

## HOW STUDENTS LEARN TO OPERATE AN ELEVATED WORK PLATFORM: THE PRACTICE OF ‘TRYING OUT’ CONTROLS

Jennifer Tichon<sup>a</sup>, Phil Diver<sup>b</sup>, Yoriko Kikkawa<sup>c</sup>, Tim Mavin<sup>c</sup>

<sup>a</sup>CARRS-Q, Queensland University of Technology, Brisbane, Australia.

<sup>b</sup>The Construction Training Centre, Salisbury, Australia.

<sup>c</sup>Griffith University, Brisbane, Australia

Corresponding Email: j.tichon@qut.edu.au

### Abstract

Working at heights is recognised as high risk work. The dangers of working at heights have been mitigated with the introduction of the elevated-work platform (EWP). However, use of EWPs has resulted in new dangers including overturning, entrapment, and collision. The layout of basket control panels vary significantly among EWP types and models and several variations can often be found in use across the same construction site. EWP operators have indicated the requirement to transition across multiple control panels is problematic. To gain a better understanding of how operators learn to use a new set of controls, this paper examined the initial course operators undertake to gain a licence to operate a boom-type EWP. Video data gained over the three-day program was analysed to elucidate how the trainees identified, selected and tested controls. Results indicate a heavy reliance on unsafe practices such as ‘trying out’ a control when its function is not known and ‘learning from mistakes’ in order to learn what a control does.

**Keywords:** Continuing Education, Engineering, Elevated Work Platform, Control Selection, Control Use.

### 1. Introduction

Working at heights is a well-recognised hazard with a long history of injuries, permanent disabilities, and deaths. As a means of mitigating height-related risks at work, many industries are now adopting the use of the elevated-work platforms (EWP) (Breslin, 2001). The EWP is a mechanically powered device (e.g. manual, electrical, or fossil fuel) that provides temporary access for workers to difficult and inaccessible areas at height. A single person, referred to in this paper as the *operator*, controls the EWP. The use of EWP is on the increase due to its versatility and ability to function in a variety of workplace scenarios. There is a wide range of EWPs available, from simple scissor lift devices to the more complicated boom-type devices. Moreover, the latest models of EWPs have the ability to operate at heights of up to 55m (180ft). Many EWP operators arrive at work each day facing a different set of operational controls and often change between several variations of control panels in one day. EWP operators are issued a generic license, with the expectation to successfully transition among different control layouts, some of which they may not have encountered previously.

As a result of the variety of control layouts, there is also a variety of directional control-response relationships found across EWP models. This is unfortunately a common situation with heavy machinery (Burgess-Limerick, Krupenis, Wallis, Pratim-Bannerjee & Steiner, 2010) and injuries due to control use errors have been previously highlighted in the mining sector (Burgess-Limerick & Steiner, 2006). Selection errors occur as a consequence of the operator using a control other than the intended control and direction errors occur when the correct control is used but in the opposite direction to that required to move the machinery correctly. When the directional control-response relationship is the opposite of what the operator expected because it is incompatible to what might be expected, for example, a downward

movement on a control cause an upward movement on the machine, the risk of incidents increases.

A recent study conducted by Workplace Health and Safety, Queensland Australia in 2015, with 460 Australian EWP operators, found that 80% of the operators reported their biggest concern were related to control panels (Geinitz, 2015). Specifically that the styles, positioning, shapes, or directions of control (e.g., switches, levers, and dials) used to manipulate the machine are not consistent across the wide variety of EWP types and brands. In the United Arab Emirates (UAE), a report following a double fatality presented the evidence that generic training on booms and lifts was inadequate for the EWP operator (Build Safe UAE, 2010). The report specified that training should be specific to the type and model of equipment being utilized rather than assuming that a EWP operator can transfer skills from one machine to another.

The International Powered Access Federation (IPAF) has been attempting to address the control direction issue by providing guidelines. The guidelines suggest that EWP operators must check directional movements with direct reference to controls before moving an EWP (IPAF, 2014). In Australia, it is a health and safety regulation that EWP operators familiarise themselves with, and operate, a EWP in accordance with a manufacturer's manual. However, such an expectation fails to recognise the realities of the workplace. Manuals may not be read due to a range of issues such as literacy levels, not being presented in the correct language or they are not stored with the EWP but rather offsite at the head office of the equipment hire company. Rather than referring to a model's manual, it is more likely that a series of checks will be run that involve using each control to discover what the corresponding movement is on the EWP.

