The Use of Adaptive VR Environments to Foster Students Learning in Multilingual Study Guidance

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Abstract. Recently, the use of immersive technology has gained an increasingly interest in teaching. Virtual reality (VR) is an example of a resource offering prominent potentials for students' learning. The purpose of the study is to investigate the ways adaptive VR environments can foster students learning in multilingual study guidance. There are large differences at a national level in how multilingual study guidance is designed. Based on a co-design approach, combining methods of action research and design-based research, this study seeks answers to how to didactically design multilingual study guidance for promoting the development of students' conceptual knowledge with adaptive VR environments. Expected outcomes of the study can be related to the development of a didactically adaptive multilingual study guidance with the purpose to promote students' conceptual knowledge by means of adaptive VR environment. These results will be based on the development process leading to a didactical design of multilingual study guidance with adaptive VR environments, which will be tested in collaboration between teachers, students, VR designer and researchers.

Keywords: Co-design · Design-based research · Learning · Multilingual study guidance · Virtual reality

1 Introduction

In recent years, the use of digital resources has gained increasingly prominence in schools and teaching [1]. The rapid development of digital tools has resulted in a situation where information and knowledge are available in new manners and our learning and reasoning to an increasing extent takes place in interaction with such external tools [1]. This development has resulted in new arenas for research and raises questions about how teachers and students can best be supported in discovering meaningful ways to use digital resources in learning activities. Virtual reality (VR) is a technology that offers virtual experiences which the user can perceive as real [2]. Through three-dimensional (3D) systems in combination with interface devices, users become immersed in a virtual environment [3]. Features such as sound, visualizations and haptic feedback create a sense of being there [4, 5]. In this way, VR constitutes an example of a technology that

invites new conditions for how to organize learning activities. However, research points to the need for more studies in this developing field [6].

Currently, we have a large group of multilingual students in Swedish schools. Every fifth student in compulsory school has basic knowledge of a language other than Swedish [7]. Multilingual study guidance in students' first language is a support that exists in Swedish schools to enhance the development of students' learning [7]. Research demonstrates that the development of students' knowledge benefits from the fact that concepts and content related to a specific subject are consolidated both in the students' first language and in Swedish [8, 9]. There are large differences at a national level in how multilingual study guidance is designed [10, 11]. The Swedish Schools Inspectorate has for many years pointed out shortcomings in how schools organize multilingual study guidance [11]. For example, multilingual study guidance is in general not designed grounded in the students' individual needs [12]. Knowledge and research on multilingual study guidance is limited and this study therefore focuses on the need for new arenas and resources that can be adapted and developed to meet student's need. VR can be used as a resource to meet individualized study guidance designs. Through VR environments, the teacher can create interactive environments based on subject-specific content suitable for the student's needs [13]. In this work-in-progress paper, we describe a study which is in initial phase where the data collection will start in autumn of year 2022. The purpose of the study is to investigate the ways adaptive VR environments can foster students learning in multilingual study guidance. The research question addresses how to didactically design multilingual study guidance for promoting the development of students' conceptual knowledge with adaptive VR environments.

This study is a cross-disciplinary collaboration between researchers, teachers, students, and an external consultant bringing in expertise in developing adaptive VR environments (VR-designer). All parties will engage in creating context-sensitive knowledge, which is based on local theories of teaching and learning in VR environments [14]. Considering this, the study will go beyond issues that only concern implementation and development of digital technology in school settings, which has central contributions in the form of a cross-disciplinary grounded model for practice-based research.

2   Related Work

Interacting in a multidimensional environment with realistic representations of everyday phenomena makes it possible for students to overcome physical separation and feel immersed in a new way of learning [15]. VR simulates physical presence and the illusion of being on site can increase students' engagement [16] as well as lead to improved communication and cultural skills [17]. In a literature review on the use of VR head-mounted display in education and training, Jensen and Konradsen [18], identify research which points to that users of VR environments based on a highly immersive system are more engaged, take the VR simulation more seriously and spend more time on a learning task (see e.g., [19]. In their study, Makransky, Terkildsen and Mayer [6] found that students learned more in low-immersive environments compared to high-immersive environments. However, since this research points to divided results [see e.g., [19], Makransky et al. [6] argue for the need of more research. Furthermore, research shows

that in virtual environments, students can actively participate in meaningful activities and take responsibility and regulate their learning through, for instance, progression at their own pace, selection of support functions and repetition [15]. Students' stress and affective filters have been shown to decrease [20], such as social anxiety and modesty, which generates greater self-confidence and more willingness and motivation to learn [21]. Some known limitations for the use of immersive technologies are, for example, pedagogical framing and individual diversity [22] and technical distraction [23].

