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Evaluating the effects of Virtual Reality training on the accuracy rate of a Supply Chain Fulfilment team.

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Abstract

Learning technology advancements have shown how employees can benefit from new and varied learning experiences in comparison to traditional on-the-job training. This is true for manual tasks which if done incorrectly could result in high error costs to companies. This paper presents research undertaken as part of a postgraduate programme at TU Dublin, to apply the use of an immersive virtual reality learning experience to evaluate the impact on a supply chain fulfilment teams accuracy rate. The overall team accuracy rate improved, producing a reduction in error rate and costs of resent/refunded orders. The participants reported that they enjoyed training with new technology and that it impacted their daily practice. This paper also discusses the benefits of using emerging technology for training over traditional trainer-led learning and how organisations could benefit from investing in new learning technology to create engaging and scaffolded content for their employees.

Keywords: learning technology, virtual reality, scenario-based learning, learning transfer, on-the-job workplace training.

Introduction

Virtual Reality (VR) training has become sought-after in corporate learning due to the platform's ability to remove risks associated with on-the-job training, the innovative design of scaffolded learning, and the learner's ability to control their learning experience (Kugler, 2017). This is shown particularly when it comes to roles that can have high costs to an organisation if performed incorrectly. The research presented in this paper will evaluate the impact of VR training on the accuracy rate of a supply chain fulfilment team responsible for processing, packing, and shipping gift-card orders. A report investigating the value of fulfilment errors throughout January to December 2019 showed that the total cost to the company was $44,324.47[1] in incorrectly fulfilled gift cards which were refunded or resent to customers.

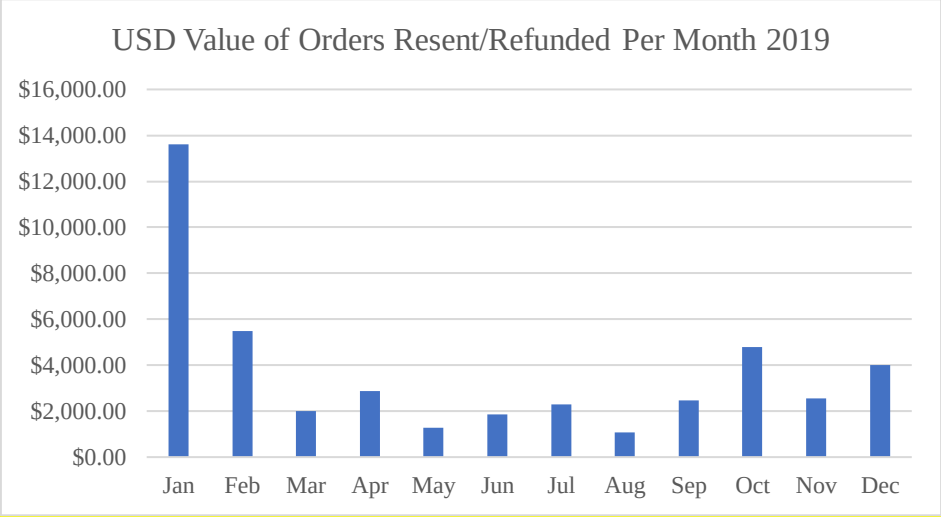

Figure 1 Bar Chart showing the total amount of orders refunded by month in 2019.

These errors affect the time spent by the customer service team receiving calls and logging issues, which in turn require investigation by a senior fulfilment team member.

[1] Data pulled from the company's internal database showing total USD value of refunds issued to customers throughout 2019.

The VR experience developed for this research was designed to align with Knowles' theory of andragogy (adult learning), with scenario-based learning for participants to build on their previous training experience (Knowles, 1980). The research design aimed to encourage the participants to analyse and evaluate both the previous training and the VR condition based on Bloom's Taxonomy (Adams, 2015), with the objective to increase participants' involvement in their learning and provide a comparative data set for this study.

This research will gauge learning transfer – the participants' ability to apply what they have learned during the immersive learning experience to their daily practice (Leaman, 2014) – and whether it improved performance. The viability of learning technology when adapted to integrate VR learning experiences, and whether the learning solution can immerse the learner will also be explored, and the cost-benefit analysis of internal VR development when compared to traditional training styles.

Literature Review

VR versus On-the-Job Training

The participating supply chain fulfilment team utilise on-the-job training, which requires senior team members to train new staff. Furthermore, new hires train with live orders which ensures the training process carries a financial risk. A study by Seymour *et al.* (2002) on surgical students showed that VR was proven more beneficial to students as it removed the risk of operating on a live patient (Seymour, et al., 2002). While fulfilment work carries lower risks than that of a surgeon, if the fulfilment team members lose concentration throughout the day, the company can see significant error costs as a result.

