LEARNOVATE
Leading Learning Innovation

ETU Report
Immersive Learning:
The Whats, Whys, & Hows

Authors:
Dr. Bilal Ahmad - Learnovate Centre
Janet Benson - Learnovate Centre

August 2022

Prepared For:

ETU

TECHNOLOGY CENTRE
ENTERPRISE IRELAND
IDA IRELAND SUPPORTED

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Table of Contents

This report was created by Learnovate at Trinity College Dublin for ETU.

1. Executive Summary

Immersion is about creating powerful experiences which take the learners into another world [13] allowing them to feel a sense of 'presence' and 'embodiment'. It can be achieved using a book, music, film or even just a feeling, experience or smell that takes the learner away from where they are to another world which may or may not replicate a real-world environment. As a simple example, hearing the sound of a fire alarm can generate a feeling of urgency in an individual, evoking an emotional response which can potentially lead to a physical one. As it is not always possible to provide real objects or artefacts to everyone, in this case, having a person hear an actual fire alarm and having to respond, technology can play a role to achieve immersion via mimicking the real-world experience.

In the last couple of decades the term **'immersion'** is often used loosely when considering adoption of the latest technologies, but there is a need to reconsider what exactly constitutes immersive learning in specific contexts e.g. industry or the corporate context. In order to achieve this, we first defined what immersive learning is, particularly in a corporate learning context, followed by addressing a number of research questions that specifically address challenges that ETU are currently investigating.

When considering the adoption of immersive learning we recommend that organisations take into account the foundational elements of immersive learning and immersion and whether these elements are required for specific learning outcomes in their organisation. For example, immersive learning is not a 'one-size-fits-all' solution for learning challenges - it needs to be properly established that immersive learning is the right solution for the problem that needs to be solved.

In this regard, we have set out a number of steps for learning leaders to follow when considering an immersive learning approach, with the caveat that there are other considerations such as organisational capabilities and potential financial constraints to be taken into account.

In general, we recommend that the intention should be to make immersive learning experiences ubiquitous by making them cross-compatible for mobiles, tablets, desktop and high tech Virtual Reality (VR)/Augmented Reality (AR) devices where possible or as needed. This will ensure coverage for diversity of learners, rather than those who are tech-savvy and self motivated to use the latest technology for learning. In addition, after conducting research on their client organisations, providers should aim to integrate the solution with the clients' existing Learning Management Systems (LMS) to aggregate learning analytics data e.g. for preparing reports.

New immersive solutions should be interoperable[1]. These should allow access to the training via the clients' existing LMS and integration of learning analytics data for capturing important metrics such as learning retention, time taken to complete training, and skills development. Moreover, it should be made relatively straightforward for non-technical people to create learning experiences. For example, to enhance learning benefits with reduced costs, provide a drag-and-drop based authoring system.

We also recommend providing support to client organisations by giving them access to a library of Extended Reality (XR) assets (custom made or freely available online e.g. 360 degree photos, videos etc), if they intend to augment these experiences. For managers and learning leaders, providing dashboards with the ability to track user progress and performance against any immersive learning experience is vital.

[1] https://en.wikipedia.org/wiki/Interoperability

2. Introduction

Immersive Learning (IL) aims to provide an immersive, simulated and often technology-enabled environment in which learners can interact and engage with the learning experience and with each other (if it is a shared experience). This type of learning experience has the potential to transform how individuals learn and provide a more realistic and engaging experience. Engagement with learning can be challenging, particularly in a corporate learning context, and IL helps to provide a more engaging experience through the use of simulation of real-world contexts, providing an interactive experience where the learning is 'active' versus 'passive', and learners get to experience feedback in real-time. The ultimate pinnacle of immersive learning is an experience which is close to the real world and which relies more on cognition of the individual [7] (sometimes referred to as cognitive immersion, as described in Section 4) relative to technologies like VR, AR which allow the learner to become immersed in the experience.

ETU is an organisation that uses immersive, simulation-based learning to provide organisations with effective and engaging learning experiences. Their platform delivers personalised learning paths through these learning experiences to improve employee skills while providing organisations with important insights and data.

