The Impact of Computer-Mediated Delayed Feedback on Developing Oral Presentation Skills: an Experimental Study in Virtual Reality

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Abstract Previous studies emphasize that feedback is essential for acquiring presentation skills. However, it remains unknown whether computer-mediated delayed feedback, provided in Virtual Reality (VR) without the intervention of the teacher, impacts students' public speaking skills. Recent technological developments allowed to convert quantitative information from VR-systems into qualitative feedback messages that directly relate to the standards for high-quality feedback. This experimental field study, therefore, focuses on the impact of automated, qualitative feedback messages in a VR-system on students' presentation skills development (n = 60). The effects are compared with a validated condition in which the delayed VR-feedback is delivered by an expert. Mixed methods, including validated rubrics and self-evaluation tests, are used for data collection. This study aims to refine educational design principles concerning effective feedback in presentation curricula. Furthermore, the results should provide insights about supporting feedback processes while releasing the pressure on resources such as time and staffing.

Keywords: feedback, oral presentation skills, virtual reality, experimental study design, higher education

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1 Introduction

Presenting is considered as a crucial competence for higher-educated professionals (Van Ginkel, Gulikers, Biemans, & Mulder, 2015). It is a prerequisite for effective communication and successful performance within professional practice (De Grez, Valcke & Roozen, 2019). However, young professionals often fail to show effective presentation behaviors in these environments (Van Ginkel *et al.,* 2019).

Research on public speaking defines oral presentation competence as "a combination of knowledge, skills and attitudes needed to speak in public in order to inform, self-express, relate and to persuade" (De Grez, 2009, p.5). Developments in this competence are related to seven educational design principles (Van Ginkel *et al.,* 2015), including three principles focused on formative assessment strategies (i.e. expert feedback, peer feedback and self-assessment) (Van Ginkel, Gulikers, Biemans & Mulder, 2017a). While feedback is crucial for students' learning (Hatti & Timperley, 2007), research has shown that innovative technologies as VR are valuable for delivering feedback within oral presentation learning tasks. Specifically, VR offers the opportunity to practice oral presentations within a virtual learning environment that imitates a presentation environment (Merchant Goetz, Cifuentes, KeeneyKennicutt & Davis, 2014). Additionally, VR provides automated feedback on, for example, non-verbal communication aspects (e.g. eye contact and use of voice) both during (i.e. computer-mediated immediate feedback) as well as after (i.e. computer-mediated delayed feedback) presentation practice (Belboukhaddaoui & Van Ginkel, 2019; Van Ginkel *et al.,* 2019; Van Ginkel, Ruiz, Mononen, Karaman, De Keijzer & Sitthiworachart, 2020).

Studies have shown that a VR-based oral presentation task with computer-mediated delayed feedback is as effective for students' development of presentation competencies as traditional face-to-face approaches (Van Ginkel *et al.,* 2019). Nevertheless, the delayed feedback of the VR-system was reflected in quantitative data feedback reports and, consequently, interpreted by an expert. However, nowadays, technological developments allow the conversion of quantitative information into qualitative feedback messages that directly relate to the standards for high-quality feedback (Van Ginkel, Gulikers, Biemans & Mulder, 2017b). Therefore, this study aims to investigate the impact of computer-mediated delayed feedback with qualitative feedback messages – interpreted without the intervention

of an expert - on students' presentation skills. It is hypothesized that the effect of computer-mediated delayed feedback with qualitative feedback messages on students' presentation skills is equal to feedback delivered by an expert. Results of this study provide insights about optimizing feedback processes supported by AI-technologies while releasing the pressure on resources such as time and staffing, as mentioned by the UN (Adubra, Da Silva, Dhungana, Mohan, Saltsman, & Van Ginkel, 2019). Moreover, findings of this research could further refine existing educational design principles concerning effective feedback within oral presentation learning trajectories.

2 Theoretical Framework

Over the past decades, VR received much attention within the educational context. From a scientific perspective, several studies demonstrated the impact of this technology on students' learning (Merchant *et al.,* 2014). Moreover, from a logistical perspective, the implementation of VR has potentials in supporting teachers with instructions and providing feedback. Therefore, it has been suggested that VR might be beneficial in overcoming educational issues as teacher shortages and the increasing number of students in higher education worldwide (Adubra *et al.,* 2019; Parmigiani, Van Ginkel, Saltsman, & Dhunga, 2020).