There have been no prior investigations in to how operators identify and select controls on basket panels despite there being up to 120 variations of controls panels now in use across Australia (Tichonet al, 2016). Across these, many controls both look and function differently; often in reverse to expectations. Variation on any scale is known to significantly increase risk. This project aimed to explore difficulties novice operators experienced when selecting controls and selecting what direction to move a control in.

## **2. Study and Methods**

A licencing course to operate a boom-type EWP was conducted in a training facility in Brisbane, Australia. The EWP used in the course was a Genie Z-45/25J. Three trainees and one instructor were involved in the program over a three-day period covering five specific stages: (A) classroom-based instruction on theory, (B) classroom-based instruction for safety harness practice, (C) EWP walk-around inspection at worksite, (D) one-on-one instructor–trainee tuition in the EWP, and (E) trainee-paired consolidation training in the EWP. This paper focuses on Stage D, one-on-one instructor–trainee tuition.

During Stage D each trainee was given initial instruction on a preoperational safety check and an introduction to the control panel. They were then asked to demonstrate a EWP operation. The instructor was in the basket with each participant during the training. During the reflective interviews, the students were asked to articulate what they were thinking at specific times in the training session. Particularly, they were asked to verbalise out loud their thought processes when ascertaining how to select and move the controls on the EWP.

### **2.1 Participants**

The three trainees were all male and aged 35-40. For students A and B, English was their first language, while for Student C English was not his first language. No participant had previously held a EWP operator's licence and this was their first time undertaking a course to achieve a licence to operate a boom-type elevating work platform. While they had seen EWPs at work in the industry they did not have previous experience driving a boom-type elevating work platform. The instructor, who delivered the licence training, had over 10 years' experience in delivering EWP licencing courses.

## 2.2 Data Collection and Methods

Classroom-based instruction (Stages A and B) were recorded with two cameras on a tripod placed at the rear of the classroom. The walk-around inspection (Stage C) was recorded using a handheld camera with the instructor wearing a remote audio recorder. The practical sessions (Stages D and E) were video-recorded using one fixed and one handheld camera. Additionally, two cameras were attached to the EWP capturing close-up video footage of control inputs from the trainee EWP operator and instructor. The student operators wore remote microphones to improve sound. On completion of all scenarios, audio recordings were sent for transcription services.

During the three-day training program, trainees participated in an extra activity not usually associated with training. This was a reflective interview on completion of their initial one-on-one instructor–student tuition on the EWP. During the interviews, the video recordings of their training sessions were played back in order to help the students articulate their thoughts during the training session. Discussions with the researcher focused on what they were thinking at “Key Moments”: This refers to time segments that appeared to be meaningful from the students’ learning perspective during the training sessions. Open-ended questions used for the reflective interviews included:

- (a) What were you thinking at the time?
- (b) What did you find the most difficult to learn/perform? and
- (c) What did you find easy or helpful for you to learn/perform?

During the reflective interview activity, the researcher and trainees openly discussed issues that had occurred during the training. Interviews focused on one student’s training session at a time; however, all students and their instructor were present at all interviews and encouraged to contribute to the conversations between the researcher and trainee whose session was being interrogated. Some interviews were longer than others depending on how the conversations developed. Times for training and reflective interviews can be seen in Table 1. It is noted that Student A had his initial reflective interview incomplete due to a family commitment. Another further session for this student session recommenced the next day.

Table 1. Research Activities, Duration, and Participants

Activity	Duration	Participant Code
Initial Training 1	13:09	Student A
Initial Training 2	13:32	Student B
Initial Training 3	9:30	Student C
Reflective Interview 1	34:58	Student A
Reflective Interview 2	25:29	Student B
Reflective Interview 3	15:54	Student C
Reflective Interview 4	43:11	Student A

## 2.3 Data Analysis and Methods

Video recordings of the interviews and training sessions were imported into qualitative data analysis computer software, NVivo 11 Pro for Windows (QSR International, 2015). The transcriptions were then aligned with the video recordings within NVivo for further analysis. Since each interview involved multiple speakers, case nodes were created for each speaker, and the content of transcripts was then aligned with each speaker’s case node. It allowed the researchers to identify who said what across the different transcripts.