The development of a VR training resource could be a cost-effective and resourceful use of human resources and talent (Hughes, 2019). However, a comparative study by Quinn *et al.* in

2003 on VR training versus traditional training in dental students showed that, in terms of feedback and evaluation, VR-based training for novice students proved less effective than traditional training (Quinn, Keogh, McDonald, & Hussey, 2003) with the VR learning participants scoring worse than their traditional learning counterparts. Furthermore, Allcoat and Mühlenens' 2018 comparative study discussed that in terms of material interpretation, the standard learning participants and the VR participants ranked equally. The study found that VR learning participants reported higher engagement over the other learning conditions in the study (Allcoat & Von Mühlenen, 2018). It must also be noted that VR may not account for all learning preferences. Participants may prefer the traditional on-the-job training because they can ask questions of the trainer and learn from the experiences of the trainer and others in the training session (Bertram, Moskaliuk, & Cress, 2015).

VR versus Video Training

Initial planning aimed to introduce video-based training for the fulfilment staff, which management believed would improve accuracy rates and act as a training resource for new employees or existing employees should they start to underperform. Due to the manual nature of the fulfilment role, it was discussed whether a more immersive and interactive learning approach would be more beneficial. Research has shown a surge in popularity in innovative technologies for workplace training for manual and repetitive tasks (Hense, et al., 2013) and VR has proven to be much more effective than traditional video-based training seen in most modern workplaces. Tichon and Scott showed in their 2019 study that participants in a Manual Handling course who utilised VR training retained on average 30% more than those that engaged in video-based training, despite identical content (Tichon & Scott, 2019). Furthermore, Brough *et al.* showed that VR training saw quicker reactions and mistake corrections in students engaging in mechanical assembly training (Brough, et al., 2007). VR

training could provide the fulfilment team with a more immersive learning experience, and a better ability to retain best practice techniques in their day-to-day role.

It could be argued that VR and video training both use gamification to improve engagement and retention. Reiners and Woods showed that the gamification elements in VR training resulted in a more positive and immersive experience over video training. The study was done with Supply Chain Management students, who reported VR training helped them to see the ripple effects of their decision making and allowed them to react efficiently to develop a solution (Reiners & Wood, 2013). Given the fulfilment teams current retroactive approach to error handling, by creating a scenario-based immersive learning experience we can also evaluate whether this has any impact on the team's reactions in terms of identifying and addressing errors in their work.

VR and Learning Theory

VR provides a controlled environment for situational learning through scaffolding (Dalgarno, 2002) and allows instructional designers to create fully immersive experiences engaging learners along their learning pathway (Shou, et al., 2020). This relates to Kolb's theory of experiential learning. Fulfilment staff can train using the VR solution to create knowledge from the experience (Kolb, 1999), minimising the financial risk to the company (Virtual Reality Marketing, 2019). Knowles' theory of Andragogy shows how VR training may prove to be a viable solution to the four principles of adult learning (Knowles, 1980). Adult learners prefer independent learning, and their learning requirements must involve the ability to control their own decision-making (Blondy, 2007). VR training can provide this as it creates the situational learning that adults require and can be designed to show the ripple effects of decision-making and the quality of that decision-making (McGrath, 2009). While immersed

in the virtual experience, learners can make mistakes without consequences and test different scenarios.

Studies have also shown that VR has proven to be beneficial for adults in terms of functioning memory. Parson and Rizzo's 2008 study shows that adults between the ages of 21 and 36 who experienced the VR CPAT environment benefitted longer-term memory functionality (Parsons & Rizzo, 2008). However, does the introduction of modern technologies take away from the engagement during a training session? A study by Baumeister *et al.* on augmented reality headsets shows some of the restrictions of head mounted displays used to administer VR training increased user cognitive load (Baumeister, et al., 2017), with participants preoccupied with learning how to use the headsets rather than the learning content.

Although several studies have shown that VR training promotes a more engaging user experience, improved memory retention, reaction time and forethought, and creates an immersive, scaffolded learning experience, it is not without its drawbacks to the learners and the instructional designers who are required to update and maintain the learning content. The use of VR in a corporate environment requires new skills from instructional designers to develop and maintain VR learning sources, which is outside the scope of their role and abilities. It may also require the company to pay outsourced developers at a high cost. However, with the rapid growth of VR over the years, comes the rapid growth of easy-to-use technology. Developing virtual experiences is becoming easier for instructional designers and learning professionals (Dickons, 2018), such as mobile VR devices, making VR training more accessible to any person who owns a smartphone (Zourrig, 2019).