ETU engaged Learnovate to conduct research in the area of immersive learning, which began with an online Research Question Workshop. The aim of this workshop was to better understand ETU's research objectives and to collaboratively refine the focus of the research. Following this workshop it was agreed that, through their research, Learnovate's aim would be to assist ETU in providing learning leaders with a guide to assist them in choosing the type of immersive learning approach and technology most suited to their organisation's needs while also helping them to think about how they can apply those approaches innovatively.

Our prioritised list of research questions developed from the Research Question workshop are:

1. How do we define 'immersive learning' in a corporate learning context?
2. How does immersive learning work, both for the employee and for the organisation?
3. As a learning leader what guide can I use in selecting appropriate immersive learning approaches and technologies?
4. How does technology change (e.g. Metaverse) impact these choices?
5. What data can be captured by immersive learning technology and how can it deliver more business value?

We structured this report to begin with the underlying theories supporting immersive learning (addressing the first two research questions above) and then proceed to identify the types of technologies that support immersive learning in the workplace (addressing the final three research questions).

3. Defining Immersive Learning

RQ1. How do we define 'immersive learning' in a corporate learning context?

From a review of the literature and in the context of this piece of work with ETU, we define Immersive Learning as follows:

> ***"Immersive Learning is a user-centred, non-linear, holistic & measurable technology- enabled simulation and experience-based learning approach aiming to provide engaging & effective learning in a safe & authentic context [8,9]."***

This definition allowed Learnovate to conduct focused research that looks at IL in a corporate context while ensuring that the research is not wholly focused on IL technology, but rather the research and evidence-base that underpins an immersive learning experience.

There are many definitions of immersive learning both from academic research [5] and from industry articles, but this definition combines most of the elements of other definitions to provide us with a more cohesive and specific definition for this piece of work.

4. How does Immersive Learning work?

RQ2. How does immersive learning work, both for the employee and for the organisation?

Immersive Learning incorporates a number of elements which, when implemented correctly, can provide an extremely engaging, effective and authentic learning experience.

Immersive Learning incorporates **presence** and **embodiment**[2], which also, where possible, facilitates **agency** and **flow**. It is worth noting that immersion can be cognitive and/or technical. **Cognitive immersion** is where a learner is immersed into a virtual dialogue, and the sense of presence is used as evidence of being immersed, for example through storytelling. **Technical immersion** is where most of the learning activities are supported by technology such as VR, AR & through the use of avatars, in particular virtual worlds & games. The experience in this case relies on the technology to create a sense of immersion through realistic graphics and visualisations to enhance the immersive experience. Specifically, VR is defined as an advanced form of human-computer interface that allows the user to interact with and be immersed in a virtual environment that reflects reality [21].

Presence i.e. the feeling of 'being there' is one of the key elements of an immersive learning environment [1, 15]. Sense of presence is expressing not what exists in the physical environment but rather what one experiences and perceives (cognitive presence) [14, 24]. In this regard, once the learner feels a sense of being in the environment, it makes the experience feel more real and in a learning context provides for a more engaging experience.

"When learners' sense of presence improves, they study content and situations more meaningfully and experience 'flow' in learning by actively participating in the learning process" [17]. This in turn leads to a more motivating, interactive and thus engaging experience and can lead to improved learning outcomes. Being there with others is called

[2] Makransky, G. and Petersen, G.B., 2021. The cognitive affective model of immersive learning (CAMIL): A theoretical research-based model of learning in immersive virtual reality. Educational Psychology Review, 33(3), pp.937-958.

co-presence; a sense of presence, and co-presence in networked applications, is essential for immersive learning - without the embodied aspects of plausibility or place illusions the learner would not find themselves wholly engaged in a learning task but distracted, confused or disbelieving of a virtual experience [22].

The concept of **embodiment** has been central to the design of XR (extended reality, as shown in Figure 1) technologies and is key to the deployment of and research on immersive learning, especially through virtual reality [22]. The term embodiment can be used to describe the sensations that arise as part of 'being inside, having, and controlling a body' [16]. The notion of 'the body' and being present in a physical or virtual sense leads to a number of conceptual lenses which we can apply to immersive learning. Embodiment in the sense of an immersive experience refers to engaging with the environment and others in the virtual space while our physical bodies may be present elsewhere.