Developing conceptual knowledge in all school subjects is an all-encompassing goal for students in Swedish primary and lower secondary school [24]. Subject knowledge and language are developed in an integrated process, which means that subject teaching, not only in Swedish, becomes important for students' language development [25]. Developing a language in parallel with learning a specific school subject presupposes that, within the framework of subject teaching, students are given conditions to acquire the language that characterizes the respective school subject. The student develops subject literacy, which includes both subject-specific concepts and linguistic resources for reading, interpreting and producing texts [26].

Research argues that an important aspect for newly arrived students to reach academic success is to offer access to all subject areas and take advantage of their first language [27, 28]. This implies that teachers need to not only focus on newly arrived students learning the Swedish language but to focus on the development of students' subject-specific knowledge at first hand [29]. In Swedish schools, teachers in multilingual study guidance should, as Dávila and Bunar [30, p. 109] put it: act "as a bridge between children's first language and the subject area content" [see also 31, 32]. The few research studies that exist in the field of multilingual study guidance highlight collaboration between teachers giving study guidance and subject teachers as to best develop study guidance in line with the knowledge goals in the curriculum [e.g., 32, 33]. Other important aspects for a successful multilingual study guidance are to offer teachers more time to plan teaching activities but also offer them arenas for competence development so that they can design activities with high quality [29].

In a review of multilingual study guidance in the Swedish school in grades 7–9, the Swedish Schools Inspectorate [10] shows that study guidance does not always provide the expected support that students need to be able to meet the knowledge requirements of the curriculum. Rosén, Straszer & Wedin [34] argue that several teachers in multilingual study guidance use digital resources of various kinds during the study guidance. For instance, teachers and students use the teacher's phone to go online and search for information or to search for YouTube clips to support students' development of knowledge. When it comes to research studies on how multilingual study guidance with digital resources is didactically designed, the literature review has not identified any relevant studies. Thus, research is needed on how multilingual study guidance is conducted in schools [32] since there are only a handful empirical studies that are undertaken in classrooms where multilingual study guidance takes place [examples of studies: 31, 33].

3   Theoretical Framework

The study is underpinned by a co-design approach combining methods of action research [35, 36] and design-based research [14, 37]. This will provide the study with a

practitioner-empowering and theoretical lens successfully combined in the past [38] to examine educational designs "in a holistic, systematic, principled and sustainable way, taking into account the complexity of the contemporary learning environments" [39]. This entails involving researchers, teachers, students, and VR designer in equally legitimate opportunities of systematic, iterative and reflective development [40] of concrete educational activities in real classroom situations [e.g., 41].

Teaching in these new forms of educational environments in which learners engage with different digital tools (e.g., VR environments) is recognized as moving away from delivering content to students towards a creative process of design for learning of new practices, activities, resources, and tools that underpin particular learning objectives in a given educational context in a continuous dialogue with the learners in practice [42]. Hence, the learning process concerns then an activity-centered design of emergent learning situations with teachers designing for learning tasks where students have opportunities to create their own learning paths, previously more controlled by a teacher who, for example, would provide a specific material [43]. Designing for learning and teaching concerns supporting students in using and expressing their knowledge and skills through and with multimodal resources which also implies recognizing expressions as signs for learning [44, 45].

Here, the fundamental parts of teaching regarding what should students learn (content), how they should learn it (methodology) and why this content and this method for these specific students (purpose and goal) need to be addressed together with a new knowledge domain that entails not only which technology to use but also a larger context based on questions concerning interactivity in the physical and virtual spaces, when to teach and where [46]. This entails awareness of the relationships that arise between technology, student, and context. The content-technology relationship is brought to the fore as a question of design and which technology to be used, also considering questions such as why and how. In the student-technology relationship, the focus shifts to the use of digital resources and the interaction. Considering these relationships, the primary role of the teacher is then related to the design and layout of teaching situations and learning activities [43, 47].

We will use a previously developed and tested Design Dice framework for didactical design [46, 48]. In this study, didactical design (DD) refers to the design of teaching sequences targeting a specific learning objective and subject content that includes a preplanned sequence of lessons, with a detailed teaching plan, including how to implement and conduct the task. Researchers, teachers, students and VR designer will work in a cyclic process which contains initial problem identification, contribution with new design ideas that is jointly discussed and reflected upon during workshops and team-meetings informing the development of subsequent didactical designs (i.e., re-designs) then implemented and tested in classroom settings. This complex change in teaching requires time, careful planning, and a gradual as well as systematic incorporation of what proves to become successful. This is where this study of, iterative, and systematic co-design work will contribute analyzing concrete educational activities in real learning situations over time.

