Problems in Educational Use of Spherical Video-based Immersive Virtual Reality in Practice: The LIVIE Experience

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Abstract: This work-in-progress paper presents the work that we have conducted in the first research cycle (the first year) of a piece of 2-cycle design-based research (DBR) on implementing LIVIE—a pedagogical approach to integrating spherical video-based immersive virtual reality (SV-IVR) into geography education. The entire DBR involved 9 teachers (from 9 different Hong Kong secondary schools at 3 different academic categories) and their Grade-10 classes in two consecutive school years. In this paper, we focus on discussing the problems unfolded in the implementation process of LIVIE in Cycle 1. The findings not only shed light on how to improve and optimize the current teacher facilitation acts in LIVIE to be enacted in Cycle 2 of the DBR, but also alert educators and researchers to the potential impeding issues regarding the educational use of SV-IVR in practice.

Keywords: Spherical video-based immersive virtual reality (SV-IVR), design-based research (DBR), LIVIE, geography education, secondary education

1. Learner-Immersed Virtual Interactive Expedition (LIVIE)

Immersive virtual reality (IVR) possesses rich educational potential (Alexander et al., 2019; Chang et al., 2020). As a subset of IVR, spherical video-based IVR (SV-IVR) provides school teachers with an affordable alternative to harness IVR-based elements in their teaching practices. Grounding on Pedaste et al.'s (2015) enquiry-based learning model, we proposed Learner-Immersed Virtual Interactive Expedition (LIVIE), a pedagogical approach to incorporating immersive and interactive virtual enquiry-based fieldwork in geography education with SV-IVR (Jong et al., 2019). LIVIE is composed of 5 pedagogical phases: (I) *Communication*, (II) *Orientation*, (III) *Investigation*, (IV) *Explanation*, and (V) *Reflection*. Phases II to V operate sequentially, involving students' self-directed learning with SV-IVR outside the classroom; while Phase I interlaces Phase II to V, involving both teacher scaffolding and group-based student support inside the classroom. As for the context of geography curriculum learning and teaching in Hong Kong secondary schools, normally, a 12-day teaching cycle is used to cover 1 curricular module (with 4 face-to-face lessons therein). Figure 1 shows the implementation design of LIVIE in a teaching cycle, while the full design description has been documented in our recent publication (Jong et al., 2020).

2. Research Design

Design-based research (DBR) is a collective effort between both researchers and teachers to initiate, evaluate and optimize educational developments/ applications, such as curricula, pedagogies, or policies, so as to secure the implementation of the developments/ applications to be practical and sustainable in schools (Bakker, 2018; Jong et al., 2006). In this 2-cycle DBR, we recruited 9 geography

teachers (from 9 different secondary schools at 3 different academic categories[14]), with comparable academic background and teaching experience. All of them had participated in our LIVIE introductory workshop. We adopted Design-based Research Collective's (2003) stage-based approach to shaping the 2 iterative rounds of *Design*, *Enactment*, *Analysis* and *Redesign*. Observing the page limit (3 pages), we can only briefly describe the works conducted in the first 3 stages in this cycle.

Design. In each school, we offered the teacher refresher training on LIVIE. Then, the teacher participated in a quasi-experiment[15] in which he/ she piloted to implement LIVIE (Jong et al., 2020). After that, we assigned the teacher a curricular module, as well as reviewing together with him/ her (i) the LIVIE materials that we had developed for the assigned module and (ii) the existing facilitation acts in LIVIE based on his/ her school context.

Enactment. In each school, we supported the teacher in implementing LIVIE to facilitate a Grade-10 class to study the assigned module. We conducted data collection inside and outside the classroom during the entire implementation process from both teacher and student sides[16]. We also carried out formative analysis on the collected data and offered the teacher timely information for adjusting his/ her facilitation acts if necessary.

Analysis. After the implementation, the class took the knowledge test[17] in which the questions were customized from the Hong Kong geography public examination questions related to the assigned module. We also further conducted in-depth post-learning interviews with some students to probe into their LIVIE experience. Finally, we carried out summative analysis on all collected data.

