Using wearable sensor technology to improve learning transfer in manual handling training

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SUMMARY

This research examined the use of wearable technology as an aid in manual handling training. The purpose of which was to establish if using wearable sensor technology can increase the transferability of training to the working environment and the factors that influence the likelihood of learning transfer taking place. Thematic analysis was used to examine the factors that may influence the transfer of learning. The findings suggest that wearable sensor technology has a place in aiding the transfer of learning from manual handling training.

KEYWORDS

Manual Handling Training, Wearable Sensor Technology, Learning Transfer

Introduction

The purpose of this research was to examine if using wearable sensor technology in manual handling training aids the transfer of learning to real working environments. The study aimed to investigate the factors that influence transfer of learning. Manual handling has been identified as a key contributor to work related musculoskeletal disorders (MSDs) across a range of industry populations including healthcare, manufacturing, fisheries, logistics and agriculture (Bork et al., 1996; Deros et al., 2010; Basahel, 2015; Asuquo et al., 2021; Remmen et al., 2021; Das, 2023). Despite the multicausal nature of work-related MSDs manual handling training is the primary method of mitigating and reducing the risk of an employee developing MSDs from their work activities. Whilst the use of manual handling training is extensive many researchers suggest that it is ineffective in reducing work related musculoskeletal injuries (Haslam et, al. 2007; Martimo et al. 2007; Clemes et al. 2010). Denis et al. (2020) reinforces this opinion by describing most workplace manual handling training as being delivered in a parachute fashion in a class room setting whereby the training is standardised regardless of the working environment. The training invariably involves lifting a standard box which does not relate to real work settings, and which consequently may result in limited transfer of learning.

Lind et al., (2023) note that there is a growing use of wearable sensor technology within the field of ergonomics. Wearable sensor technology uses multiple sensors connected to an external receiver such as a tablet device to objectively record biomechanical movement and complete a risk analysis on the data obtained. It enables participants to objectively observe their manual handling technique and in doing so highlight high risk biomechanical movement. Spook et al., (2019) suggest that monitoring work exposure with wearable sensor technology may have the potential to promote worker health. While Lind (2023) perceives that wearable sensor technology has a potential role in preventing work related MSDs and thus maybe beneficial in improving the effectiveness of manual handling training. Due the gap in the existing research this study aimed to examine the use of wearable sensor technology to improve the transfer of learning in manual handling training.

Methods

Employees perceptions provided the framework for examining the use of wearable sensor technology in manual handling training. The participants were 10 male warehouse operatives (22-59 years), who are required to undertake manual handling activities as part of their work role. The initial part of the study was the delivery of a Power Point presentation around manual handling techniques and the risk associated with manual handling. Following this education session non-invasive wearable sensors were used to obtain biomechanical data to analyse work tasks and in turn a risk rating was determined. Joint Action Solutions (JAS) was the brand of wearable sensor technology used within this study. JAS is an automated injury risk assessment system. The system uses non-invasive wearable sensors that obtain musculoskeletal data to analyse tasks and generate scored manual task risk assessments delivered to an iPad. JAS uses a machine processing system to process the sensor data. Sensors are placed on both arms over clothing via an elasticated strap / band. A waist sensor was attached to a belt that the participants were asked to wear. A sensor was also placed via a clip to the back of the participant's collar. The final sensor was placed at the back of the head which is held in place through a pocket in an elasticated head band. There is no direct skin contact with the sensors. The parameters measured were as follows; neck flexion/extension, rotation and side flexion; back flexion/extension, rotation and side flexion; arm left arm elevation and right arm elevation.

Individually each participant completed a work manual handling task which was videoed for between 5 and 8 minutes on an iPad. The use of the video allowed the data to be collected and viewed in context. Following data collection participants were given feedback around their manual handling lifting technique with good practice reinforced. The feedback was verbal with the video recording being used to highlight the movements that had the potential to create musculoskeletal problems. Participants were asked to implement any new learning into their daily work based manual handling tasks. A follow up semi structured questionnaire was conducted four weeks after the training, in order to ascertain the participants views on the benefits and effectiveness of the training provided. The interviews were transcribed from which key themes were identified.

Analysis and Results

Thematic analysis (Braun & Clarke 2022) was the analytical strategy used to assess the data. Through thematic analysis overarching themes were identified with seven sub themes. The themes and subthemes are shown in figure 1.

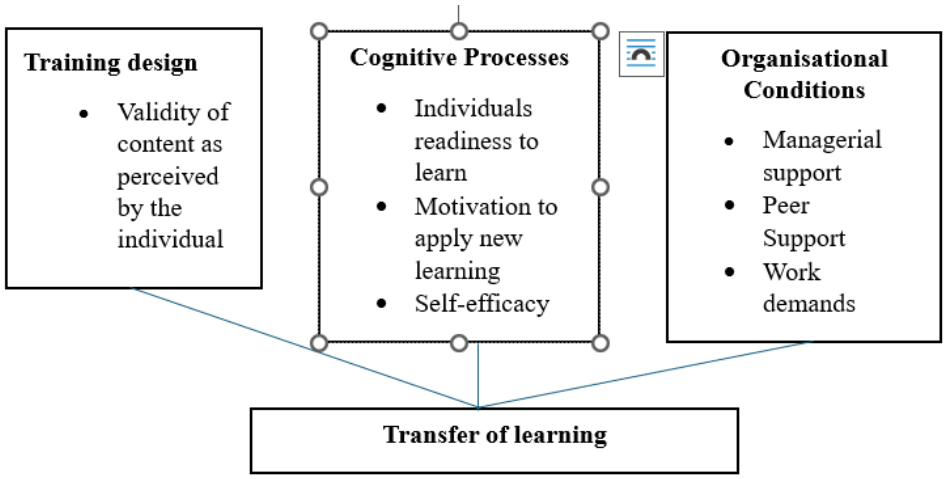

Figure 1: Key theme and sub themes drawn from the interview transcripts.

The research analysis showed that participants previous experiences was very generic in nature whereas the use of wearable sensor technology was more content relevant to their work role and thus easier to apply in daily manual handling tasks which they perceived added validity to the training. Content validity is seen as an important factor in the transfer of learning. Content validity is viewed as the relatability of the manual handling training to the real working environment.

Cognitive processes were also a determining factor in the participants perception of the learning obtained and the transfer of the learning to their work tasks. Cognitive processes are considered as the mental action or process of acquiring knowledge and understanding thoughts and experiences. It encompasses processes such as perception, thought, attention, intelligence and imagination in the formation of knowledge, the ability to make decisions, memory creation, and the ability to evaluate and create reasoning (Smid et al., 2020). Cognitive processes inform decision making and in the case of this research this relates to transferring the learning gained from the use of wearable sensor technology in manual handling training. Cognitive process subthemes included a participant's readiness to learn, their motivation to apply new learning and self-efficacy.

The final theme that emerged was organisational conditions. Managerial support, peer support and work demands were viewed and factors in the transfer of learning.

Conclusion

This research examined the use of wearable sensor technology and its value in transferring manual handling training to a real-world occupational setting. Wearable sensor technology has been used to assess the potential for work related MSD. The advancement of technology and it's use within the field of ergonomics affords the opportunity to explore if technology such as the wearable sensor technology used in this research can be employed as a training aid which can ultimately improve the transfer of learning. The use of wearable sensor technology in manual handling training improves perceived content validity due to its relevance to the participant. The challenge moving forward is to embrace technology and explore where it can be beneficial in reducing work-related MSDs.

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