

Interactive comment on “Understanding groundwater – students’ pre-conceptions and conceptual change by a theory-guided multimedia learning program” by U. Unterbruner et al.

Anonymous Referee #2

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This paper presents an interesting study on the important subject of groundwater education. The paper discusses students’ mis-conceptions about the subjects, describes the development of a multi-media learning program, and conducts pre- and post-tests to evaluate impact of the intervention. The paper is based on adopting the Model of Educational Reconstruction (MER) as a research design. The paper is interesting, important and follows a valid scientific approach. However, the paper needs improvements in several key areas, such as:

1. Methodology: The manuscript needs to do a better job in explaining the MER model. For example, last paragraph, page 11692, states that: “A balance between science-

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related issues and educationally oriented issues is considered a necessity in effective teaching and learning.” But what are these issues specifically? (science-related “issues” and educationally oriented “issues”).

2. Design of tests and interpretation of results: The new learning program includes aspects related to introducing new and correct scientific contents on groundwater, and introducing such concepts using multi-media means. Can we isolate the effects of these two different aspects, i.e., new content on the one hand, and multi-media elements on the other hand? Can the evaluation research questions and tests isolate the individual effects of these different aspects of the intervention? In other words, did the improvement result from introducing new and correct scientific content, or was mainly attributed to the use of multi-media techniques?

3. Manuscript length: the manuscript is a little too long and can benefit from a more concise presentation of background, methodology, and results.

4. Writing style: while the manuscript is fairly well-written, it needs a significant revision to improve its readability. For example, there are several places where the language style is a little awkward, sentences are fragmented and repetitive, and there are many problems with punctuations (commas, periods, capital and small letters), etc. There is also an excessive use of numbering/bullets throughout the manuscript. I included below some examples of these, but the authors need to check the entire manuscript.

Examples of minor corrections (please check the entire manuscript for more of these):
-Line 10 page 11692: “In a first step, we developed the multimedia learning program theory-guided”; this sentence needs to be re-phrased. Problems with use of punctuations (periods; commas, etc.), sentence lengths and structure (e.g., lines 10-15 on page 11700). Excessive use of numbering makes reading the manuscript rather difficult to follow (e.g., see pages 11700, 11701, 11706, 11707).

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