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A blended learning approach to safety training: Student experiences of safe work practices and safety culture

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ABSTRACT

Within the furniture manufacturing industry a high proportion of occupational accidents are as a result of non-compliance to machining regulations and incorrect work practices. Safety training plays an important role in reducing accidents and promoting a safety culture within this sector. This article details an action research study undertaken during the first year of a new Degree in Timber Product Technology, which set out to evaluate the impact a blended learning environment and reusable learning objects (RLOs) could have on promoting safe work practices and a safety culture amongst students. A constructivist approach was taken and the module design was underpinned by Kolb's model of experiential learning, placing more responsibility on the learners for their own learning and encouraging them to reflect upon their experiences. The findings of this study suggest that students with prior industry machining experience required a change in their attitude to machining which was achieved within the practical labs, while students with no machining experiences were intimidated by the learning environment in the practical labs but whose learning experience was enhanced through the use of RLOs and other eLearning resources. In order to reduce occupational accidents in the furniture manufacturing industry the promotion of continuing professional development (CPD) training courses is required in order to change workers' behaviour to machine safety and encourage lifelong learning so as to promote a safety culture within the furniture manufacturing industry.

1. Introduction

The European furniture industry is worth an estimated €126 billion, with 150,000 companies employing around 1.4 million people (Eurostat, 2009). The Irish furniture manufacturing sector is a small industry compared to its European counterparts; the most recent figures available from Heanue (2009) state that in 2006 the sector employed a total of 5602 persons in 298 firms. This industry is a labour-intensive industry with 86% of the companies comprising of fewer than 10 workers (Eurostat, 2009; UEA, 2007). The nature of the work in these small and medium-sized companies sees work-pieces being machined manually, which can result in a hazardous proximity between the operator and the moving tool occurring (Hovden et al., 2010). Ratnasingam et al. (2012) describes this as a 3-D environment which is "dangerous, dirty and degenerative". It is estimated that more than 100,000 workers are injured in European furniture factories, leading to numerous days of absenteeism and consequently a loss in productivity (UEA, 2007). Health and Safety Statistical information from the United Kingdom (UK) show that accidents involving contact with dangerous parts of machinery or the material being machined accounted for approximately one quarter of all the fatal injuries recorded in the woodworking industry, and approximately half of all major injury accidents (HSE, 1998).

Within the Irish context, little exists in the way of statistical information pertaining to occupational accidents in the furniture industry. Of the accidents reported to the Health & Safety Authority (HSA) in 2010, 1262 occurred in the manufacturing sector (HSA, 2011). This sector includes 23 different categories ranging from the manufacture of food products, fabrication of metal products, through to the manufacture of furniture. From this information it is unclear to what extent woodworking related machine accidents are occurring. In light of this the majority of the reports referred to within this article are from the Health & Safety Executive (HSE) in the UK.

The European Association of Furniture Producers (UEA) analysed Europe's safest countries in 2007 and identified a number of best practices used in promoting occupational safety, and concluded that suitable safety training plays an important part in promoting a "safety culture". The term "safety culture" is loosely used to describe the corporate atmosphere or culture in which safety is understood to be, and is accepted as, the number one priority within the wood machining industry (Cullen, 1990). Wallen and Mulloy (2006) and Ho and Dzeng (2010) concur with the findings from the

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UEA, and state that an important element in promoting safety culture is the quality of safety training as it has a direct effect on workplace safety.

The Dublin Institute of Technology (DIT) in Ireland has been educating students in the timber industry for the past 100 years. Throughout this time teaching practices and emphasis on machine safety have evolved. According to Wallen and Mulloy (2006), one of the central paradoxes of education is the ability of learners to make use of newly acquired knowledge outside of the classroom or learning environment. Frequently, learners who appear to have acquired certain knowledge and skills and can answer questions in the classroom are unable to apply this knowledge and skill in work settings. In the furniture industry this can result in students attempting to operate machines in breach of regulations. This article details an action research study undertaken at DIT which hypothesised that blending traditional teaching practices with a student centred learning approach through the use of eLearning and the provision of re-usable learning objects (ROLs), would alter the way students operate woodworking machines and promote a safety culture amongst first-year students on a Timber Product Technology (TPT) degree.