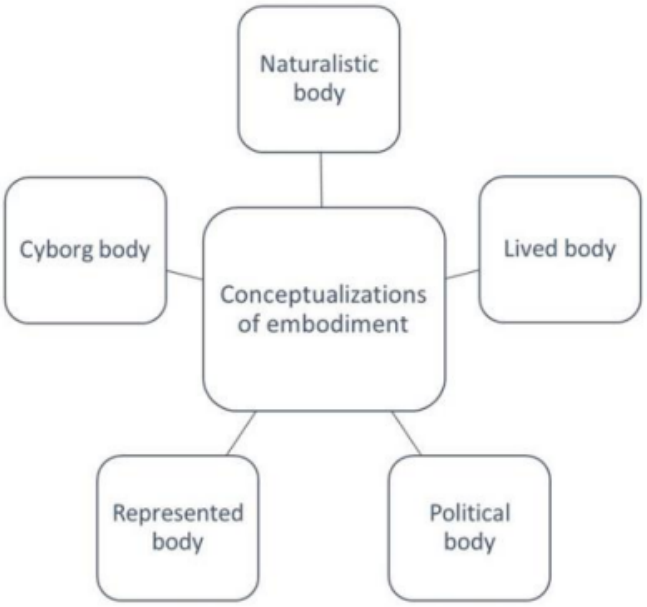

Figure 1 : Conceptual lenses through which to explore the topic of embodiment from Southgate [22]

In relation to presence and embodiment, the use of emotion for learning should be addressed. Emotion has a substantial influence on the cognitive processes in humans, including perception, attention, learning, memory, reasoning, and problem solving [23]. Therefore, facilitating emotional reactions in learners through the immersive experience can generate an even greater learning effectiveness with advanced outcomes.

According to Moore and Fletcher [19], a sense of **agency** can be described as 'a feeling of generating and controlling actions'. Allowing learners control over their actions in the virtual world, as well as control over parameters in the virtual environment, enhances the sense of immersion in the experience. Low agency would result from immersive virtual environments where interaction is not possible and where the user follows a fixed narrative [18].

Taking into account some of the above concepts, Makransky & Petersen recently developed a model (Figure 2) for immersive learning which synthesises existing immersive educational research to describe the process of learning in Immersive Virtual Reality (IVR).