Methodology

A pragmatic constructivist approach to learning served as the foundation for this project. This concept is focused on how people generate, use and exchange intelligence to take effective action. This framework was appropriate since it established a guide to the participants' activities around best practice and error resolution, which was based on their prior understanding of processes within their function. The data obtained during action study cycles was evaluated and established formative strategies for the subsequent cycles based on the findings.

Participants

All participants at the time of research were Supply Chain Associates in full-time employment and had been employed in that role for a period of between six and 12 months. A total of five participants (all female due to no male team-members) were available to take part in the study as they had all completed on-the-job training for this role and fulfilled on average 600-1000 orders per week. The study was approved by the TU Dublin Research Ethics Committee since the research was undertaken as part of a Master's programme in applied e-learning at TU Dublin. All participants gave informed written consent for each round of research (Survey, Observation, VR Training Session, Focus Group) and were aware of their right to withdraw consent at any time during this research.

Apparatus

The cycle one survey was delivered via MS Outlook Forms to gauge participants views of their current skillset relating to their role. Responses were anonymous. The VR training course was hosted on a laptop with WampServer, an opensource software stack consisting of Apache Web Server, MySQL, and PHP, allowing the training course to be delivered to any device running via a web browser. Training was administered via a OnePlus 3T Smartphone

with a 5.5-inch AMOLED screen running at 1080x1920 resolution and weighing 158 grams. The Smartphone was paired with an iTech VR Box to run the training course using the Google Cardboard VR through the Firefox web browser mobile app. The combined weight of the headset and phone was 438 grams. For participants who were unwilling or unable to use the VR headset, the training was also available in desktop VR.

The third cycle of research was a focus group which was planned to be hosted onsite in the warehouse. However, due to the Covid-19 pandemic restrictions, the focus group was hosted on Zoom WebApp with participants dialling in from home. The focus group was recorded via the app and a Sony ICD-PX370 Mono Digital Voice Recorder placed in the researcher's desk during the call. The recording was then uploaded into the Otter.ai transcription software, exported into a text document and reviewed further to ensure accuracy.

Design and Implementation of Learning Material

The training content was developed using Adobe Captivate eLearning software which had been updated with VR support in 2019. Other software was considered including Unity, React VR and InstaVR. Adobe Captivate was decided upon due to its low barrier of entry in both technical abilities needed to develop VR content and monetary aspects. This also had the benefit of allowing the distribution of the same course content in a desktop VR environment as well as a headset VR environment.

The course content was designed by using a Yi 360 VR camera to take still photos and videos of the supply chain fulfilment office. These stills and videos were then transposed into a 3D environment using the Adobe Captivate software to create a virtual representation of the office. Hotspots were positioned strategically allowing the user to navigate and interact with the virtual content. These interactions included navigating the office, taking quizzes, and

reading course content presented on slides throughout the module. A menu function would appear for participants if they looked downward for five seconds. This menu allowed them to navigate back and forth through the modules if necessary. VR desktop solutions utilised traditional point, click and drag movement to navigate content within a web browser. Feedback within the course is provided in two forms, the first being positive feedback presented as floating text as the participants completed quizzes or tasks successfully. The second form was constructive feedback shown when the participant answered a quiz question incorrectly or failed to complete a task. This feedback was presented as a 360-degree pre-recorded video. It showed a senior member of the supply chain team explaining where the participant went wrong, the outcome of the mistake and how to avoid it in the future. These were the only sections in the course which required any audio.

Procedure

The procedure was the same for all participants throughout all three cycles of data collection and VR learning. It was planned to reiterate the cycle one survey at the end of the research period. However, restrictions in place due to the Covid-19 pandemic led to closure of the office, and questioning using a survey reflecting on errors made within the previous six weeks was not feasible. For the virtual learning phase, participants were instructed to make their way through the entirety of the three modules the course contained. The modules were broken down as follow:

- Navigation of the Virtual Space and Fulfilment Preparation
- Best Practice for Fulfilment
- Error Finding and Resolution.

The training took place in a meeting room. The participants were each allocated 60 minutes to come to the meeting room to experience the VR environment, with the researcher available to provide guidance when needed.

Figure 2 Participants using the VR and Desktop versions of the learning content.

To assess if they felt the VR training had any effect on their accuracy rates and how it compared to the conventional training they received, the final data collection cycle involved the participants engaging in a focus group.

Results

Survey

The initial survey was created to determine the participants' own views of their current error rates and abilities to resolve them. The first section of the survey included a Likert Scale assessment of nine statements regarding the training they had received and their current performance. The second section asked the participants to answer "Yes or No" questions relating to any recurring errors experienced, such as picking the incorrect stock or counting the incorrect gift card currency. The third section involved two questions with free text

answers to gather feedback on how the participants had been trained and any performance barriers they faced.