Previous research has shown the effectiveness of VR-based presentation tasks including automated feedback on students' development of oral presentation competencies (Belboukhaddaoui & Van Ginkel, 2019; Boetje & Van Ginkel, 2020; Van Ginkel *et al.,* 2019; Van Ginkel *et al.,* 2020). Additionally, students highly appreciated the automated feedback and perceived the VR environment as motivating (Van Ginkel *et al.,* 2019). The present aimed experimental study contributes to the scientific literature in this field for several reasons. In summary, it can be stated that:

1. While previous experimental field studies focused on VR-based tasks for developing presentation skills and guaranteed ecological validity, several scientific discussions point to intervening factors in presentation modules (such as instructions or feedback from other sources) that negatively impact the internal validity (Van Ginkel *et al.,* 2019). Therefore, an experimental

study that focuses on the effect of computer-mediated delayed feedback with qualitative feedback messages, conducted in a controlled lab-setting, is needed to critically evaluate the value of this type of feedback.

2. While previous studies on VR and presentation skills focused on comparing the computer-mediated feedback condition with a situation in which students receive expert feedback (Van Ginkel *et al.,* 2019), VR-research focusing on the impact of computer-mediated delayed feedback on presentation skills - without the support of the expert - is lacking hitherto. Therefore, this experimental study tests the impact of computer-mediated delayed feedback on presentation skills solely provided by the VR-system.
3. Although previous studies focused on the impact of VR-technologies for developing presentation competencies, knowledge, skills and attitudes towards presenting were taken into account (Van Ginkel *et al.,* 2019). However, as addressed earlier in other VR-studies (Boetje & Van Ginkel, 2020), other factors might impact the learning outcomes as well. Therefore, in this study, students' perceptions towards the adopted VR-technology and feedback modalities are included, since these factors could serve as crucial intermediate variables according to the current literature (Merchant *et al.,* 2014).
4. Although previous studies on VR and presentation skills mainly discussed the impact of the learning environment on learning outcomes, student characteristics are scarcely integrated in these studies. However, as reported in VR-studies (e.g. Merchant *et al.,* 2014; Van Ginkel *et al.,* 2019), students' perceptions of VR differ depending on their preferred learning activities. In order to test the generalizability of the impact of VR on varying cohorts of students with regard to their presentation skills development, it is suggested to incorporate the following student characteristics in this experimental study: (1) students' traits (such as gender, age, and educational level) and (2) experienced versus non-experienced students regarding presenting in VR.

3 Method

In the last semester of the school year 2020-2021, students (n=60) of a Dutch University of Applied Sciences will be recruited for the experiment. Participants will be informed about the intention of the study and have to confirm their informed consent. Additionally, the Netherlands Code of Conduct for Scientific Practice is adopted to ensure research integrity (Van Ginkel *et al.* 2019).

The participants in this study will be randomly assigned to either the experimental condition or the control condition. The experimental condition (n=30) consists of a VR-based oral presentation learning task including computer-mediated delayed feedback with qualitative feedback messages. In this condition, students used a VR-headset to practice a five-minute presentation on a self-selected topic to a virtual audience consisting of virtual students in a virtual classroom. After the presentation practice, students will receive automated feedback with qualitative feedback messages - delivered by the VR-system - on non-verbal communication aspects including eye contact and use of voice (i.e. pace, volume and frequency). This feedback will be interpreted by the students without the intervention of an expert.

The control condition (n=30) involves a similar VR-based learning task that consists of oral presentation practice within a similar VR classroom environment and computer-mediated delayed feedback. However, feedback on the VR-registered non-verbal communication aspects will be delivered by an expert.

The present study involves an experimental post-test design. Firstly, participants in both conditions will receive a brief introduction about the experiment, the presentation task and how to use the VR set-up. Secondly, participants will practice their presentation within one of the two conditions in the VR environment. Finally, as a final session, students in both conditions present their presentation in front of a small audience – comparable to the audience within the VR classroom environment - within a face-to-face setting. During this final presentation, students' presentation performance will be assessed by adopting a validated rubric (Van Ginkel, Laurentzen, Mulder, Mononen, Kyttä, & Kortelainen, 2017). Additionally, students have to complete additional questionnaires to assess students' sensitivity towards the feedback source and perceptions towards the (1) development of presentation skills, (2) VR environment and use of VR and (3) the value of computer-mediated feedback.

For data analysis, MANCOVA will be carried out to determine potential differences in impact, between the experimental condition and the control condition, on students' presentation skills and perceptions towards the VR-technology, value of feedback and sensitivity towards the feedback source. Further, students' traits are adopted as co-variates in this experiment.

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