IMMERSIVE LEARNING AND THE USE OF A CONVERSATIONAL AI APPLICATION

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Abstract

This paper investigate the usefulness of immersive learning and a conversational AI application for on-the-job training of local IT-support personnel in a Swedish municipality. The objective was to use diagnostics from participants and incorporate recorded variants approved by disciplinary experts to prevent a bottleneck effect in the competency supply chain. The design considerations to create new platforms for skills development were to solve complex issues with high-value data, to create knowledge from a realistic integrated experience and to regularly improve the answers in the knowledge repository. During the dialogue scenario local IT-support personnel was trained to discern abnormalities in workflows and processes when using our middleware platform. The data collection was used for big data analytics to extract meaningful insights, hidden patterns and unknown correlations from disciplinary experts. The conversational AI application was used to implement a competency development model for active participatory learning and the disciplinary experts got to approve recorded variants from participants to improve the answers in the knowledge repository. The conclusion was that immersive learning and the use of a conversational AI application can be used to transfer the tacit knowledge embodied in assumptions, values, judgments, and consequences from experts to novice learners. The potential of immersive learning with embodied conversational avatars was recognised, but not achieved during this study since the AI-powered dialog authoring tool had limited training data and the interaction was not seamless.

Keywords:

Immersive Learning, Conversational AI Application, On-the-job Training, Platforms for Skills Development.

Introduction

Methodological advances (i.e., microlearning, social-emotional learning, gamification, experiential learning) for competency development and the adoption of Artificial Intelligence (AI) has open new opportunities for transferring disciplinary and subject specific procedural knowledge. One competency development model for on-the-job training is conversational learning. The implementation is often done as roleplay, where the learner is trained in an imaginary situation with no drastic consequences from mistakes or failure. The conversational AI application that was used for this dialogue scenario, was developed by a Swedish start-up called Fictive Reality[1]. Their approach to immersive learning is that failing is the best way to learn and knowledge retention is improved when being immersed in a virtual room while talking to an avatar.

Fictive reality is a AI-powered immersive learning experience platform (LxP) that is content independent and delivered using software as a service (SaaS). One main design features of the application is to let the content creator extract high-value data and use cases into a knowledge repository, which enable big data processing to create an AI-generated transcript for the training session. The functioning of the system is to analyse the answer and to try recognise the participants intent with fuzzy matching (Tian et. al. 2020). This will allow the AI to understand several variations from only ten examples, which sometimes is referred to as an AI-powered dialog authoring tool. The data can come from many different sources, but this study used recoded variants from disciplinary experts or manually accepted answers from participants. Another feature of the Fictive Reality app was the possibility to deliver diagnostics that produce a rating of attitude, use of fillers, and hesitation. The application use immersive learning with embodied conversational avatars (ECA) to create a realistic integrated experience for the participants. According to Edgar Dale's (1946) *Pyramid of Learning*, only 50% of possible learning retention is achieved through passive learning and declines without the use of active learning. Finally the Nonaka and Takeuchi's (1995) *Knowledge Spiral Model* address the notion of explicit and tacit knowledge. Their research claim that explicit knowledge is often found in shared training material or knowledge repositories, while tacit knowledge is highly personal and is only learnt through experience. Since the turnover rate of competence and skills has increased in our society, there was a need for the design to regularly improve the answers in the knowledge repository stored in the application.

[1] Read more about the AI-powered authoring tool from Fictive Reality https://www.fictivereality.com/

Previous research related to this virtual reality learning platform has involved student projects focusing on roleplay-based training using customisable content and intelligent dialogues for developing soft skills (i.e. problem-solving, decision-making and stress management). Their development area was to improve the dialogue and realism of the conversational AI (Arnaud, 2021). Another development area is to improve the analysis of user's behaviour to give the participant feedback on how to improve things such as posture, speech, wording, eye-contact and stress-levels. This was developed into a virtual coaching feedback function and can be shared with the trainer for assessment purposes. Automated AI-technology has also been used to recreate job simulations to scan and filter large quantities of job candidates without taking up time for the recruiter, which also remove potential bias during the interview (Fictive Reality, 2021). According to a pilot study called "The effectiveness of virtual reality soft skills training in the enterprise" (Eckert & Mower, 2020) there is potential to make users more efficient to act on what they've learned after training and be able to learn faster than traditional classroom training. It is also suggested that the users are more focused than during traditional e-learning exercises and become more emotionally connected to the content, which improves knowledge retention.