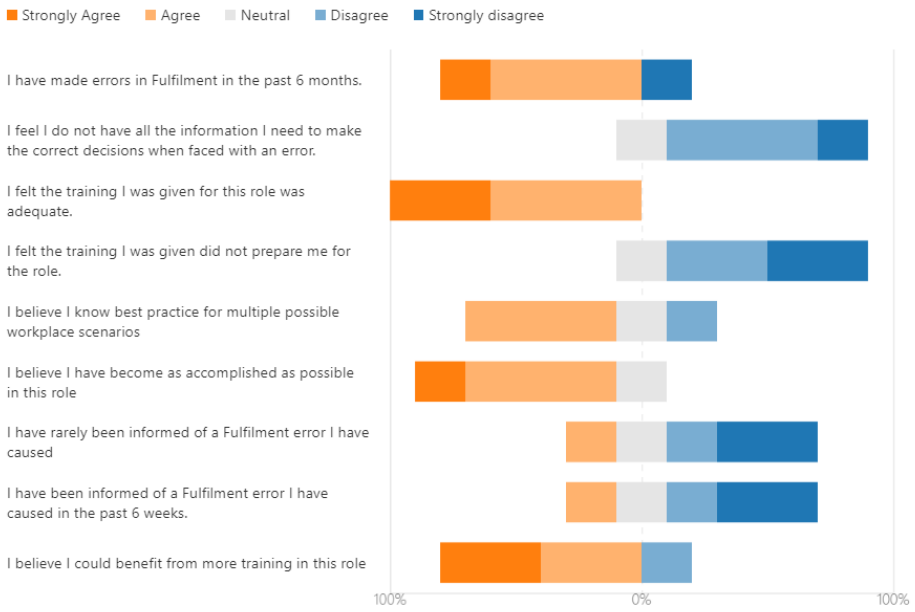

Figure 3 Clustered Bar Chart showing the results of the *Perception of your Performance* of the Cycle One Survey

The results of the Likert Scale show that 80% of participants felt that they had become as accomplished as possible in their role in fulfilment; however, 80% also believed they would benefit from more training with regards to fulfilling orders. Further to this, 60% of participants said they had rarely been informed of an error they had made, while 60% also stated they have been informed of an error they made in the six weeks prior to taking the survey. While 80% agreed that they had made an error in the previous six months, most of the participants believed that the training they received was adequate, they rarely made mistakes they were aware of, and believed that they were equipped with the best practice knowledge to resolve an error they encountered during fulfilment.

Section 2 of the survey asked participants what mistakes they were aware they had made in the past six months. The mistakes listed in the survey reflect those most common on the fulfilment team.

Participant	Picked Incorrect Folder	Counted Incorrect Currency	Counted Incorrect Denom.	Surplus Vouchers After Fulfilment	No Vouchers to Complete Fulfilling	Unsure what to do on Error
1	No	Yes	Yes	Yes	No	No
2	Yes	Yes	Yes	No	No	No
3	Yes	Yes	Yes	Yes	Yes	No
4	No	No	No	No	Yes	No
5	Yes	Yes	No	Yes	Yes	No
% Results	60%	80%	60%	60%	60%	0%

Figure 4 Participants' answers for Survey Section 2 displaying individual answers and percentage total of errors made in the previous six months

The results show that of the five possible mistakes they could make, all five had been experienced by the fulfilment team in the past six months, with the most common mistake being counting the incorrect currency. However, the sixth question relating to error handling showed that all participants knew the correct action to take to resolve an error.

Section 3 allowed the participants to reflect in their own words on their training experience for their role and any issues they felt impacted on their performance. All participants reported that they had received one-to-one training from a senior supply chain team member, who took them through the fulfilment process and key techniques for fulfilment:

> *They had selected a few one domination [stores]and I was shown how to match the shop codes and how to fulfil an order. Then I was shown how to fulfil orders using multiple denominations and easier ways of counting too.*

> *[They] took me to another room on my first day and went through the fulfilment process with me. She gave me a step-by-step process and sat with me on my first day to answer any questions I had.*

Regarding current performance barriers the fulfilment team faced, recurring throughout were loss of concentration due to the repetitive nature of the task, with one participant commenting that the recognition of one error can throw off their concentration for the rest of the day. The results of this section of the survey indicate that the participants were happy with the training they received. However, the key performance indicators which impact on their accuracy are the repetitiveness of the role and the effect of realising an error on their performance, resulting in participants to *"Overthink too much sometimes which will slow down my process"*. Based on these comments, a section on concentration could be considered as an addition to the training content in the future.