Interview transcripts were first inspected via an inductive approach of the matic analysis (Braun & Clarke, 2006). This data-driven method was suitable to tease out unknown aspects which were, in this study, the students’ learning perspectives. A more narrowed-down approach was then used to tease out from the interview transcripts what students found difficult with respect to controls and from the training videos, what mistakes they made. Finally, matrix queries (QSR

International, 2015) were conducted to obtain tabular summaries of the results from these analyses.

### 3. Findings

Thematic analysis of the reflective interviews highlighted four distinct areas of students' learning. First, the result of the analysis outlined learning processes used by students to determine correct controls and to complete the given tasks. Second, the students talked about mistakes made during the session or struggling with their first experience of operating the EWP. Third, the conversations among the interviewer, interviewee student, instructor, and other trainees focused on the problems that underpinned the students' mistakes or difficulties. Finally, the analysis reported some trainer-related components of the training program that the students found useful.

#### 3.1 Learning Basket Controls

During the interview, trainees were encouraged to describe the processes they used in learning to operate the EWP. NVivo-assisted analysis of the interviews identified five activities students used as learning methods during the training sessions: (a) asking instructor, (b) trying out, (c) watching instructor, (d) using visual cues, and (e) deconstructing the task.

summarises the result of a matrix query for these subthemes of learning processes. Overall, the first four activities (a, b, c, &d) were used by students to make sense of location, functions, and sensitivity of the controls. On the other hand, the last activity (e) focused on their method for completing an operational task during the training session.

Table 2. Subthemes: Learning Process

Learning Process Subthemes	Student A	Student B	Student C	Frequency/ number of students
Trying out	15	3	3	21 / 3
Asking instructor	9	1	3	13 / 3
Watching the instructor	6	0	2	8 / 2
Using visual cues	4	1	0	5 / 2
Deconstructing the task	12	1	6	19 / 3

#### 3.2 Process of Understanding the Controls

The instructor informed the researcher that it was his preferred approach to give his students more time trying out controls rather than intervening to direct them to the correct control because he believes that they only get the feeling of controls via hands-on time. Although all students agreed they relied on the "trying out" method (see Table 2), there were some differences across individual students in terms of their preferred methods to understanding and using controls.

For example, Student A said he prefers to play with the controls "rather than asking what it does by default". He described his learning process: (a) looking at the control and its pictograms by himself, (b) anticipating what the control does, (c) have a try to shift up and down on a certain control, and (d) directly ask the instructor for clarification if he is unsure. Similarly, Student B said he prefers to "try to do it by myself" and to use each control to see its movement though 5 or 10 minutes of "familiarising yourself" time. On the other hand, Student C described his way of learning as: He always watches how the instructor operates the EWP first before he starts his first operation because he believed "you learn more by just watching".

#### 3.3 Control Selection Mistakes

Interview transcripts were also examined with the focus of identifying what mistakes these students made during the training sessions. All students talked about their mistakes or struggles when they were deciding on the next EWP movement during the training sessions. In combination with video analysis, four aspects were identified as the mistakes/struggles that these students experienced: (a) selection of controls, (b) selection of control function/direction,



(c) adjustment of control function, and (d) order of actions to achieve a goal. First, *selection of controls* refers to a wrong choice of controls when they aimed to move a particular part of the EWP. It can be shown in an example: Student A pointed primary boom up and down (Control 18) when he wanted to extend telescope (Control 17).

