360-degree Models in Environmental Engineering Education: an Explorative Case Study

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Abstract: 360-degree models are defined as the algorithmic merging of multiple 360-degree images of an enclosed space creating a single visual model of the space that can be viewed from various positions within the space. As means of virtual reality, 360-degree models can be understood as a medium with impact on learning. Aiming at evaluating the educational potential of 360-degree models in the field of environmental engineering, an explorative pilot study featuring an innovative sanitation system has been conducted (N=17). Quantitative measurements of motivation, emotion and usability show positive results. Guided interviews revealed both key points and problems to be addressed. Although the learning efficiency is still to be validated, the study renders 360-degree models as promising learning tools that might enrich tertiary education in environmental engineering.

Keywords: Virtual Reality, 360-degree Model, Education, Environmental Engineering, User Experience, Motivation, Emotion.

1   An Explorative Case Study

360-degree models are algorithmically assembled 360-degree images of objects, for example spaces, which allow observers to view the objects almost from all directions. 360-degree models differ from 3D models generated by 3D scanners in lacking quantified depth information [SK14]. An important field of application of 360-degree models, which has been established for several years [Am10], is virtual visits to real estate, which allow prospective buyers or tenants to gain an impression of the property independent of time, location and people [Fe18]. Beyond its use for commercial purposes, 360-degree models are also suitable as a learning tool, for example [Ph18] describe a 360-degree model teaching safety on construction sites.

In environmental engineering, locations that can be depicted using 360-degree-technology include not only structures, but also laboratories and test facilities. Thus, the aim of the explorative pilot study is exploring the potential of 360-degree models as learning tools. The 360-degree model of an innovative sanitation system, having been augmented by textual, graphical and video annotations and aiming at public awareness rising is explored by environmental engineering students regarding usability, motivation and emotions. The

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study comprised of four phases: **Exploration** consisted Ten minutes lasting exploration phase of the 360-degree model either on a tablet (N=8) or on a desktop computer (N=9). A **questionnaire** asked besides prior knowledge, demographics and a self-estimation of the learning outcomes, for usability [MHN12], emotions [Pe11] and motivation [RVB01]. A **post test** comprising of five multiple choice questions aimed at evaluating the knowledge gained from the exploration of the 360-degree model. **Semi-structured interviews** of 5 minutes duration gathered further feedback. Table 1 describes identified strengths and weaknesses.

Strengths	Weaknesses
• Provides holistic overview over topic	• Uncertainty about kind and extend of information
• Information are highly understandable and memorable	• Deficient structure of information
• Useful support to create mental models	• Complex approach to learn detailed information
• Opportunity to present new projects quickly	• Specific information searched are hard to find
• High motivation of usage	

Table 1 Educational use of a 360-degree model: summarized results

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