

Dear Veli-Matti Karhulahti and reviewers,

Thank you for the feedback regarding our submission of the manuscript “Learning from comics versus non-comics material in education: Systematic review and meta-analysis” to the PCI RR. We believe that your thoughtful comments and constructive suggestions have strongly benefited the quality of the manuscript. We are excited to inform you that we have diligently incorporated your feedback, making the necessary changes to enhance the overall quality of our manuscript; and that we agree with your assessment and prefer to adhere to the exploratory plan for the reasons discussed in the previous review round. Your recommendations have played a pivotal role in refining this updated version, and we truly appreciate your commitment towards this end. We have listed a point-by-point overview of the changes below.

Thank you for your invaluable input and the positive impact it has had on our manuscript.

Yours sincerely,

The authors.

## ***Revision round #2***

**Decision for round #2 : *Revision needed***

### **Minor Revision**

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Dear Marianna Pagkratidou and co-authors,

Thank you for all careful revisions. We were again lucky, as all four reviewers generously returned to re-assess the plan. In general, they are all satisfied with the current version. There are a few minor final edits requested, and I let you address them respectively.

One reviewer has left a longer comment regarding the loss of epistemic value due to the transformation of the plan from a confirmatory to an exploratory one. Although I agree that, in the reviewer’s own words, your team would be in “a very good position to formulate these theoretical arguments,” for me the lack of confirmatory inference (which would require further assessment of effect size meaning etc.) is not a significant loss here. Oftentimes the

labor required to convincingly test a hypothesis in a confirmatory setting is larger than the potential gains. A well-designed exploration can be almost equally informative, especially as an RR that is transparent for readers (who can then respectively assess to what degree these rigorously obtained effects are meaningful). This also solves the language issue, which some reviewers were still worried about (misinterpretations might be fatal in confirmatory but not exploratory tests).

*That said, if you find the reviewer's argumentation convincing and still wish to add a formal hypothesis, please contact me before submitting the next version so that we can together ensure that the carefully crafted current plan doesn't break.*

Response: Thank you, Dr. Karhulahti. While the reviewer made some very good points, and despite the fact that initially we had also opted to formulate a hypothesis, we are now rather inclined to follow your suggestion and adhere to the exploratory plan.

Two short notes.

1. Although you've decided to refrain from h-testing, page 18 (and abstract) still mention h-testing. If the study is exploratory, the reference to h-testing should be removed to avoid confusion: the study will simply report the obtained effect(s) and discuss what these effects may mean (without making confirmatory claims about effectiveness). In such exploratory design, there is also no need to justify effect sizes anymore -- it's ok to plan e.g., equivalence tests, just keep in mind that you cannot claim to *confirm* the null at Stage 2 (confirmation would require formal tests against justified effect sizes).

Response: Thank you, we have adjusted our manuscript by removing the hypotheses from the abstract, the table and from page 18.

Abstract changes: The past decades have seen a growing use of comics (i.e., sequential presentation of images and/or text) educational material. However, there are inconsistent reports regarding their effectiveness. In this study, we aim to systematically review empirical studies that have investigated the use of comics in education; and to quantitatively explore these effects using a meta-analysis. To do so, we will search PubMed, Scopus, and Web of Science for studies employing an experimental design that uses comics education material compared to non-comics education material in general population samples. Our findings will not only shed light on whether comics are equally or more effective education material than texts, but also on the conditions in which comics can foster learning.

2. As reviewers point out, it would be important to add further information about inter-rater reliability. We recently created reporting guidelines for transparent coding, which you may find helpful for adding the missing information: <https://doi.org/10.31234/osf.io/86y9f>

Response: Please see below the changes that we made at page 15:

Inter-rater reliability will be calculated among the two reviewers, using Cohen's Kappa estimate (see Conry-Murray et al., 2023). Specifically, Cohen's Kappa will be initially calculated for a small pool of papers (10%). If agreement is not satisfactory (i.e., <80%), the two reviewers will meet to discuss disagreements. The process will be repeated until satisfactory agreement is reached (i.e., >80%) or until screening is complete.

After minor revisions, I believe the plan can be ready for IPA and does not require further external review rounds. However, I might briefly consult selected reviewers, depending on the changes in the next version. Again, you are free to contact me before submitting, in case you're unsure how to solve some of the requested revisions.