Second, *selection of control function/direction* refers to the mistake of pressing a correct control but in the wrong direction. For example, during the interview for Student B, Students A and B reported that they had problems in understanding “telescoping” (or extension). In fact, Student B pressed telescope extension (Control 17) in the wrong direction during the training session and then was asked about what he was thinking at that moment during his interview. The following comment was made by Student A when Student B was unable to articulate his problem (“I don’t know”). It explained that their interpretation of which direction they expected the telescope to move was different from the actual direction that the telescope moved (direction of controls):

I think one of the observations was that it depends on how you look at the pictograms. For example, where the arrow is and how it points to the view that you see from the machine. They are all very similar but there is one that's quite different ...the extension that comes out of it....If you are up high, up would be going up further but that's actually going down [pushing towards the machine]. That would be relevant to the viewer or to a beginner. If you're down low and your horizontal is close to the ground, it makes perfect sense because that's the direction you're traveling....It makes perfect sense if you're low but if you're up high, then you are actually vertical with that particular arm. It [the pictogram] doesn't make sense and that's the position you must hold or want to use it in. (RIT2\_132-138)

This example highlighted the important consideration of how novices may interpret the direction of a control, via a pictogram on the panel, in terms of where they stand in the machine (horizontal) and what position the machine stands (vertical).

Third, *adjustment of control function* refers to an incorrect strength/degree with which the students manipulate a particular control. For example, Student C was surprised when the wheels moved more than he expected. Finally, *order of actions to achieve a goal* refers to a non-ideal process of completing a task. For example, Student B extended the telescope out (Control 17) at the beginning of his session. The instructor then stopped him and explained to that the movement of telescoping out is one of the last movements for completing the task (i.e., unfolding the knuckle boom) as it can increase the risk of the EWP unbalancing and may cause it to fall over. Importantly, the instructor himself also experimented with the controls when Student A asked him a question about the control function (RTI1\_50):

Student A: That is where I asked the question, and then the Instructor has said just stop. He started doing it, as in he tested moving it, moving the whole machine on one [control]and then moving it up and down on one [control] and then both of them went faster immediately. We established [the understanding] that it was a little bit up and down, in and out, and everything was faster when you adjusted [creep speed: Control 16]

### 3.4 Practical Issues and Problems During Training

Further analysis of the interview data determined that mistakes tended to occur within the following five themes relating to practical issues and problems:

- (a) abstract ideas of what “the best practice” is (e.g., unstructured/inconsistent procedures of performing a task);
- (b) heavy reliance on “trying out” methods to operate the machine (e.g., selecting a wrong control function, selecting a wrong direction);
- (c) inconsistent terminology in EWP operations (e.g., no access to operational manual);
- (d) interpretation of visual cues (vague pictograms on the machine or unclear diagrams on the workbook); and

(e) transitioning from one to another model of EWP.

Table 3 shows the result of the matrix query for these five themes. More frequency was found for Student A across all themes because this student participated in two interviews for his session as well as tended to contribute more not only during the interview of his session but also of other students' sessions.

Table 1. Problems and Issues That Are Aligned with Learning Processes or Underline the Mistakes and Struggles

Problem and issues	Student A	Student B	Student C	Frequency/ number of students
Abstract idea of "best practice"	16	2	2	20 / 3
Heavy reliance on trying-out methods	8	2	3	13 / 3
Inconsistent terminologies	10	1	0	11 / 2
Interpretation of visual cues	10	1	0	11 / 2
Transitioning issues	2	1	1	4 / 3

### 3.5 Abstract Idea of “Best Practice”

The students and instructor talked about “what best practice is” during the interviews. The following example highlighted the gap between what they should do legally (regulation) and what they would choose to do practically (what they called “best practice”):

Student A: Best practice compared to regulations is understanding what the rules are and what the best practice is but these are two different things, isn't it, Instructor?

Instructor: Yeah, there's what it'll [the EWP] allow you to do and what you probably should do logically. It comes down to ground condition as well....

Student A: The best practice is probably more in relation to risk assessment and your comfort level, and then regulation, what we're clarifying, is what we're bound to by law. (RIT4\_144-146)

In relation to this topic, they also discussed external issues about what employers may expect them to do in order to minimise the cost:

Instructor: when you hire it [the EWP], you weigh up – so okay it costs us an extra \$100 an hour to get the bigger one, but they're going be 3 hours quicker, so you're going to save 2, 300 dollars. (RIT4\_147)

Moreover, a contradiction between what the students were told in the lecture and what they are expected to do was also highlighted in the interview (RIT4\_125-126).

Student A: Just remembering what we looked at in the theory that morning about it's not good practice to go above [a certain height], although you can, is that right Instructor?

Instructor: Yeah, technically you can...I know it [regulation] says don't go over it, but you can imagine if you've got a crane in the city, using a tower crane, you've got to lift over power lines.