4   Methodology

The research team has already established collaboration and agreement with three schools, two teachers in multilingual study guidance and the VR designer. The teachers and the VR designer have started an initial collaboration regarding the development of VR environments in teaching activities. Approximately eight students (aged 9 to 13) from three schools will participate in the study. In this study, multilingual study guidance teachers, students, VR designer and researchers together plan for and carry out workshops and implement DDs in order to develop teaching practices. Throughout the design phases, we will continuously gather empirical material, which includes a) documentation of interviews with teachers working with multilingual study guidance, students and VR designer, b) documentation of collaborative work in workshops, c) documentation of teaching activities in the adaptive VR environments, and d) documentation of stimulated recall interviews with teachers, students, and VR designer. Audio recordings of interviews and video recordings of activities in the VR environment constitute the main method for documenting communication and interaction between teachers, students, and VR designer. Recordings of activities in the VR environments will be used to analyze how teachers and students interact in the VR environment. The video recordings of VR activities will also be used as props in stimulated recall interviews for teachers, students and VR designer to reflect on opportunities and challenges with the study guidance carried out in the adapted VR environments [49].

Different analytical tools will be used to make comparisons between different types of DDs of multilingual study guidance activities and between different schools. We have made a preliminary planning of which analysis tools to use but depending on the nature of data some flexibility is required. One of the methods used is workshops. The workshop format leans on highly dialogic and iterative processes and supports collaborative learning and partnership between teachers, students, developer, and researchers in the project [50]. According to Ørngreen & Levinsen [50], research on the workshop method is limited. With this study we contribute to a growing knowledge using innovative methods in collaboration between teachers, students, VR designer and researchers with a special focus on DD involving adaptive VR environments to foster students conceptual learning. The audio recordings and stimulated recall interviews will be analyzed using thematic analysis [51] where we identify patterns in the empirical material which in turn are organized into themes. The study will derive from a three-year, iterative, and systematic co-design work where concrete educational activities in real learning situations over time will be analyzed.

5   Expected Outcomes

As already mentioned, we have not yet collected the data and thus not carried out any analyses. However, results from the authors' previous studies on the use of digital technologies in school settings demonstrate that digital tools have the potential to reconfigure learning activities that support students' learning. However, it is not enough to add technology to enhance learning but rather, it must be embedded in a systematic pedagogical

arrangement that focuses on specific educational goals [e.g., 52, 53]. Furthermore, previous results indicate a diversity of experiences on the effect on digital technology in school settings which is important to consider [e.g., 54, 55].

Expected outcomes of the study can be related to the development of a didactically adaptive multilingual study guidance with the purpose to promote students' conceptual knowledge by means of adaptive VR environment. These results will be based on the development process leading to a didactic design of multilingual study guidance with adaptive VR environments, which will be tested in collaboration between teachers, students, VR designer and researchers.

References

1. Säljö, R.: Medier i skola och undervisning – om våra kunskapers medieberoende. In: Godhe, A.-L., Hashemi, S.S. (eds.) Digital Kompetens för Lärare, Malmö, Gleerups, pp. 17–35 (2019)
2. Blascovich, J., Bailenson, J.: Infinite Reality. HarperCollins, New York (2011)
3. Huang, H.M., Rauch, U., Liaw, S.S.: Investigating learners' attitudes toward virtual reality learning environments: based on a constructivist approach. Comput. Educ. **55**(3), 1171–1182 (2010)
4. Slater, M.: Immersion and the illusion of presence in virtual reality. Br. J. Psychol. **109**(3), 431 (2018)
5. Mikropoulos, T.A., Natsis, A.: Educational virtual environments: a ten-year review of empirical research (1999–2009). Comput. Educ. **56**(3), 769–780 (2011)
6. Makransky, G., Terkildsen, T., Mayer, R.: Adding immersive virtual reality to a science lab simulation causes more presence but less learning. Learn. Instr. **60**, 225–236 (2019)
7. Skolverket: Studiehandledning på modersmålet: att stödja kunskapsutvecklingen hos flerspråkiga elever. Stockholm, Skolverket (2019)
8. Cummins, J.: Urban multilingualism and educational achievement: identifying and implementing evidence-based strategies for school improvement. In: Van Avermaet, P., Slembrouck, S., Van Gorp, K., Sierens, S., Maryns, K. (eds.) The Multilingual Edge of Education, pp. 67–90. Palgrave Macmillan UK, London (2018). https://doi.org/10.1057/978-1-137-54856-6_4
9. García, O.: Bilingual Education in the 21st Century: A Global Perspective. Wiley-Blackwell, Malden, MA (2009)
10. Skolinspektionen: Studiehandledning på modersmålet i årskurs, 7–9. Skolinspektionen (2017)
11. SOU 2019:18: För flerspråkighet, kunskapsutveckling och inkludering. Modersmålsundervisning och studiehandledning på modersmål. https://regeringen.se/rattsliga-dokument/statens-offentliga-utredningar/2019/05/sou-201918/. Accessed 10 June 2022
12. Avery, H.: Teaching in the 'edgelands' of the school day: the organization of mother tongue studies in a highly diverse Swedish primary school. Power Educ. **7**(2), 239–254 (2015)
13. Garshi, A., Jakobsen, M.W., Nyborg-Cristiensen, J., Ostnes, D., Ovchinnikova, M.: Smart technology in the classroom: a systematic review. In: Porspects for Algorithmic Accountability (2020)
14. McKenney, S., Reeves, T.C.: Conducting Educational Design Research. NY, Routledge, New York (2012)
15. Meril-Yilan, S.: A constructivist desktop virtual reality-based approach to learning in a higher education institution. In: Becnel, K. (ed). Emerging Technologies in Virtual Learning Environments. IGI Global (2019)
16. Fryer, L.K., Coniam, D., Carpenter, R., Lăpușneanu, D.: Bots for language learning now: current and future directions. Lang. Learn. Technol. **24**(2), 8–22 (2020)