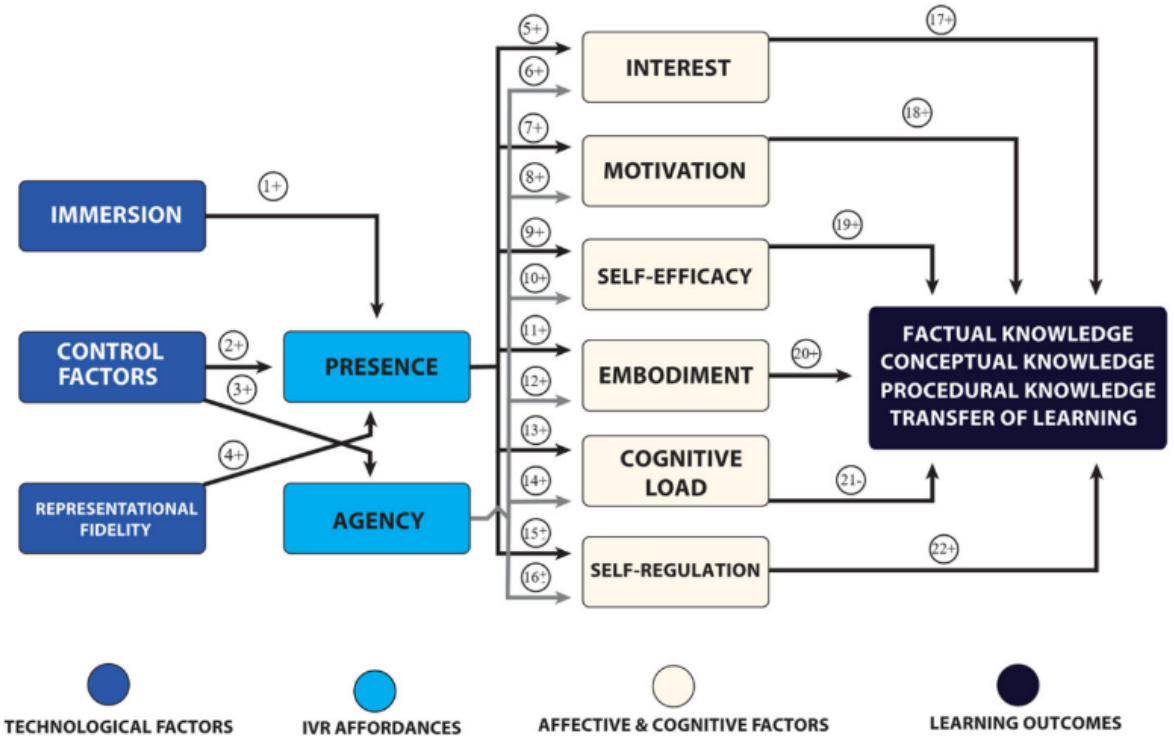

Figure 2 : Overview of the Cognitive Affective Model of Immersive Learning (CAMIL) from Makransky & Petersen [18]

While this theoretical model is relatively new, it may be **worth considering by organisations who develop immersive learning experiences** or by those implementing them, to help sense-check that the immersive experience has been built in solid learning and motivation theory.

Finally, Mihaly Robert Csíkszentmihályi, an Hungarian-American psychologist who recognized and named the psychological concept of **'flow'**, a highly focused mental state conducive to productivity. Csíkszentmihályi outlined his theory that people are happiest when they are in a state of flow—a state of concentration or complete absorption with the activity at hand and the situation. Csíkszentmihályi described flow as 'being completely involved in an activity for its own sake' [20]. Being fully immersed in a virtual environment can encourage this experience of 'flow'; if learners are fully immersed in the experience they can carry out tasks and learn without the need for external motivators.

Immersive Learning can be a win-win model that works for both employees and organisations. Organisations can train employees better, faster and more efficiently than many more conventional methods, while employees are provided with a more engaging, interactive and motivational learning experience. Investing in IL makes learning more accessible and drives positive outcomes for businesses and workers.

Existing implementations of IL reveal that employees feel engaged, excited and become de facto ambassadors of this type of training. IL programs can improve performance by **up to 70%** e.g. results from a study regarding a compliance course that used to take 25 minutes, can be completed within 3 minutes using VR [10]. It is on track to revolutionise corporate training in ways that will benefit both businesses and workers.

Moreover, as hardware is becoming more financially viable for organisations to implement and software is fully customizable to business needs, forward thinking employers have started to use Immersive Learning. They are motivated by cost-effectiveness, scalability, effectiveness and the possibilities of innovation in this space. Market trends indicate the latest price to buy a headset is as little as 10% of what it used to be a few years ago [10].

Consuming 360° videos with a VR headset can better help develop the professional knowledge and problem-solving skills of employees within an organisation [3] in comparison to traditional pedagogical approaches. With an increased focus on **soft skills or transversal skills** in organisations, IL approaches could be the most effective and engaging ways in which to develop soft skills and also assess them, an area that has proved difficult for organisations to date.

However, existing studies weakly support that this method can inspire **rapid** progress in independent learning and critical self reflection for employees [3]. Nonetheless, By incorporating proven learning principles into immersive interfaces for engagement and learning, many companies are realising the benefits such as better on-the-job-performance, higher employee confidence, long-term knowledge retention, and faster and more effective training.

"Immersive learning increases engagement multifold and piques the curiosity of learners. By offering measurable outcomes and instant gratification, it makes them want to improve themselves. As a corporate learning solution, it can be tailored to support organisational vision, practices, and culture."[3]

As with any approach to learning, it is important to consider the learner and whether they are open to and ready to engage with an immersive learning experience. By its very nature IL is very learner-focused, so having a developed understanding of your particular learners and their needs is key.

---

3 https://elearningindustry.com/immersive-learning-in-corporate-training-truths-and-misconceptions#:~:text=Immersive%20learning%20increases%20engagement%20multifold,vision%2C%20practices%2C%20and%20culture.

5. Best Practices for selecting Immersive Learning

RQ3. As a learning leader what guide can I use in selecting appropriate immersive learning approaches and technologies?