Observation Data

Cycle two of the research was conducted through gathering of observation data. This was done by pulling the information from the company's internal database and analysed using MS Excel. For this research, it was decided to pull orders which had been fulfilled five weeks before VR training and five weeks post-VR training (10 weeks total). The intended purpose of this research cycle was to track each participant's accuracy rates through information stored in the database and matching it with the fulfiller who signed their name to that order on the physical stock report (fulfilment associates are required to sign and date any stock they are removing from the safe room). However, due to the office lockdown during the Covid-19 pandemic, this information was not available to retrieve as no electronic version is available. The observation instead analysed the overall team error rate.

Prior to VR training taking place, the accuracy rate of the fulfilment team was 99.91%. Post-training, during the observation period the fulfilment team's accuracy rate was 99.95%, an

increase of 0.04%[2]. Although the difference in accuracy may appear minor, there are other metrics which show the validity of VR training over traditional one-to-one training. The observation data shows that during the five week pre-training period, the fulfilment team made a total of 20 errors. Based on a five-day working week, this equates to an error being made every 1.25 days. However, during the post-training five week period, the number of errors made was seven. This equates to an error every 3.5 days, reducing the frequency of errors by 50%[3]. This aligns with the financial cost to the company for resends/refunds issued to customers due to fulfilment errors. Over the ten week observation period, the total value of resends/refunds issued to customers for orders impacted by fulfilment errors was $5,760.29. 78.45% of this total value was for orders fulfilled in the pre-training observation period ($4,591.08).

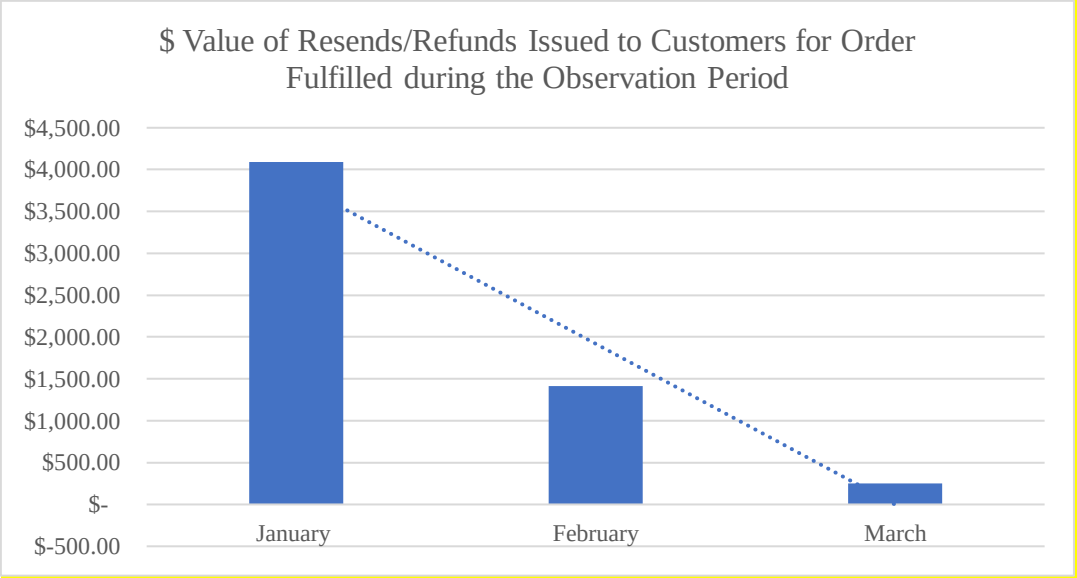

Figure 5 Graph showing the decrease in $ value of resend/refunds issued over the ten week observation period

[2] Calculated by the number of orders fulfilled during the observation period, minus the number of orders in which required a resend/refund to be issued.
[3] Due to the restrictions in place during the Covid-19 pandemic, the company saw a reduction in orders between the pre-training and post-training observation periods.

Given the frequency of error rate calculated during the pre-training period was 1.25 days, with an average fulfilment error value of $166.20[4], the value of errors over a year would equal $34,702.56. Based on the error rate of 3.5 days as calculated from the five weeks post-training period, using the same average error value, the cost to the company would be reduced to $12,393.77, a total reduction in costs of 64.29%. This savings figure does not include potential savings for the cost of shipping each resent order, which would see further reduction. The observation data indicates that post-VR training learning transfer took place as the reduction in errors and associated costs indicates a marked decrease among participants without their input on the learning experience having yet been obtained.

Focus Group

A focus group was conducted as cycle three of the research to allow the participants to analyse, evaluate and discuss their experiences with the VR training tool and whether they believed it had an impact on their performance, based on the hierarchy of Bloom's Taxonomy. The data collected has been categorised thematically and analysis is now presented by theme.