### 3.6 Heavy Reliance on “Trying Out” Methods

For all initial training sessions, the instructor provided the orientation of controls to each student through (a) explaining and demonstrating the controls, (b) letting the student get a feel for the controls, and (c) asking them to complete a quiz which required the students to follow the steps. Overall, the students were most likely to talk about “trying out” methods as their initial orientation of the controls as they “learn from mistakes” (RIT2\_40). This was consistent with the instructor's comment: “[you will not understand] unless people jump in and do it a lot of the time, they're just like, ‘Oh yeah, I know what you mean now’”.

Student A: I've tried to give it [a control] a go to see how far I'd get and just go bit by bit with each section. (RIT1\_74)

Student B: I would try to do it myself, to use each [control] to see. If you press this one, I think I moved a thing to here, if you press that one you go up. After 5 minute or 10 minutes it's like you're using the right thing [control] or not...(RIT4\_97)

Student C: I wasn't really thinking on that task. I was more thinking like a step by step. Work my way [in the EWP] up to there, instead of thinking I'm going to get here straight away. (RIT3\_32)

While they are trying out the controls, trainees tended to ask the instructor questions in order to confirm if they made the "right decision" for the next step or to understand the best way of approaching the task. This also highlighted the usefulness of having the instructor in the basket during the first trial.

Student B: I get so confused [about which is the correct control]. Should we use this [or] we use the other one? Then, would it would better for me just to ask [Instructor], so it's not a big deal. When I did, the instructor said, "Use this one; we use this one." (RTI2\_86)









Instructor: The first time you get familiar with the controls, the first time you go, "Okay, which one do I want to click?" You're going through them all. Then, after a few you remember, okay I used that one the most and I used that one the most. Yet you remember those two and then you slowly get used to...different controls. (RTI2\_50)

Student C highly valued watching a demonstration of the instructor's EWP operation and indicated that this was his preferred way of understanding the task. In contrast, although Student A also talked about observing the instructor's demonstration, both Students A and B valued testing the controls to get a "feeling" for how it works.

Furthermore, when they tried to fold or relower the EWP (i.e., lower primary boom, secondary boom, and jib down), they seemed to consider the whole process of unfolding or raising the EWP (i.e., raise primary boom, secondary boom. And jib up) in reverse. To do so, they seemed to visualise the folding process through a step-by-step.

Student A: It was the thought processing of what I'm going to do from this height to get down without making anything wobble too much. Just maintain like...which part am I going to move first to get us down. (RIT2\_170)

Table 4. List of Pictograms and Terms That Were Used

Pictogram on the Genie controls	Genie manual (4 <sup>th</sup> )	Training Workbook (parts/movements)	The participants
	proportion control handle for drive function and thumb rocket for steer function (15)	no applicable part /no applicable movement	slew (Instructor)
	jib boom up/down switch (5)	jib (c) /articulating up and down	jib (Instructor)
	platform rotate switch (6)	platform controls (A) and platform (B) /no applicable movement	N/A
	platform level switch (7)	platform controls (A) and platform (B) /no applicable movement	N/A
	primary boom extend/retract switch (17)	no applicable part /telescoping in and out	extension scissors arm (Student A); extender (Student A); big bar (Student B); extension (Instructor); telescoping your extension (Instructor) Confused with jib (Student A)
	primary boom up/down switch (18)	base boom (D) /hinging up and down	main boom (Instructor); boom up (Student B)
	secondary boom up/down switch (19)	mid boom and tower (E) and lower boom (F) /raising & lower boom up and down (?)	scissors (Student A); two bottom scissors (Student A); bottom boom (Instructor)
	turntable rotate switch (20)	turntable (I) / slewing right and left	N/A

Note: Compiled with reference to Genie Industries (2012).

### 3.7 Interpretation of Visual Cues

Students' highlighted two issues in interpreting the pictograms on the control panel. First, students were likely to get confused which control was for the action that they want to take when looking only at the pictograms. In fact, it was observed that these students sometimes selected the wrong control due to the poor quality of visual cues in the pictograms (see the section of mistakes and struggles).