5.1 Learning Needs Analysis

Firstly, there is no one-size-fits-all answer to this question, as the best immersive learning approach for an organisation will depend on a variety of factors e.g. the organisation's size, budget availability and learning objectives.

Organisations often focus first on the technology and how it can be implemented rather than starting with the learning problem and looking at potential solutions to that problem.

Before focusing on the technology, it is recommended that organisations revisit their Learning Needs Analysis process and any learning implementation procedures that are currently in place to identify if these can be utilised to identify where an IL experience may fit.

- ☐ 1. What is the **learning problem** that needs to be solved?

  As with developing any learning solution, a **Learning Needs Analysis (LNA)** needs to be completed to identify the learning problem to be solved, the potential approaches that can be used, and the identification of an appropriate solution. This should contain any assessment requirements and whether a potential IL solution needs to incorporate the assessment capability or whether that can remain with the current system e.g. LMS and sit outside the IL experience.

- ☐ 2. What is the **capability** of the organisation?

  While your L&D department or learning development team may not necessarily have the skills necessary to implement an IL technology solution, is there the opportunity and the desire for upskilling or could assistance be enlisted from another department

such as IT? It may be worth considering whether your organisation enlists outside help from an organisation who has the expertise in developing immersive learning content, and in this regard the next question is key.

As mentioned previously, it is worth investigating if the learning benefits and outcomes outweigh the effort, both resource and financial, to develop the experience.

☐ 3. What is the **budget**?

Is there a budget to implement an innovative learning solution or do you as a learning leader need to make a case for obtaining an additional budget to implement an immersive learning approach?

While there are levels of IL approaches, which we discuss in more detail later in this section, it is worth identifying if a sophisticated IL approach is required for a learning challenge or whether an IL experience such as via good storytelling or 360° imagery (photos or videos) would adequately address the learning need.

Also, it is worth considering the upfront cost in investing in any hardware and the cost of maintaining any equipment.

☐ 4. What is the **size** & **type** of the organisation?

If your organisation is relatively small, the need for immersive learning technology may be low. Again, this relates to benefit versus effort and the type of organisation and learning context that is presented.

For example, if an organisation is focused on training in safety critical tasks such as construction, mining, or very machine-heavy or technical work, then IL can be an excellent fit. Allowing learners to learn in a safe environment is one of the key benefits of IL.

☐ 5. What technology is **available**?

In this instance it is important to do your research. It may be worth benchmarking

with other similar organisations to identify which immersive learning technology they have implemented and what has (and has not) worked.

It is also worth identifying why a similar organisation has implemented a particular IL approach or technology. Was it simply that this was available to fill a specific learning need or has this other organisation done research in this space?

☐ 6. Can the organisation conduct a **pilot**?

Conducting a pilot of a smaller number of learners and gathering feedback is one of the most useful ways to ensure that the solution is the right fit. Gathering feedback in a constructive way, while also identifying your learning metrics & KPIs up front, and identifying if they have been achieved, will help with making your use case and making a decision on the approach.

Many organisations have implemented IL approaches and technologies to fill one specific need and then identify the lessons learned as part of this implementation.

Once a pilot is complete, as with any learning approach, the focus is on iteration, improvement and possibly addressing a different learning challenge to see if IL is a good fit.

5.2 When does IL fit and how?

Taking into account the research underpinning IL and the previous section on identifying the learning need before implementing any approach or technology to address a learning challenge, the Table 1 outlines how an organisation may engage in decision-making in regard to IL.

As mentioned previously, this is not intended to be a panacea for implementation of IL for all organisations, as additional factors need to be taken into account such as context, nuance in the organisation, financial constraints, organisational capability and the specific needs of the organisation's learners. However, this table should serve as a starting point for organisations to begin to think about how and why IL might work for their learning needs.

This table includes the elements that make immersive learning work and matches this theory to the learning approaches and technologies associated with IL.

In order to begin to select a suitable IL approach and associated technology, the first step is to suitably assess the learning need to identify if there is a learning benefit to a fully immersive experience. For example, in the case of content such as health and safety training or tasks that are safety critical, a fully immersive experience allows learners to make decisions and address safety incidents in a safe way. Bringing a level of emotion into these experiences can also make the learning more 'sticky'.