Good luck and best wishes!  
Veli-Matti Karhulahti

by *Veli-Matti Karhulahti*, 11 May 2024 15:12  
Manuscript: <https://osf.io/preprints/metaarxiv/ceda3/>  
version: 1

**Review by Adrien Fillon, 22 Apr 2024 11:25**

Dear Authors and Editor,

I am sorry for the delay, I thought I submitted a review, but it seems to have been lost. I don't have much to say about the current draft, as I am satisfied with the author's changes regarding my contribution to the meta-analytic properties of the present study. I saw that the comments were more extensive regarding the field of investigation, on which I don't have any expertise.

Again, I think that once the authors, editor, and reviewers agree on the specific area to investigate, the protocol described in the method section can correctly test a meta-analytic effect of comics on learning.

Good luck with the analysis.

Response: Thank you very much for your feedback and for clarifying your position regarding the current draft. We appreciate your insights and we are glad to hear that you are satisfied with the revisions we made based on your suggestions.

#### **Review by Benjamin Brummernhenrich, 29 Apr 2024 10:09**

I am glad that the authors have taken the time to revise their manuscript and plans. In my opinion, many parts of the plan are stronger in this version as a result of dealing with many issues that the reviewers had pointed out. Especially the details of the empirical part, such as open access to data and materials, stronger specification of the meta-analytic process, including effect size thresholds etc., are much clearer now.

Response: We appreciate your kind words and the time that you have put into this project. Thank you!

I also think that the specification of texts instead of general "non-comics" is a very sensible step. However, I feel that the way that the authors have dealt with one of the other main points of my (and some of the other reviewers') assessment - regarding the theoretical foundation of the hypotheses - is not ideal. The authors have opted to do away with the hypotheses, labeling all analyses as exploratory. This may have been a response to the recommender's encouragement "to either formulate a theoretical, empirical, or other basis for testing the chosen hypotheses or transforming the plan toward a more exploratory direction". But I feel that this makes the whole plan weaker instead of stronger. The point of a meta-analysis - in my understanding - is to ascertain whether an effect exists and maybe estimate its size. It is a confirmatory exercise that you would only undertake if there is a sensible reason to expect an effect. The authors now argue that "it is not our claim that comics are beneficial for comics [sic], but rather to interrogate the claims by a range of other scholars that comics are beneficial for education". I find that argumentation questionable. The authors acknowledge that the claim exists and that it is this claim that is being assessed - how is this then different from a hypothesis that is being tested? I find it especially surprising considering that the authors have done research in this area themselves and that the keywords include some of the constructs that arguably play a role in mediating these effects (e.g. visual language fluency and spatial cognition). As far as I can tell, the authors seem to be in a very

good position to formulate these theoretical arguments, given their expertise and experience in the domain.

The authors demonstrate that they have this expertise by presenting some theoretical arguments for the plausibility of the claimed effects. In my view this is very valuable and, instead of dropping the hypotheses, this should be extended into - as was the original aim per the title of the manuscript! - a systematic review of the theoretical and empirical arguments for the existence of the effects that the meta-analysis will focus on: Why can we expect comics be superior to texts in certain situations? Why should this apply specifically to STEM fields? This should be much easier to accomplish now that that the focus is on texts as the comparison point instead of all non-comics material. This would be a very worthwhile endeavour as it would enable the authors to both present empirical evidence as well as conclusions on a theoretical level. Especially if the effects *do not* obtain in the expected direction, this would enable a more fruitful discussion of the factors that may be responsible for this outcome, such as specific characteristics of the study designs or materials of the studies included in the meta-analysis.

This is still the main issue I see with the plan. Again, I think this is a very worthwhile endeavour, and it would be much more so with more reasoning about the plausibility of the effects under analysis, not less. I will report some smaller details that have come up in the revision in the following.

Response: We appreciate your thoughts and concerns, but following the previous feedback, and the recommender's suggestions, we prefer to conduct an exploratory study. As the editor pointed out a well-designed exploration can be almost equally informative, especially as an RR that is transparent for readers (who can then respectively assess to what degree these rigorously obtained effects are meaningful).

- I wonder if the title is still appropriate. It still says "Learning from comics versus non-comics", whereas the focus is now specifically on the comparison with texts.

Response: Considering that we are planning to extract exploratory information for other non-comic materials, too, we decided to keep the Stage 1 title in its current form. However, the title may be revised in Stage 2 appropriately, if needed.

- The meta-analysis by Topkaya et al. (2023) is cited in the text but does not appear in the References section.

Response: The citation has now been added in the References section.

- Table 1 does not have a caption.

Response: We have added the following caption: Study design plan.

Right now, Table 1 seems a little superfluous because much of it is redundant: the entries in all cells for the columns "Hypotheses", "Sampling plan", "Analysis plan", "Rationale for deciding the sensitivity etc" and "Theory that could be shown wrong etc." are the same for all three research questions.