For example, Students A and C had problems with telescoping (Control 17) as different angles of looking at the view from the machine requires a different interpretation of a pictogram. Furthermore, individual differences were found in use of these visual cues. Student A found pictograms on the controls useful and actually used the pictograms from the beginning of his initial training. In contrast, Students B and C found the pictograms became meaningful only after they understood the controls through their clarifications with the instructor.

Interviewer: Were you using the pictures a lot....Did they work for you?

Student C: Yeah towards the end they did. In the beginning I was more asking the instructor "is it this one?" Once I knew, I took account of the pictures. (RIT4\_79-80)



### 3.8 Transitioning Issues

Transitioning issues in relation to controls were highlighted when they talked about using different models and machines. For example, Students A and C highlighted the difference in sensitivity between controls across two different machines:

Student A: I had imagined what a forklift does, and it didn't actually turn as far as I thought it would, because a forklift, a forklift goes even further doesn't it? It's just my own perception obviously, and his perception of this bigger EWP machine compared to a forklift was different to mine. (RIT4\_68)

Student C: I didn't realize you only move it [the EWP] a bit and the wheels turn a fair bit. (RIT4\_70)

Importantly, even the instructor made a mistake in the first session of the workshop as a consequence of his experience on different models (RIT1\_32):

Instructor: One of the things is when you're doing this [moving a control] to see how it compares to different machines. The joystick on the machine that I normally use, it takes the boom up and down. What I did here, was I went to bring the boom up, pushed it forward and actually traveled forward... So actually I pushed the wrong control here.

### 3.9 Instructor Explanation of Controls.

Thematic analysis of interview transcripts also highlighted advantages in the current EWP training methods. In particular, the trainees appreciated the instructor's hands-on guidance and support. The instructor briefed the controls one by one with the students at the beginning of the initial session, provided the students with direct instruction if necessary at the point of time (concurrent debriefing), and gave the student a quiz which guided the student through the entire process of unfolding the knuckle boom. Student A valued the instructor's advice that he drew from his years of experience with EWP operations: "I'm asking about the smartest way to operate it" (Student A: RIT1).

### 3.10 Other Non-Control Issues Identified Inconsistent Terminologies in Use

Inconsistent terminologies were highlighted during the training and interview sessions. For example, it took 50 seconds for the instructor and interviewer to figure out that Student A was actually talking about the "jib" (RTI1\_34-43). The student tried to describe the part as he did not know the part name, and the instructor and interviewer opened the training workbook for the student to point at. Furthermore, when the interviewer asked the name of a machine part, the instructor answered "yeah. It's 10,000 different ways of calling it" (RTI4\_154). **Error! Reference source not found.** shows the variations of terms used (a) in different sources such as the manual (Genie Industries, 2012), (b) the course workbook and (c) by different people (the students and instructor). The variations confused the trainees when they later reflected on decision making on which controls to select for use.

## 4. Discussion

This study illustrates the unstructured process used by these novice operators to learn control selection and determine directional movement during their initial licence training. During their attempts to operate the boom-type EWP, even with the instructor alongside them in the basket, they demonstrated a number of learning approaches that could put them at risk. These unstructured approaches included 'trying out' and 'testing' controls to try to discover what their purpose was and how they would move the machine.

The reflective interviews highlighted trainees spent a lot of time trying to cognitively picture how they would move the EWP to get it into the position the instructor had directed them to achieve. In trying to work out how to achieve what was required of them, they experimented a great deal with the controls to understand their function. This preliminary analysis of the data indicates that unsafe practices such as trying or testing a control to the extent the machine part

moved, at times faster than expected is heavily relied upon. If the novice operators didn't know the function of a control, it was not unusual for them to learn from their mistakes. This may also be the case for experienced operators when faced by a new control panel they have not used previously. The video evidence collected in this study revealed the experienced instructor found the Genie joystick performed a completely different function to what he expected, but only after he had pushed it forward and the machine had moved in an unexpected manner. This may in part provide some explanation of why current EWP operators report differences between control panels is one of their major concerns.

