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# Design of Embodied Learning in 3D Virtual Worlds for Pre-service Teachers

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**Abstract:** This study intended to design embodied learning in 3D virtual worlds (ELVW) for the development of real-world problem solving competencies. The strengths and weaknesses of the ELVW model were explored in pre-service teacher education in South Korea. Through ELVW, elementary school pre-service teachers (n = 35) significantly improved their self-efficacy in preventing and addressing school-bullying behaviors. From interviews, this study identified strengths of ELVW in pertaining to embodied experience, collaborative learning, and instructional supports. To improve the ELVW practice, more efforts are needed to overcome technical and time constraints and to investigate the role of embodied experience in the 3D virtual world.

**Keywords:** Virtual world, embodied cognition, collaborative learning, teacher education

## 1. Introduction

Literature of embodied cognition has revealed that the body, which dynamically interacts with the physical world, plays a crucial role for knowledge construction and reasoning (Black, Segal, Vitale, & Fadjo, 2012). Embodied learning can occur not only through direct interaction with the physical world but also through an avatar, which represents a learner, in 3D virtual worlds (i.e., augmented embodiment; Black et al., 2012). The embodied experience and interaction, which are crucial for physical and social presence, have been considered as key affordances of virtual worlds (Dalgarno & Lee, 2010). The current study aims to develop the model of embodied learning in 3D virtual worlds (ELVW) for improving real-world problem solving competencies of pre-service teachers. Particularly, this study is interested in the development of classroom management competencies in pertaining to school bullying, which is a serious problem in South Korea. The research questions of this study are as follows:

- What are the strengths of ELVW for improving real-world problem solving competencies of elementary school pre-service teachers?
- What are the limitations of ELVW in the context of Korean pre-service teacher education?

## 2. Embodied Learning in 3D Virtual Worlds

The ELVW model is designed to improve real-world problem solving competencies in complex and ill-structured domains. Particularly, this model can be beneficial for learners who do not have enough opportunities for learning by doing in the physical world. Through ELVW, learners can use their perceptual and embodied experience in 3D virtual worlds for developing an in-depth understanding of a complex problem situation and collaborative problem solving skills. Although a small number of studies presented instructional models based on embodied cognition (e.g., Han & Black, 2011), little attention is paid to embodied learning in complex and ill-structured domains. Based on literature of embodied cognition, problem-based learning, and collaborative learning, this study created the ELVW

model that fosters real-world problem solving competencies through learning by doing in the virtual world (see Figure 1).

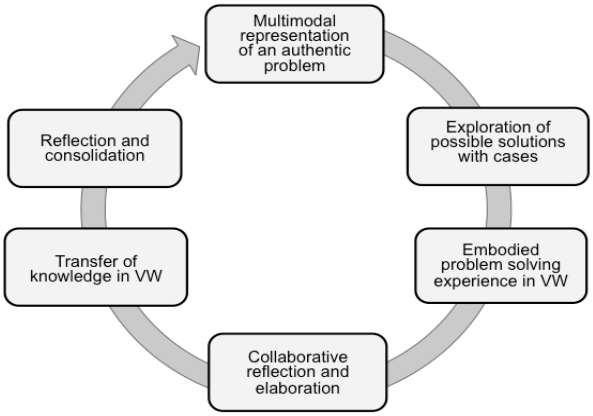


Figure 1. Model of embodied learning in a 3D virtual world (VW)

The ELVW model consists of collaborative problem solving and reflection activities in blended learning environments. The ELVW activities are developed and implemented on the basis of the following design principles:

- Real-world problems are presented with multimedia that support multimodal representations.
- Multiple cases (or perspectives) are compared and contrasted to support problem solving.
- Learners collaboratively create and evaluate solutions through argumentative discourse.
- Learners solve real-world problems through embodied experience in the virtual world.
- Learners have autonomy in interacting with the virtual world through avatars.
- Virtual world enables learners to express their ideas in both verbal and nonverbal ways.
- Embodied experience should be followed by reflection and consolidation activities.
- Instructor should provide appropriate instructional supports when they are necessary.
- Learners are encouraged to transfer their knowledge to different problem situations.

## 3. Methods

In the study, 35 (11 male and 24 female) elementary school pre-service teachers participated as part of the school-counseling course in South Korea. According to the ELVW model in Figure 1, participants had collaboratively solved a school-bullying problem in blended learning environments for four weeks. They discussed a real-world problem, conducted a role-play (i.e., embodied problem solving), and reflected on their embodied experience at a 3D virtual classroom in Second Life (see Figure 2). Instructional supports including scaffolding and feedback were mainly provided in a classroom.

Figure 2. Avatars in a 3D virtual classroom

The survey of self-efficacy (Cronbach's $\alpha$=.93) in preventing and addressing school-bullying behaviors was conducted before and after the ELVW activities. In addition, the survey of perceived achievement (Cronbach's $\alpha$=.91) was implemented right after the ELVW activities. The surveys used a five-point Likert scale. In addition, 10 participants were interviewed in terms of strengths and

weaknesses of ELVW. The grounded theory approach was applied to analyzing interview data through constant comparison and discussion among three researchers.

## 4. Findings

This study found a positive influence of ELVW for self-efficacy about school bullying. A paired sample t-test showed that pre-service teachers' self-efficacy significantly improved through the ELVW activities ($M$ = 2.84 vs. 3.58), $t$ (34) = 4.74, $p$ < .001. Their perceived achievement was somewhat positive ($M$ = 3.4, $SD$ = .75). Consistently, the interview analysis revealed more strengths than weaknesses, which were mainly related to technical problems and time constraints. The strengths of ELVW were summarized as follows:

- Verbal and non-verbal communication through avatars contributed to the presence and situational interest of pre-service teachers in the virtual world.
- Embodied experience in the virtual world helped pre-service teachers to take diverse perspectives of stakeholders in a school-bullying problem.
- Collaboration with group members encouraged active participation.
- Success and failure cases of experienced teachers were helpful in understanding a problem situation and exploring possible solutions.
- Collaborative reflection was helpful for making sense of embodied experience in the virtual world.
- Pre-service teachers had sufficient autonomy in deciding their activities in the virtual world.

The strengths above were closely related to the pedagogical principles of the ELVW model. This study also identified the weaknesses of ELVW as follows:

- Due to the Internet speed, pre-service teachers had difficulty in interacting with others through avatars in the virtual world.
- Pre-service teachers did not have enough time to carry out a role-play in the virtual world.
- Verbal and non-verbal communication should be enhanced for more natural interaction in the virtual world.

## 5. Conclusion

The current study designed the ELVW model based on the literature of embodied cognition, problem-based learning, and collaborative learning. In teacher education, this study found that the ELVW activities significantly improved pre-service teachers' self-efficacy in preventing and addressing school-bullying behaviors. In addition, this study found a few strengths of ELVW in pertaining to embodied experience in the virtual world, collaborative problem solving and reflection, and appropriate instructional supports (e.g., success and failure cases, autonomy support). To improve the ELVW activities, future research is recommended to prevent technical problems and time constraints and to enhance verbal and non-verbal communication with advanced technologies (e.g., motion sensing input devices). In addition, more attention should be paid to the role of augmented embodiment in the virtual world for learning process and outcomes.

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