Rationale of this study

The training simulation aimed to develop a dialogue scenario for local IT-support personnel at schools in a Swedish municipality. If successful, the conversational AI application can become a knowledge repository where the expert knowledge set could be transferred to local IT-support personnel. This would help them to solve complex issues for end-users on executive-level (i.e., school leaders and administrators). The main objective was to use diagnostics from participants and incorporate recorded variants approved by disciplinary experts to prevent a bottleneck effect in the competency supply chain for local IT-support personnel in the participating municipality. The solution was to evaluate if a conversational AI application can be used to transfer tacit knowledge embodied in assumptions, values, judgments, and consequences from experts to novice learners. This require that the system can use big data analytics to extract meaningful insights, hidden patterns and unknown correlations from disciplinary experts. The study also involved an evaluation of the usefulness of the Fictive Reality application as a competency development model for active participatory learning and immersive learning. Finally on-the-job training will only be attractive for the organisation if the quality of the knowledge repository is maintained over time. The research question investigated in this qualitative study was:

RQ: Can immersive learning and a conversational AI application be useful for on-the-job training of local IT-support personnel in a Swedish municipality?

The three design considerations that was tested during this study based on requirements for the competency development model was to deliver diagnostics and incorporate recorded variants that allow workers to solve complex issues with high-value data [C1], to create knowledge from a realistic integrated experience [C2] and to regularly improve the answers in the knowledge repository [C3].

Method

Design-based research (DBR) has been described by Feng Wang and Michael J. Hannafin (2005) as *"a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories"* (p.6-7). This specific dialogue scenario was a scripted training using the "Answer" mode of conversation in Fictive Reality. The local IT-support personnel [n=340] participated in a preparation course and a few of them [n=3] was then tested on questions about IT-architecture and problem solving in the developed training simulation. The dialogue scenario created for conversational learning was used with the intention to improve performance and facilitate learning. This required that the learners had the opportunity to learn a specific knowledge set from a training material given before working with the conversational AI application. To evaluate the prototype of this solution, the concept *knowing* was understood as applying knowledge or learning how to do something and *competence* was understood as the capability to perform in a given task environment. This can also be described as extending the repertoire (i.e. knowing) as compared with improving performance (i.e. competence).

After the preliminary design phase, where disciplinary experts [n=2] recorded ten variants of correct answers, the prototyping phase was conducted as two micro-cycles. The first cycle involved recording the participants [n=3] answers and the second cycle involved adding correct recorded variants to the knowledge repository by the disciplinary experts. Finally, the reflective phase collected comments on *the usefulness of the system* from the

semi-structures interviews with the participants and the experts after they filled out an online survey. The survey "Evaluation of Training Application" was designed based on a SWOT-analysis of the participants experience with this instruction:

> *"In Fictive Reality you find the scripted training for Certifiering av Lokalt IT-stöd (in Swedish). Please press View to see, hear and read the scenario (step 1). Then select Speak to act out the scenario (step 2). During the revision please fill out the following questions (step 3). 1) Please comment on the usefulness of the system, 2) What strength do you see with the system? 3) What weakness do you see with the system? 4) What opportunities do you see with the system? 5) What threats do you see with the system? 6) Please Let me know if you have any comments below!"*