Effectiveness of VR as a Training Tool

The participants had a positive response to the use of emerging technologies for training. All participants said they enjoyed the experience, would use it again to train for the fulfilment task, and believed it would be beneficial for learning other tasks, such as processing returned stock.

[4] Based on the average value of failed orders in 2019.

The participants used the focus group to evaluate the gaps in the training they had received. They reported that when they trained with the senior team member, as it was their first week on the job, they felt stressed and that this had an impact on their learning. They also reported that due to the length of time they spent training for a straightforward task, they did not feel comfortable to ask for further training from the senior team member who was busy with day-to-day operations. A benefit of the online resource noted by the participants was the ability to return to the virtual content in their own time should they require it, and had this resource been available to them, they would have used it.

The most notable training gap addressed during the focus group was the incorrect currency picking error. From the initial survey conducted during cycle one, 80% of participants stated they had incorrectly fulfilled an order in the previous six months due to picking the incorrect currency. One participant noted during the discussion that this error, though mentioned in their one-to-one training, was not evaluated at the time:

> *[It's not an issue] when you're training, because the folders are already picked for you. So, you know, they are [the] correct denomination to the correct currency to the correct store.*

The VR training did cover this error by including a scenario which required participants to enter the safe room, navigate to the correct safe and select the correct currency for fulfilling an order. If the participant selected the correct currency, they received positive feedback and were able to continue the course. If they selected the incorrect currency, they received feedback in the form of a pre-recorded video of a senior team member providing feedback by equating the error to a customer service complaint and outlining how to avoid the issue in future.

> *With VR we could see the whole process, like you go into the drawers and check the folders and the different denominations and all the things that include [sic] in fulfilment. So, I think it was a little bit wider than the training that we see right now.*

There were some disadvantages noted by participants; some bugs in the tool, as well as a lack of experience with VR resulting in dizziness. However, this did not impede their overall enjoyment.

> *[A] negative point it is… technology has its bad days. So, like it was a little bit blurred that day and I got dizzy.*

Learning Preferences

Many participants reported during the focus group that they were visual learners and found the VR training suited their learning style. However, 20% of participants stated that they were more kinaesthetic (practical) learners and believed they would benefit from having to perform the task of fulfilling as part of the training (Boyle, 2005). Due to the limited functionality available in Adobe Captivate to create a virtual environment, it could not be developed to allow participants to interact with objects. This suggests that the training may not need to be administered completely virtually. There is the opportunity to use it as part of a blended learning solution, using VR for scenario-based learning and error handling, while using the one-to-one training for the fulfilment task for learners to gain experience with the practical aspect of the role. This could provide new team members with a multi-faceted learning experience based on their learning style (Dunn, Beaudry, & Klavas, 2002). It allows an organisation to be innovative with learning technology, by being able to adapt their content to suit their employees (Chen, Toh, & Ismail, 2005). Furthermore, there is value in exploring facilitation through various mediums across cognitive load distribution (Essmiller, et al., 2020), ensuring trainees do not become stressed during their training learning new technology and content impacting their ability to retain knowledge.

Learning Transfer

Organisations may be apprehensive about introducing new learning technologies as they cannot guarantee whether any learning transfer has taken place. However, research has shown

that new perspectives in learning and cognitive psychology have benefitted from using virtual environments (Bossard, Gillies, Buche, & Tisseu, 2008).

There are two key areas where we can identify that learning transfer took place in this research, as the participants applied the knowledge learned in the VR experience to their daily practice. The first was the decrease in errors caused by incorrect currency picking from the stock room post-training. This shows that scenario-based learning transfer occurred and impacted participants' performance. The second area is in error handling and resolution. During the cycle one survey, all participants agreed that they were confident in how to handle any error they were faced with. When this topic was reiterated during the focus group, participants indicated that their confidence had been reinforced due to the VR training. Participants were better prepared to resolve an issue, whether they spotted the error during fulfilment or post-fulfilment and could address it with senior team members when they needed to.

> *You're in a position where you're more comfortable to take a step back and figure out the error and whether it's something you can fix yourself or whether it's something you need to approach another team member with. But I feel like I'm a lot more comfortable in how to do it.*

The importance of learning transfer can also be attributed to learning culture within the workplace's innovation around learning. By adapting to new technologies in learning, organisations will not only benefit from learning transfer in their employees but also how learning culture can enhance the overall innovation within an organisation (Reid & Samer, 2005).