17. Cheng, A., Yang, L., Andersen, E.: Teaching language and culture with a virtual reality game. In: Proceedings of the 2017 Chi Conference on Human Factors in Computing Systems, pp. 541–549 (2017)
18. Jensen, L., Konradsen, F.: A review of the use of virtual reality head-mounted displays in education and training. Educ. Inf. Technol. **23**(4), 1515–1529 (2017). https://doi.org/10.1007/s10639-017-9676-0
19. Alhalabi, W.S.: Virtual reality systems enhance students' achievements in engineering education. Behav. Inf. Technol. **35**(11), 919–925 (2016)
20. Lin, T.J., Lan, Y.J.: Language learning in virtual reality environments: past, present, and future. Educ. Technol. Soc. **18**(4), 486–497 (2015)
21. Papin, K.: Can 360 virtual reality tasks impact L2 willingness to communicate? In: Future-proof CALL: Language Learning as Exploration and Encounters – Short Papers from EURO-CALL 2018, pp. 243–248. Research-publishing.net (2018). https://doi.org/10.14705/rpnet.2018.26.844
22. Parmaxi, A.: Virtual reality in language learning: a systematic review and implications for research and practice. Interact. Learn. Environ. (2020). https://doi.org/10.1080/10494820.2020.1765392
23. Berti, M.: Immersions for the Language Classroom. Italian Open Education: Virtual Reality Immersions for the Language Classroom, pp. 37–47 (2019)
24. Schleppegrell, M.J.: Academic language in teaching and learning. Elem. Sch. J. **112**(3), 409–418 (2012)
25. Rubin, M.: Språkliga redskap - Språklig beredskap: en praktiknära studie om elevers ämnesspråkliga deltagande i ljuset av inkluderande undervisning. Malmö universitet, Fakulteten för lärande och samhälle (2019)
26. Shanahan, T., Shanahan, C.: What is disciplinary literacy and why does itmatter? Top. Lang. Disord. **32**(1), 7–18 (2012)
27. Cummins, J.: Teaching minoritized students: Are additive approaches legitimate? Harv. Educ. Rev. **87**(3), 404–425 (2017)
28. Valdés, G.: Entry visa denied: the construction of ideological language borders in educational settings. In: Garcia, O., Nelson, F. (eds.), The Oxford Handbook of Language and Society, pp. 321–348. Oxford University Press, New York, USA (2017)
29. Vogel, D., Stock, E.: Opportunities and Hope Through Education: How German schools Include Refugees. Education International Research, Brussels (2017)
30. Dávila, L., Bunar, N.: Translanguaging through an advocacy lens: the roles of multilingual classroom assistants in Sweden. Eur. J. Appl. Linguist. **8**(1), 107–126 (2020)
31. Reath Warren, A.: Developing multilingual literacies in Sweden and Australia: Opportunities and Challenges in Mother Tongue Instruction and Multilingual Study Guidance in Sweden and Community Language Education in Australia. Stockholms universitet, Stockholm (2017)
32. Engblom, C., och Fallberg, K.: Nyanländas lärande och språkutvecklande arbetssätt. Rapport från en forskningscirkel. Uppsala, Uppsala universitet (2018)
33. Duek, S.: Med andra ord. Karlstads universitet, Samspel och villkor för litteracitet bland nyanlända barn. Karlstad (2017)
34. Rosén, J., Straszer, B., Wedin, Å.: Transspråkande i studiehandledning som pedagogisk praktik. Lisetten **1**, 16–19 (2017)
35. Elliott, J.: Principles and methods for the conduct of case studies in school-based educational action research. In: Anderberg, E. (ed.) Skolnära forskningsmetoder, pp. 111– 141. Lund, Studentlitteratur (2020)
36. Adelman, C.: Kurt lewin and the origins of action research. Educ. Action Res. **1**(1), 7–24 (1993)
37. Design-Based Research Collective.: Desing-Based Research: An Emerging Paradigm for Educational Inquiry. Educational Researcher, **32**(1), 5–8 (2003)

