small group discussion, teacher verbal question and student verbal answers during lectures, or students sharing personal experiences are effective[12,23,28]. The findings of this study appear to provide solid evidence that active-learning is effective in providing successful learning outcomes for construction students. It could also be argued that the research findings also indicate a direct link between specific teaching practice and student learning.

This study may be important in providing evidence for the link between teaching practice and learning outcomes because it is predicated upon earlier research that suggests construction students prefer activities-based learning[3]. For construction students an 'active mode of participation'[11] needs to be a collaborative effort between students[12] along with activities which engage students with a lecturer[26]. These kinds of activities in the classroom appear to help students engage with the course content so that they perform at a higher level.

The purpose of this research was to provide evidence for a link between instructional technique and student learning. It appears that an important component of that link is the type of behaviour that is expected in the classroom. If students are expected to sit passively when they prefer to move around, or to listen to the lecturer rather than interact with their peers, then it is possible that the negative outcomes which plague construction education will continue.

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