Similarly, if the content is technically difficult to learn and requires the learner to practise a number of times and receive feedback, then implementing a simulation approach through scenario-based learning or game-based learning can be very effective. Renowned game-based learning and gamification expert James Paul Gee refers to this as the 'psychosocial moratorium principle' [25].

Storytelling is an effective learning approach that also engages learners. Ensuring that a learning experience tells a story that learners can relate to, and even develop an emotional connection to, provides them with a motivating experience and can be achieved without sophisticated technology or indeed, the need for any technology, while still helping to facilitate a level of immersion.

Table 1: Choosing an IL approach based on IL factors

	360° image & video	Scenario-based learning	Immersive Simulation	XR
Storytelling	●	●	●	●
Emotion	◐*	◐*	●	●
Presence	●	●	●	●
Embodiment	◐*	◐*	●	●
Flow	◐*	◐**	●**	●
Agency	◐*	◐**	●**	●
Self-efficacy	◐*	◐**	●**	●**
Scalability	●	●	●	◐***
Inclusivity	●	●	●	○

* Depends on the nature of the image/video/experience

**Depends on the nature of the experience. For example is a pre-designed path in place for the learner or can they branch into different scenarios?

***Further research needs to be completed into the practical scalability of XR

6. Changing Technology Landscape

RQ4. How does technology change (e.g. Metaverse) impact these choices?

The metaverse is a relatively new concept and is defined as an interconnected web of social, networked immersive environments in persistent multiuser platforms. It enables seamless embodied user communication in real-time and dynamic interactions with digital artefacts. It is based on the **convergence** of technologies that enable multisensory interactions with virtual environments, digital objects and people such as virtual reality (VR) and augmented reality (AR) [4].

Shortly, the current choice of harnessing the potential of immersive technologies like VR and AR will eventually help to use the latest trending technologies like Metaverse.

Listed below are the limitations of using a single immersive learning technology in relation to using a fully-fledged artificially intelligent Metaverse in the future:

- **Technology Limitations**

  Technology like VR is limited to providing simulated 3D environments, however, the Metaverse draws support from VR, AR, decentralisation and allows it to integrate other technologies.

- **Ownership**

  In the case of technology like VR, generally the technology provider owns the hardware and the content, whereas, with Metaverse, content creators have ownership of the experiences.

- **Persistence**

  VR type experience is stopped as soon the device is turned off, whereas, experiences created using the Metaverse stays on cloud even when the user is not exploring the experience.

- **Difference in Goal**

  The Metaverse's ultimate goal is to be a digital space where all internet activity can take place as a mirror of the physical world, in comparison with a bespoke VR based solution for training in a specific context.

To reiterate, the latest trends like the Metaverse, are not limited to possibilities and adoption of any of the immersive experiences now will pay dividends in the long run.

It remains to be seen how and why the Metaverse will be used to address learning in particular and if organisations will look to the Metaverse to solve some of their learning challenges.

While the technology continues to evolve, it is worth conducting research into how these particular emerging technologies can benefit the learning experience and whether organisations are really ready to embrace these innovative approaches to learning or will continue to rely on the more traditional learning approaches.

7. Data Analytics

RQ5. What data can be captured by immersive learning technology and how can it deliver more business value?

There is no limit to the type of data that can be collected using immersive learning experiences. However, an example of Key Performance Indicators (KPIs) mentioned in a research study that can be used to evaluate these experiences (e.g. for process industry like chemicals) include time, number of mistakes, hints and instruction repetitions, events and equipment identification [2]. **Time and number of mistakes** are the most frequently reported amongst all of them as shown in Figure 3.