Business Case

This section of the paper will outline the potential cost savings seen through the development of the VR training resource created for this study rather than face-to-face training, by performing a cost-saving analysis on the development and administering of the training. Based on the current training program for the supply chain fulfilment team, a senior team member spends on average 20 hours training a new hire during their first week. Using the Brightwater Salary Survey 2020, we can perform a cost-benefit analysis comparing traditional training with the implementation of VR training. According to the survey, the average yearly salary of a Supply Chain Specialist is $72,114.25 (Brightwater Recruitment Specialists, 2020)[5], meaning their cost per hour based on a seven hour workday in a five-day workweek is $39.47. Assuming they spend 20 hours training each new hire including preparation time, this incurs a cost of $789.40 per new employee trained. The company hires on average six new fulfilment team members yearly, resulting in a yearly cost of training of $4736.40.

To compare, the development of a virtual training solution would require a different assessment of cost, such as the time taken to design, build, and maintain a course and the average salary of an instructional designer. According to the survey, the average salary of an Instructional Designer is $55,472.50 (Brightwater Recruitment Specialists, 2020), meaning their cost per hour based on a seven-hour workday in a five-day workweek is $30.36. Based on industry standard of six weeks to develop a course (Kapp & Defelice, 2009), the initial cost of developing a course would be $6,982.80. Allowing for ongoing maintenance of the course of one workweek, the additional yearly cost would be $1062.60.

[5] Currency converted from EURO to USD using Google Converter to maintain consistency with other references to currency.

While the initial cost of designing the VR course is higher than that of the traditional training with a senior team member, the cost of VR would negate within the first two years and would save $8775.00 by the end of a four year period. This analysis does not include the cost of a senior team member to train the new hires with the virtual training content or the cost of the hardware to administer the training. However, given that the virtual training takes less than 30 minutes to complete and could be made available on the users' smartphones or on their desktops, these costs would be minimal.

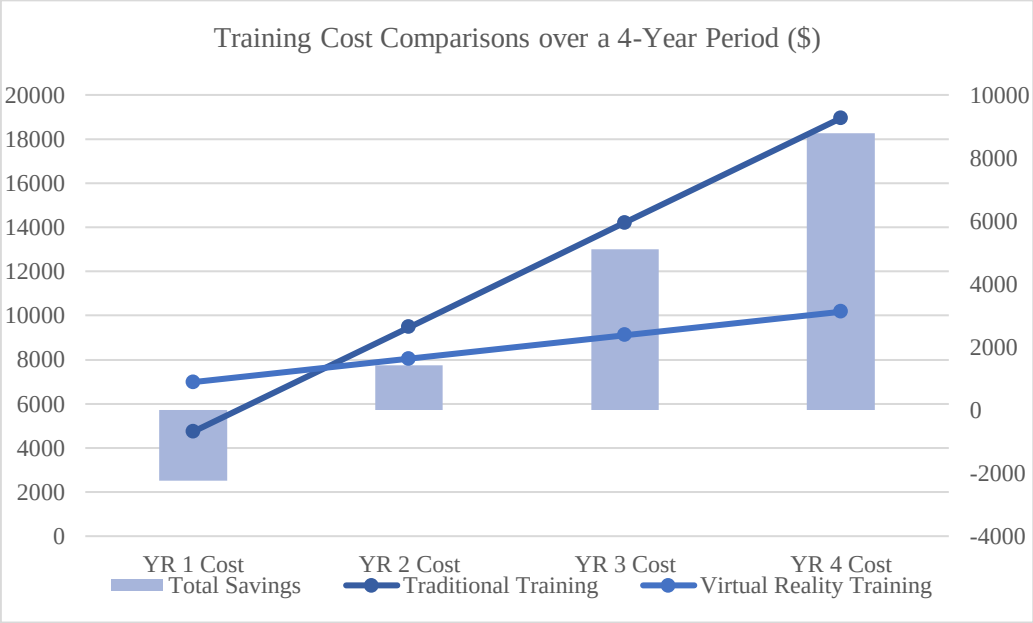

Figure 6 Combination graph showing training cost comparisons of traditional training versus virtual reality training over four years.

Organisations may still be sceptical of introducing a virtual training program that does not require a senior team member to be present, however, given that Adobe Captivate is SCORM compliant (Adobe, 2019) training content developed within the platform can be integrated into existing learning platforms allowing for a record of training on their employee profile. As mentioned above, VR can also be introduced as part of a blended learning solution to ensure the learner achieves a high standard of training, reducing but not eliminating the

number of hours a senior team member needs to be present for the training, whilst still reducing the overall cost of training over a given period.