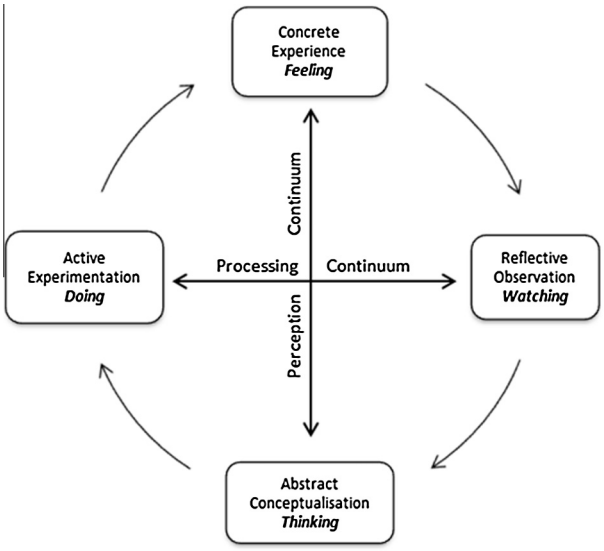

Fig. 1. Adaptation based on Kolb's Experiential Learning Cycle (Kolb, 1984).

2. Theoretical framework

The pedagogical approaches used in student education can vary greatly depending on the nature of the learning required. Students in the area of wood machining require more than practical demonstrations and lecture notes; they need to develop their psychomotor and cognitive skills that allow them operate machines safely (Ferris and Aziz, 2005). The research study detailed in this article was built on Kolb's cycle of experiential learning supporting the students in learning by doing. This constructivist approach to learning places more responsibility on the learners for their own learning. It involves students in more decision making processes as they learn by doing rather than just by listening and performing meaningless tasks which are often not in context (Rogers, 2002). David Kolb's theoretical model of experiential learning has particular relevance for disciplines that employ more active or experience-based learning and teaching approaches such as wood machining.

Since the early part of the twentieth century educators have shown that students learn more effectively if they are actively involved in the learning process rather than simply being passive learners. John Dewey challenged educators to develop educational programs that incorporated real life learning experiences. In the 1960s and 70s many psychologists, sociologists, and educators believed in the value of experience during learning, not as a replacement to the theory lectures but as an addition to them. In recent years, David Kolb promoted the use of experiential learning, stating that learning is a multi-dimensional process. He describes "Learning as the process whereby knowledge is created through the transformation of experience, knowledge results from the combination of grasping experience and transforming it" (Kolb, 1984, p. 41). Kolb's presents experiential learning in the form of a cyclical model, as illustrated in Fig. 1.

Kolb created a holistic framework to approach teaching and learning. His experiential learning model is based on two continuums.

- Processing continuum: an approach to a task, such as referring to learning by doing or watching.
- Perception continuum: an emotional response, such as referring to learn by thinking or feeling. In addition to this Kolb also caters for the learners learning styles through his Learning style Inventory.

At each end of the continuum a step in the learning process is provided, these include: learning based on concrete experience, reflective observation on that experience, formation of abstract concepts based upon the reflections and testing the new concepts, followed by repetition of these four steps. Kolb called this 'experiential learning' since experience is the source of learning and development (Kolb, 1984). Depending upon the situation or environment, the student may enter the learning cycle at any point and will best learn the new task if they practice all four modes.

The term learning styles refers to the view that different people learn information in different ways. The concept of learning styles suggests that individuals differ with respect to the mode of instruction or study most effective for them (Pashler et al., 2008). Kolb (1984) argues that learning styles are also useful indicators of potential learning success because it provides information about individual differences in learning and information processing. Wolf and Kolb (1984) suggested that learners develop different learning styles that emphasise preference for some modes of learning over others, leading to particular characteristics (Fry et al., 2009). Learning styles are considered one of the more important factors influencing eLearning and personal academic competence (Ford and Chen, 2000; Kolb, 1984).

Within this model Kolb has described four basic learning styles: Accommodative, Assimilative, Divergent and Convergent. Incorporated within each learning style is a combination of two of four learning modes: concrete experience, reflective observation, abstract conceptualisation and active experimentation (Richmond and Cummings, 2005).

- Accommodating Learners: have the ability to learn from primarily "hands-on" experience.
- Converging Learners: are best at finding practical uses for ideas and theories.
- Assimilative Learners: are people who prefer readings, lectures, exploring analytical models, and having time to think things through.
- Diverging Learners: are people with a preference to work in groups, listening with an open mind and receive personalised feedback.

Each learning style is located in a different quadrant of the cycle of learning as illustrated in Fig. 2.