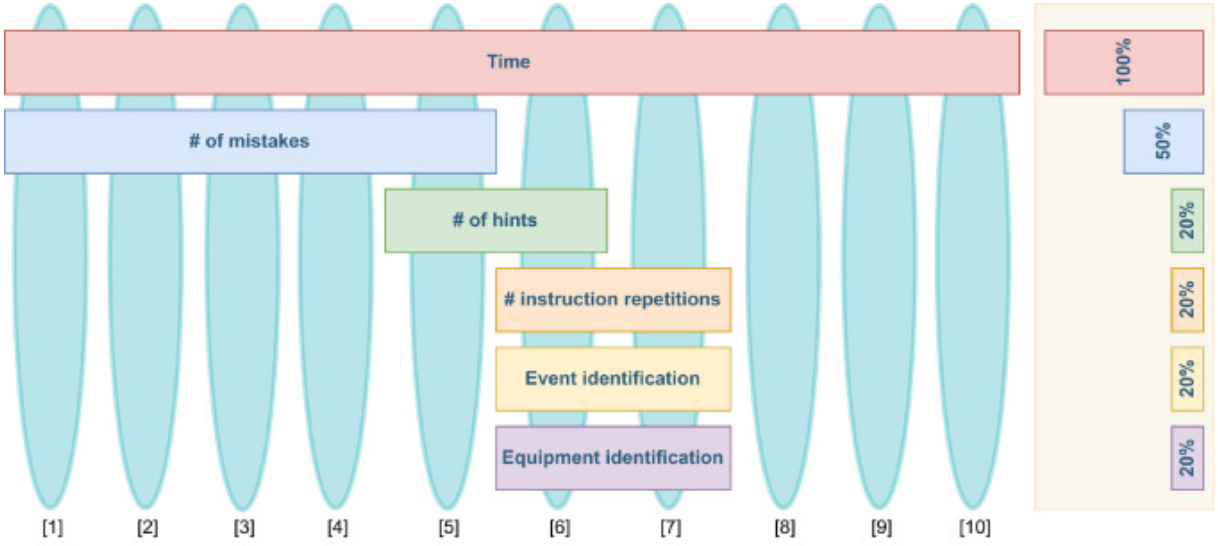

Figure 3: KPIs reported in different research studies for evaluation of immersive experiences [2]

As indicated previously, Immersive Learning for employees leads to a great deal of Immersive Data for Decision Makers [6]. Story-driven, immersive learning approaches offer so many more chances for gathering meaningful data than a simple checkbox type of question in a typical learning and assessment exercise. It makes it easier for managers to guide employees on their career paths when they get to know the real time data of 'decisions' and 'feedback' along with engagement, frequency, risk tolerance and skill measurement of employees whilst using immersive learning approaches. The types of data which managers should strive for :

1. **Decisions Data -** The decisions data help managers to identify correct or incorrect decisions made by learners and the need for improvements in specific sections of a training course.
2. **Engagement -** Examples of data regarding engagement include time spent on each element, how the employee interacts with numerous objects, order they click the interactive elements, whether they complete the question/task, how quickly they move through the course/training. This type of data will help to categorise the truly engaged and the learners only going through motions.
3. **Frequency -** It is really helpful for managers to know which experiences are used more than once, to make decisions on where to invest more in the future.
4. **Risk Tolerance -** It's also useful to understand the risk-based choices which employees make in a simulated environment and how they will perform in the real world. This will alleviate the chances of accidents in the real world environment.
5. **Skill Measurement -** When learners are immersed in immersive learning experiences like simulation based training, it is vital to capture data to measure their skills level to get a sense of how they will perform in realistic situations. Existing case studies conducted by ETU and Royal College of Surgeons Ireland reveal up to 7% increase in soft skills of learners like communication, when trained via simulation based environment [26].

With such data, managers can provide tailored feedback on interactions, provide employees a safe space to fail, improve knowledge retention up to 75% and last but not the least, personalise the learning experiences.

For technical perspective[4], the specific data points that can be captured with immersive learning experience are:

1. **Usage Data**

   This includes who is using the data, frequency of usage and time taken to complete a specific task. It can help the training manager to ensure high participation and the training is engaging for the learners. It is also helpful to keep learners aligned with the pre-set objectives and outcomes of learning. The amount of data is directly proportional to better learning of how the training is used, how to facilitate it and meet learners needs.

2. **Progress and Completion Data**

   Progress and completion of specific courses/modules data is beneficial for both learners and managers to track how far they are from completion.

3. **Replays Data**

   Replays data help to understand how frequently the learners are restarting or repeating the same lessons. It can reveal where the learners are facing difficulty or need to repeat for improvement in knowledge retention.

4. **Timing**

   This indicates how much time was taken by the learner to make a decision for taking action and also for completion of a specific module within a training. Again, this can reveal the areas of difficulty and ease for users.