Discussion

This study aimed to evaluate the effect of VR as a training tool on a fulfilment teams accuracy rate. Overall, the accuracy rate for the team was minimally impacted. However, further breakdown of the data shows that VR training provided the fulfilment team with other benefits. The most frequent error caused by the fulfilment team and impacting customers was picking the incorrect stock currency from the safe room. Addressing this issue and designing a scenario-based immersive learning environment resulted in learning transfer and change in practice. This reduced the overall fulfilment team error frequency by 50%. This is not to suggest that during their initial training the participants did not appreciate the significance of picking the correct stock. However, by practically evaluating this scenario, the VR training provides the learners with a greater understanding of their everyday tasks and awareness through a new perspective (Knowles, 1980). Furthermore, it allowed the participants to evaluate each stage of learning as defined by Bloom's Taxonomy, with more interest shown in how they would like to be trained in the future.

Further learning transfer occurred with regards to error management with participants reporting that post-VR training, they felt increased confidence in their own abilities and feel they can manage an error without relying on others to resolve it. Considering the above, the fulfilment team could begin to respond proactively to errors, rather than retroactively (Berg & Vance, 2017). This applies to the above-mentioned point that research participants in other studies had quicker reaction times and mistake correction because of VR training (Brough, et al., 2007). A retroactive response costs the company and results in negative customer experiences. VR scenario-based training could resolve this ongoing issue for the company

while also providing a more engaging and andragogical learning experience for the employees.

None of the participants reported that they found the new technology too difficult to use (Baumeister, et al., 2017) or felt that having to learn new technology distracted from the content of the training course (Allcoat & Von Mühlenen, 2018). They also welcomed the idea of using VR for training for other processes and enjoyed the possibility of learning independently (Rogers, 2020). Although participants enjoyed the experience of learning with VR overall, the learning experience did not account for various learning preferences such as those who prefer one-to-one practical training and having the ability to ask trainer questions (Bertram, Moskaliuk, & Cress, 2015). Fulfilment training does not need to be either VR based or one-to-one instructor-led training, but rather a combination of both as part of a blended learning solution (Kirkley & Kirkley, 2005).

This research also aimed to question whether VR training is a viable option for workplace learning if the company wants to develop it internally. The cost-benefit analysis shows that, while the cost of development would be higher, the company would save money over four years by implementing internally developed VR training. This is the result of both lower training costs (Jenkins, 2019), but also savings in resends and refunds issued to customers. However, Adobe Captivate does not allow instructional designers to create an immersive environment. As noted by the participants in this research, they found the virtual training solution lacked the practical element of being able to interact with the stock even though they found the scenario-style navigation of the stock room beneficial. This further indicates that VR can be implemented as part of a blended learning solution (Shou, et al., 2020) which is both cost effective and a better use of talent (Hughes, 2019).

To further study accuracy rates of the fulfilment team, this research would benefit from a larger set of participants that could be divided into two groups for a comparative study, 1) VR training only, 2) one-to-one training control group with the aim to produce more granular data to evaluate impact on accuracy rates. The study would also benefit by comparing VR with various other active and passive learning conditions such as group training and practice-based discussions. It would also be more beneficial to monitor accuracy rates over a longer period and to reiterate the cycle one survey again post-training to measure whether the participants felt the training was beneficial after the novelty of the learning experience had worn off (LearnUpon, 2018). Furthermore, the research would benefit from gathering data around how feedback was provided during the VR training experience and evaluating the participants' assessment around this piece.

A final comment can be made regarding the importance of having virtual online training as an option for all role types, especially during the climate in which this research was conducted (Li & Lalani, 2020). When offices closed during the Covid-19 pandemic, online learning became more necessary than it was before. However, with physical on-site jobs such as order fulfilment, online learning platforms allow employees to continue developing skills and improving their performance for when they can return to their day-to-day role. Workplace training no longer must take place on-site. In view of the growing need for innovations in learning technology, the effects of the global pandemic may see more creative developments in learning technology growth and adaption over the coming years.

Conclusion

The aim of this study was to determine if VR is a useful training tool by comparing the accuracy rate of the Supply Chain team before and after VR training. Additionally, the study looked at the potential benefits of using VR learning experiences in on-the-job training. The Supply Chain team's accuracy rate increased slightly when VR was introduced, and they now have a training resource to refer to at their leisure. Furthermore, by reinforcing best practice processes within their roles, the participants adopted a more proactive rather than reactive approach to error management, as evidenced by the lower frequency of errors involving sending the incorrect currency to clients. This can save on company costs by preventing the initial error and the subsequent customer care and reshipment costs associated with resolving the issue. Although VR development is initially more expensive, there are now many instructional design programs available that can help make the process more affordable to develop in-house. Maintaining a VR learning resource is also cheaper over time compared to senior team members giving up time for repeat training sessions, demonstrating that VR and other diverse learning technologies are beneficial for organizations to adopt in the long term to reduce expenses, as well as creating an interactive and enjoyable learning experience for their employees.

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