38. Majgaard, G., Misfeldt, M., Nielsen, J.: How design-based research and action research contribute to the development of a new design for learning. Des. Learn. **4**(2), 8–27 (2011). https://doi.org/10.16993/dfl.38
39. Sun, Y.H.: Design for CALL – possible synergies between CALL and design for learning. Comput. Assist. Lang. Learn. **30**(6), 575–599 (2017). https://doi.org/10.1080/09588221.2017.1329216
40. Schön, D.A.: Educating the reflective practitioner: toward a new design for teaching and learning in the professions, vol. 1. San Francisco, Jossey-Bass (1987)
41. Cviko, A., McKenney, S., Voogt, J.: Teachers as co-designers of technology-rich learning activities for early literacy. Technol. Pedagog. Educ. **24**(4), 443–459 (2015)
42. Mor, Y., Craft, B.: Learning design: reflections upon the current landscape. Res. Learn. Technol. **20**, 85–94 (2012). https://doi.org/10.3402/rlt.v20i0.19196
43. Selander, S., Kress, G.: Design för lärande - ett multimodalt perspektiv. Stockholm, Norstedts (2010)
44. Bezemer, J., Kress, G.: Multimodality, Learning and Communication: A Social Semiotic Frame. Routledge, London (2016)
45. Selander, S.: Didaktiken efter Vygotskij: design för lärande. (Första upplagan). Stockholm, Liber (2017)
46. Sofkova Hashemi, S., Spante, M.: Den didaktiska designens betydelse: IT-didaktiska modeller och ramvillkor. In: Sofkova Hashemi, S., Spante, M. (eds.) Kollaborativ undervisning i digital skolmiljö. Malmö, Gleerups (2016)
47. Boistrup, L.B., Selander, S.: Designs for Research, Teaching and Learning: A Framework for Future Education. Routledge, New York (2022)
48. Sofkova Hashemi, S.: Exploring educational designs by schematic models: visualizing educational value and critical issues of recognition and socio-material frames. Des. Learn. **14**(1), 14–28 (2022). https://doi.org/10.16993/dfl.171
49. Calderhead, J.: Teachers' beliefs and knowledge. In: Berliner, D.C., Calfee, R.C. (eds.) Handbook of Educational Psychology. Simon & Schuster Macmillan, New York (1996)
50. Ørngreen, R., Levinsen, K.: Workshops as a research methodology. Electron. J. e-Learn. **15**(1), 70–81 (2017)
51. Braun, V., Clarke, V.: Using thematic analysis in psychology. Qual. Res. Psychol. **3**(2), 77–101 (2006)
52. Edstrand, E.: Learning to reason in environmental education. Digital tools, access points to knowledge and science literacy, (Diss.) Studies in Educational Sciences, University of Gothenburg (2017)
53. Sjöberg, J., Brooks, E.: Genusrelaterade dilemman i kollaborativa aktiviteter när elever utvecklar speldesign - villkor för aktörskap. In: Kontio, J., Lundmark, S. (eds.) Digitala didaktiska dilemman. Stockholm, Natur & Kultur (2022)
54. Roumbanis Viberg, A., Forslund Frykedal, K., Sofkova Hashemi, S.: Teacher educators' perceptions of their profession in relation to the digitalization of society. J. Praxis High. Educ. **1**(1), 87–110 (2019)
55. Spante, M., Sofkova Hashemi, S., Lundin, M., Algers, A.: Digital competence and digital literacy in higher education research: systematic review of concept use. Cogn. Educ. **5**(1), 1–21 (2018). https://doi.org/10.1080/2331186X.2018.1519143