5. **Body Movements (e.g. for VR)**

   These reveal non-verbal signals indicating the feelings of learners in a specific situation and helpful for predicting learners behaviour in realistic situations.

[4] Although technical data may seem to be of less relevance for the L&D team, getting it aggregated by the tech team and presenting it via dashboards can reveal useful insights about learner behaviour.

6. **Retinal Eye Tracking**

   It helps to reveal who, where and what learners are looking at. It shows unconscious bias or how the learner is processing their surroundings.

8. References

[1] Dengel, A. and Mägdefrau, J., 2019, June. Presence is the key to understanding immersive learning. In International Conference on Immersive Learning (pp. 185-198). Springer, Cham.

[2] Fracaro, S.G., Glassey, J., Bernaerts, K. and Wilk, M., 2022. Immersive technologies for the training of operators in the process industry: A Systematic Literature Review. Computers & Chemical Engineering, p.107691.

[3] Lau, K.W., Lee, P.Y. and He, M.Y., 2018. 360 degree immersive videos: a way to improve organizational learning practices. Development and Learning in Organizations: An International Journal.

[4] Mystakidis, S., 2022. Metaverse. Encyclopedia 2, 486–497.

[5] Dengel, A. and Mägdefrau, J., 2018, December. Immersive learning explored: Subjective and objective factors influencing learning outcomes in immersive educational virtual environments. In 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE) (pp. 608-615). IEEE.

[6] https://tinyurl.com/mrybhf4d

[7] Murray, Garold (2009). "Narrative inquiry. In Qualitative research in applied linguistics". Palgrave Macmillan, London: 45–65.

[8] https://www.futurevisual.com/blog/immersive-learning/

[9] https://www.youtube.com/watch?v=NhlRfphvMwg

[10] https://tinyurl.com/54fdfdcy

[11] Skarbez, R., Smith, M. and Whitton, M.C., 2021. Revisiting milgram and kishino's reality-virtuality continuum. Frontiers in Virtual Reality, 2, p.27.

[12] https://www.youtube.com/watch?v=KLOcj5qvOio

[13] https://www.youtube.com/watch?v=Iz3Awb_wBU4

[14] Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American journal of distance education*, *19*(3), 133-148.

[15] Ijsselsteijn, W., & Riva, G. (2003). Being there: The experience of presence in mediated environments.

[16] Kilteni, K., Groten, R., & Slater, M. (2012). The sense of embodiment in virtual reality. *Presence: Teleoperators and Virtual Environments*, 21(4), 373-387.

[17] Kim, J. S., & Kang, M. H. (2010). Structural Relationship among Teaching Presence, Learning Presence, and Effectiveness of e-Learning in the corporate setting. *Asian journal of education*, *11*(2), 29-56.

[18] Makransky, G., & Petersen, G. B. (2021). The cognitive affective model of immersive learning (CAMIL): a theoretical research-based model of learning in immersive virtual reality. *Educational Psychology Review*, 33(3), 937-958.

[19] Moore, J. W., & Fletcher, P. C. (2012). Sense of agency in health and disease: a review of cue integration approaches. *Consciousness and cognition*, 21(1), 59-68.

[20] Nakamura, J., & Csikszentmihalyi, M. (2014). The concept of flow. In F*low and the foundations of positive psychology* (pp. 239-263). Springer, Dordrecht.

[21] Schultheis, M. T., & Rizzo, A. A. (2001). New directions for rehabilitation: virtual reality technology. *Rehabilitation Psychology*, *23*(3), 296-311.

[22] Southgate, E. (2020, June). Conceptualising embodiment through virtual reality for education. In *2020 6th International Conference of the Immersive Learning Research Network (iLRN)* (pp. 38-45). IEEE.

[23] Tyng, C. M., Amin, H. U., Saad, M. N., & Malik, A. S. (2017). The influences of emotion on learning and memory. *Frontiers in psychology*, 8, 1454.

[24] Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence*, *7*(3), 225-240.

[25] Gee, J. P. (2005). Learning by design: Good video games as learning machines. *E-learning and Digital Media*, *2*(1), 5-16.

[26] https://www.etu.co/resources/simulation-training-changes-real-world-behavior