Preliminary Design Phase

The preliminary design phase included the development of the knowledge set, the dialogue scenario and the training scenario. Tacit expert domain knowledge can, according to the Dutch philosopher Herman Dooyeweerd, be elicited based on describing approximately fifteen modal aspects of reality (Basden, 2020). Most knowledge repositories contain quantitative, analytical, formative, and lingual aspects of a situation, but the focus of this dialogue scenario was tacit knowledge embodied in assumptions, values, judgments, and consequences of using that knowledge (Basden 2002). This personal knowledge can be shared as an organisational resource when solution are generated and a common understanding is formulated (Crossan et al., 1995). The *knowledge set* can then be codified into "how-to" and "best practice" instructions and the topic for this training simulation was to discern abnormalities in workflows and processes related to the middleware platform. As mentioned before the participant should in the end be able to solve complex issues for end-users on executive-level with the help of our middleware platform. Using big data analytics (BDA), these competences can be implemented to compensating for performance deviation and the local IT-support personnel extend their skills to make new decisions which will lead to new performance (Liu, 2020). The feedback from this process can then then be used to build new shared knowledge and generate additional training data into a knowledge repository (figure 1).

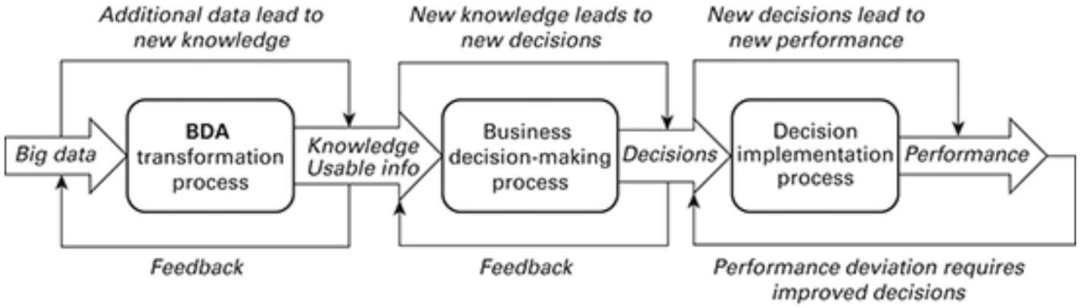

Figure 1. BDA and knowledge support for business decisions (Liu 2020).

The preparation course covered ten different topics related to the core competences for our local IT-support personnel. The computerized examination test did randomly pick real-world tasks from a question bank, which upon passing grade allowed participants to qualify for the next part of the certification. To get ready for the in-person examination with one of the IT-controllers, the participant got to use the dialogue scenario in Fictive Reality for conversational learning. This *dialogue scenario* also included practice scenarios on different topics that prepared them for the final part of the certification (figure 2).

Figure 2. The process for working with the training material.

The specific situation in the developed conversational *training simulation* with Fictive Reality was related to the topic IT-architecture from the preparation course. It described the functionality of our middleware platform from the perspective of issues addressed by personnel working as local IT-support. The introduction phase of the scenario

explains to the learner that he or she was going to get questions about IT-architecture, digital devices and technical troubleshooting.

Prototyping phase

The Fictive Reality application uses a conversational AI to control the embodied conversational avatar during play sessions and the *Content Creator* need to supply at least ten variants or more of the same topic to make the AI create the training simulation. The application can be used on a PC or Mac, but for maximum immersion it is recommended to use a head-mounted display (HMD). It is also complemented by a web app to allow browsing, dialogue creation and administration.
The implementation of the dialogue-based training was initially developed from key aspects in the knowledge set by manually adding text answers in the column *"The player should say…".* More realistic variants was then generated from recorded play sessions with disciplinary experts. The experts then had to pick suitable response and behaviour from recorded variants from participants to extend the training data. The application can only add approved answers by the content creator as correct. During the training process the incorrect or partly correct answers must be discarded. The final step was when the application provides diagnostics and rating as virtual coaching feedback to the player (figure 3).

Figure 3. The process of training the AI-powered authoring system.

When the dialogue was recorded the application allow participants to listen back for memory consolidation. The approved recordings can then be used as a knowledge repository with high-value data for solving complex issues in the organisation. Since this training simulation was in Swedish, when the phonetic variants from different participants was included the quality of the speech-to-text interpretation improved and became more accurate. Every time the dialogue scenario was changed the avatar needs to be retrained.