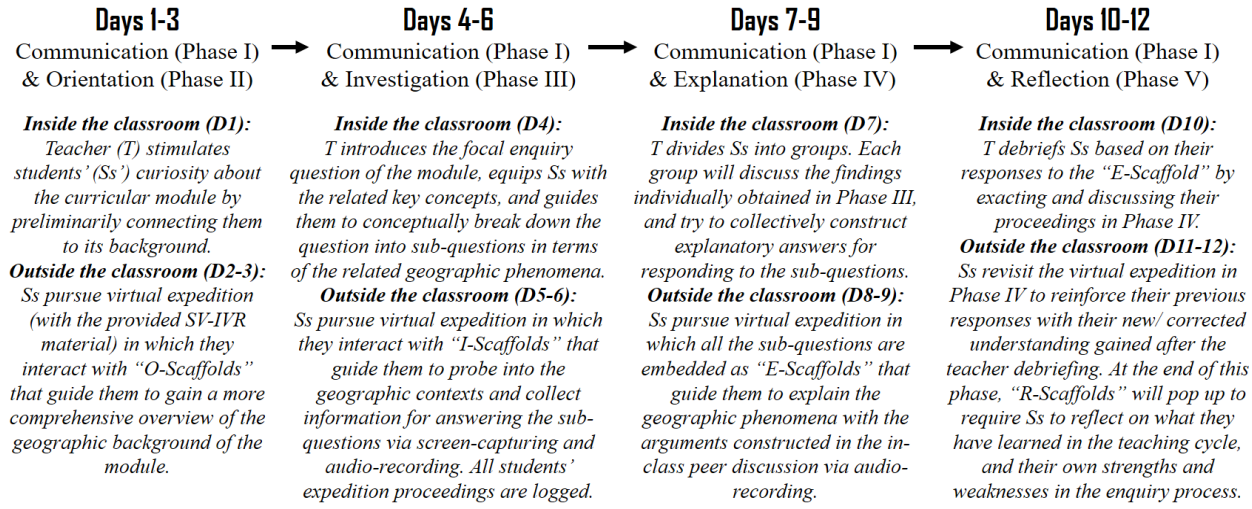

Figure 1. Implementation Design of LIVIE in a 12-day teaching cycle

3. Findings

We only focus on reporting the problems unfolded during Cycle 1's Enactment stage in this work-in-progress paper, as summarized in Table 1. In Cycle 1's Redesign stage, we set up 3 working groups with the 9 teachers to discuss and address these problems. We grouped the 3 teachers at the same schools' academic categories to (i) discuss the findings obtained in Cycle 1, and (ii) worked together to

[14] Hong Kong secondary schools are divided into 3 academic bands; Cat-1, Cat-2, and Cat-3 are respectively the upper, middle, and lower.

[15] After the training, most of the teachers deemed that it would be much better if they could gain some real LIVIE implementation experience before enacting the facilitation work in the Enactment stage of the DBR. Also, they were interested in knowing, in particular, would the pedagogical effectiveness of LIVIE be really better than the conventional textbook-based approach's. As agreed by all teachers and their schools, before the Enactment stage in Cycle 1, each of them piloted to implement LIVIE to teach a curricular module via a quasi-experiment with 2 Grade-9 classes (Jong et al., 2020).

[16] The data included (i) self-reported data [teacher's think-aloud reflection, just-in-time student-researcher/ teacher-researcher chat, multiple purposive student/ teacher interviews]; (ii) observational data by the researcher; and (iii) documentary data [teacher's access logs, and students' virtual expedition proceedings, etc.].

[17] The test result in this cycle will be compared with the one in Cycle 2.

derive interventions for optimizing LIVIE. The "optimized" teacher facilitation acts in LIVIE to be enacted in Cycle 2, and their corresponding effectiveness will be presented and discussed in our upcoming papers.

Table 1. Problems Unfolded during the Enactment Stage in Cycle 1

<table>
<tr><th>Cat-1 Schools</th><th>Cat-2 Schools</th><th>Cat-3 Schools</th></tr>
<tr><td colspan="3">• Some students from low SES (socio-economic status) families were inexperienced in using the borrowed smartphones, having troubles in operating the App for accessing the SV-IVR materials in Phases II, III, IV and V. In the research, the majority of the students used their own smartphones to access the SV-IVR materials. (Remark: For students who had no smart phone or their phones were not able to install the App for accessing the materials, they could borrow one from the research team.)
• Some students complained that the App was not quite user-friendly; it took time for them to figure out how to use their head movements to interact with the SV-IVR materials.
• Some students felt dizzy after conducting the virtual expeditions.</td></tr>
<tr><td rowspan="2">• Some students were less motivated to learn with LIVIE because they realized that the conventional textbook-based approach was more effective to help them get higher marks in the geography examination.
• Some students regarded that the O-Scaffolds in Phase II were not effective enough to guide them to gain a comprehensive overview of the geographic background of the module.
• Some students regarded that the I-Scaffolds in Phase III were not effective enough to guide them to collect the information for answering the sub-questions.
• Some students in the same group had very divergent views while conducting the discussion on Day 7 (i.e., Phase I: In-class Peer Discussion), provoking serious verbal conflicts.
• Some students were too dominating on Day 7 (i.e., Phase I: In-class Peer Discussion), hindering other groupmates to elaborate their views.</td><td colspan="2">• Some students regarded that the contents covered on Days 1 and 4 (i.e., Phase I: In-class Connection and In-class Conceptualization) were not concrete enough to prepare them for conducting the out-of-class enquiry tasks required in Phase II and Phase III.
• Some students just partially completed the out-of-class enquiry tasks required in Phase II, Phase III, and/ or Phase IV, impeding their in-class participation on Days 4, 7 and 10.
• Some students misunderstood the instructions embedded in the O-Scaffolds and I-Scaffolds respectively in Phase II and Phase III, and eventually came up with serious misunderstandings of some important conceptions and findings.
• Some students were only interested in participating in the virtual expeditions but not participative in the in-class activities on Days 1, 4, 7, and 10, and eventually came up with major misconceptions about some fundamental geographic knowledge.</td></tr>
<tr><td>• Some students were unwilling to interact with their groupmates on Day 7 (i.e., Phase I, In-class Peer Discussion).
• Some students were too shy to record their findings and arguments when conducting the out-of-class enquiry tasks required in Phases III and IV, hindering the effectiveness of the peer-discussion and teacher debriefing conducted on Days 7 and 10 (i.e., Phase I: In-class Peer Discussion and In-class Debriefing).</td><td>• Some students did not understand the instructions embedded in the O-, I-, E-, and R-Scaffolds, and eventually skipped some or all out-of-class enquiry tasks required in Phase II to Phase V.
• Some students did not pay attention to the teacher on Day 1 (i.e., In-class Connection), Day 4 (i.e., In-class Conceptualization), and Day 10 (i.e., In-class Debriefing), and were reluctant to participate in the group discussion on Day 7 (Phase I, In-class Peer Discussion).</td></tr>
</table>

Acknowledgement

The work described in this paper was substantially supported by a grant from the Research Grants Council of Hong Kong Special Administration Region, China (Project No.: 14612119).

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