This study also revealed how novice operators approach the problem of folding the knuckle boom. That is, they attempted to cognitively visualise the future movements of the knuckle boom through multiple steps. Future work to understand this visualising process used to deconstruct the task before using controls may also be beneficial. The findings also highlight the need for further investigation into the wide variations in terminologies used by operators and trainers. Such work could be used to determine the extent of this issue and what its impact may be for dangerous miscommunication during operation, for example, between operator and spotter. Additionally, a similar analysis of experienced operators transitioning from a familiar control panel to an unfamiliar panel is indicated following the episode filmed during this research revealing a highly experienced operator, discovering the Genie joystick performed a completely different function to what he expected, but only after he had deployed the control and the machine had moved some distance.

With regard to the methodology used here, both participating students and the instructor described learning enhancements that arose from the opportunity to participate in a debriefing with video of their individual training sessions. They found it highly useful to be given an opportunity to clarify their learning while watching a visual recording of their performance and reported it helped them to reinforce relevant rules into their learning. The study method was useful in clarifying the best positions for cameras recording actions and interactions of the trainee participants. In particular, the camera recording from the right angle looking at the controls and platform (basket) provided a very clear view of hand movements on and across the controls in addition to the platform and boom movement.

### **Conclusion**

In conclusion, this study examined the process of how students learn to operate a boom-type EWP machine. Unsafe practices including "trying out" controls to the extent that corresponding parts of the EWP moved and "learning from mistakes" when controls were operated incorrectly, indicate that a safer method for learning controls is needed. A training simulator for EWPs would provide a method to train on differing control panels without the need for reading literacy and would bridge the gap between manuals in different languages. The current problematic practice of issuing operators with a generic licence for multiple EWPs needs to be supported by a device that can train at the EWP model-specific level. A safe space to try out controls would not only benefit novice operators, but would also support experienced operators to transition safely from one control panel to another.

We have begun work to trial and assess an innovative portable control simulator to aid on-site training prior to an operator being required to move from one control panel to another. The assessment focusses on how to enhance and improve familiarization with controls and if such a device can assist to build a level of automaticity before operating any EWP type or model.

## References

- i. Braun, V., & Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), pp. 77-101. [Online] Available at: doi:10.1191/1478088706qp0630a
- ii. Breslin, P., 2011. Eliminating falls from heights in the Australian Construction Industry: How effective are elevating work platforms? *Australian Construction Safety Journal*, 1(2), pp 10-17.
- iii. Build Safe UAE, 2010. *Man Lift Fatalities, Safety Alert #413*. [Online] Available at: <http://www.ewpa.com.au/uploads/Safety%20Guidance%20Notes/Safety%20Alert%20413%20-%20Man%20Lift%20Fatalities.pdf>
- iv. Burgess-Limerick, R., Krupenia, V., Wallis, G., Pratim-Bannerjee, A., & Steiner, L., 2010 Directional control-response relationships for mining equipment. *Ergonomics*, 53(6), pp. 748-757.
- v. Burgess-Limerick, R. & Steiner, L., 2006. Injuries associated with continuous miners, shuttle cars, load-haul-dump and personnel transport in New South Wales underground coal mines. *Mining Technology*, Volume 115, pp. 160-168.
- vi. Geinitz, B., 2015. *CTC Safety Series – EWP Safety. March 4. Queensland Construction Strategy Unit, Workplace Health & Safety Queensland*. [Online] Available at: <http://www.ctc.qld.edu.au/ctc-safety-series-ewp-safety/>.
- vii. Genie Industries ed., (2012). *Genie: Operator's manual (z-45/25; z-45/25j)*. (4th ed.). USA. [Online] Available at: <http://manuals.gogenielift.com/Operators/english/114344.pdf>
- viii. International Powered Access Federation (IPAF), 2014. *IPAF Guidance for Instructors and EWP Operators: Important do's and don'ts to avoid trapping/crushing injuries while working in a EWP platform*. [Online] Available at: <http://www.ewpa.com.au/uploads/Information%20Sheets/AvoidingTrapping.pdf>.
- ix. QSR International, 2015. *Nvivo 11 pro for windows*. Victoria, Australia: s.n.
- x. Tichon, J., Mavin, T., Diver, P., & Dyer, K., 2016. *Part-task training for safe operation of elevated work platform (EWP) controls. Poster Presentation at HFESA 2016 Conference, Gold Coast*. [Online] Available at: <https://www.ergonomics.org.au/resources/hfesa-conference-proceedings/conference-proceedings-2016-conference> [Accessed 31 Aug, 2017]