Reflection phase

The Fictive Reality application need feedback to develop an understanding of what is classified as a suitable response and could also be used to decide how the avatar should behave. This practice scenario was scripted training following a fixed order, but diagnostics form the virtual coaching feedback was activated. The diagnostics of participants answers need feedback from disciplinary experts to adjust levels and expectations when delivering rating. The application allows experts to disagree with the AI rating and can then store feedback that can be used in the future to further improve the functionality. The collected data from the reflection phase was from three participants in the survey and from two disciplinary experts. The usefulness of the system was at this early stage not seen as realistic to real-world situations. Also, the local IT-support personnel normally collect a lot of contextual information (cf. rich data) to fully understand the performance deviation of the middleware system. The strength with the Fictive Reality application, was the possibility to deliver diagnostics based on performance instead of only evaluating quality of the content. During a demonstration for the participants it was shown how recorded variants were added to the dialogue scenario and this was experienced as something that increased usefulness of the application. The weaknesses mentioned related to the lack of functionality (i.e., speech-to-text) when using Swedish language for the dialogue, but also the diagnostics from the virtual coach were experienced as inconsistent. The disciplinary experts could tell that only partly correct answers given by the player was approved by the system and they would have liked the possibility of branching answers into three groups of variants (i.e., correct, partly correct, and fail) to make the virtual coaching more adaptive. Another highly appreciated function with the Fictive Reality application was using the gamified learning as an immersive experience in a VR-environment. The retention of the key aspects from the knowledge set was experienced as very high compared to the multiple-choice questions in the preparation course. The application also inspired disciplinary experts to re-conceptualize their understanding of on-the-job training and gave them motivation to deploy automation processes during the on-boarding process to save time. Finally, the threats expressed by the participants were focused on increased time for administration of the recorded variants and quality control during the retraining of the system.

Conclusions

In this study of a conversational AI application to implement immersive learning, the Fictive Reality application was used as a competency development model for active participatory learning during on-the-job training. The results indicate that *knowing* how to use the middleware platform to solve complex issues for end-users on executive-level was hard to capture in a scripted training with fixed dialogue. If the key aspects had been related to customer service or diagnostic questions with a large data set of solutions to several known issues, maybe the training session could have been more adaptive and easier to develop. Still the *competence* from training in a simulation of a real-world situation was seen as valuable.

The first design consideration [C1] was that the Fictive Reality app allow local IT-support personnel to solve complex issues with high-value data. Some responses indicated that the conversational AI application probably would be more useful after more training of the system with recorded variants, but one participant preferred more traditional machine learning models (c.f. KB DSS) to extract actionable insights from large and complex datasets. The second consideration [C2] was that the Fictive Reality app allow local IT-support personnel to create knowledge from a realistic integrated experience. From the analysis of the survey answers, there was not much support for the argument that the training sessions using immersive learning actually did improve the skills in realistic situations where the knowledge set was required. The greatest weakness mentioned in the interviews, was that the content creation and updating the topics took valuable time from traditional training where IT-controllers interacted physically with end-users. One preferred competency development model that they were missing, was to allocate synchronous time with the experts to share ideas or exchange experience as well as to discuss possible solutions with peers. The third design consideration [C3] was that the Fictive Reality application allow disciplinary experts to improve the answers in the knowledge repository in the next iteration. The Fictive Reality application that was studied was more focused on facilitating learning and improving performance (i.e. skills development) rather than extending the repertoire (i.e. knowing). The participants believed that the training simulation can be used for reducing the overall cost of skills development with some more training of the system. The dialogue scenario would probably also benefit from an integration with an electronic performance support systems (Dalkir 2011). It was believed that the data collection through diagnostics could in the future be used for big data analytics to extract meaningful insights, hidden patterns and unknown correlations from disciplinary experts. Finally the participants experienced that the use of a conversational AI application was useful to transfer the tacit knowledge embodied in assumptions, values, judgments, and consequences from experts to novice learners.

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