Response: We have updated the table by deleting the Rationale column and by making the necessary adjustments to the Interpretation column, please see below:

Research question	Hypotheses	Sampling plan	Analysis plan	Rationale for deciding the sensitivity of the test for confirming or disconfirming the hypothesis	Interpretation given different outcomes	Theory that could be shown wrong by the outcomes
1. What are the claimed benefits of comics vs text for education?	We refrain from forming concrete hypotheses, as our analysis will be exploratory in nature.	Systematic Review	Meta-analysis	We are doing frequentist tests, so we will use $\alpha=0.05$ . The rationale is the fact that it is the standard level in the literature. We will use equivalence testing for the null, by examining whether the minimum effect sizes of interest ( $0.2$ and $0.3$ ) are	This is an exploratory study. Interpretation for all results will be presented in the discussion. If we find that comics have a greater impact on learning than text, then this could mean that the sequential images and text provided in comics confer an advantage for communication compared to text. If	This is an exploratory study. Explanations for all results will be presented in the discussion.

- There is a formatting problem in the References section as some references are indented, some not.

Response: We have now updated the Reference section with all the references being indented. Thank you for bringing this to our attention.

- I do not think generative AI solves the translation problem mentioned by myself and others; it may even exacerbate it. You cannot check the accuracy of the translation for languages that you do not know. The example given by Solip Park was an enlightening one and only one of the many problems that could arise.

Response: We truly appreciate your concerns, but we have decided to use Generative AI to translate for languages that we know. Also, as the editor suggests, now that we will adhere to an exploratory design, this will solve the language issue as misinterpretations might be fatal in confirmatory but not exploratory tests.

- I welcome the calculation of inter-rater reliability, but would have expected a little more detail, closer to what was reported in the "Statistical analysis" section: How will the agreement be calculated, what coefficient will be used, and what is the cutoff for a satisfactory agreement? What happens if this is not reached?

Response: We will calculate inter-rater reliability via the Covidence that will extract Cohen's Kappa measurement and we will follow the guideline by Conry-Murray et al., 2023 to make sure that we code and calculate in a transparent way. If we do not reach a satisfactory agreement, then we will use an approach where we would screen a few (e.g., 10%) evaluate reliability and discuss if there is a large mismatch and repeat. Please see the changes in the manuscript:

Inter-rater reliability will be calculated among the two reviewers, using Cohen's Kappa estimate (see Conry-Murray et al., 2023) and if we do not reach a satisfactory agreement, then we will use an approach where we would screen a few (e.g., 10%) evaluate reliability and discuss if there is a large mismatch and repeat.

Again, I hope these comments are helpful to the authors and I would very glad to see this manuscript go to the next round!

Response: Thank you! We have taken into consideration the suggestions and made the changes in the manuscript.

[Download the review](#)

Thank you authors for their consideration and revision of RR.

Problem statement: There are inconsistent findings regarding the effectiveness of learning when using comics compared to non-comic materials, namely texts.

Goal: (a) A systematic review of using comics in education, (b) meta-analysis to quantify the overall effect of empirical studies that used comics versus texts, and (c) explore whether comics affect learning differently when it comes to STEM compared to non-STEM fields.

Hypothesis: (i) If learning via comics operates in the same way as learning via non-comics material, namely texts, then, comics and texts will have the same impact on learning; (ii) if the combination of text and images confers greater communicability beyond learning via texts, then we hypothesise that comics will have a greater impact on learning.

I found the revised RR is more rigorous and thus looking forward to see the research findings from the authors in the future.

Some minor notes to add:

- Topkaya et al., 2023 is not included in the bibilograph despite being extensively referred to in the manuscript.

Response: [We have now added the citation in the reference section of the manuscript.](#)

- I still believe that the authors could consider adding variables of interactive media in “13. Control condition (texts)”, such as games. This could include board games or game-like quizzes in the education setting, which I consider interesting aspects to also look into.

Response: [That would be very interesting indeed. We will code for those too. Please see the changes in page 16 the following:](#)

[Control condition \(texts\): We will document information regarding the type of the text; and for any non-comic educational material used, we will document exploratory the information by using the following coding system: text \(=1\), photo \(=2\), animation video \(=3\), games \(=4\), etc.](#)



- In relation to “3. Location” and “4. Education field”, the authors could consider looking into the location’s pedagogical context and elaborate them in the report. For instance, how is STEM significant in the location’s pedagogical values and curriculums? How much autonomy is given to teaching professionals in terms of choosing their teaching materials in, let’s say, formal education? (i.e., were comics common in the learning environment in that location or is it something that is new and unconventional?)

Response: In relation to the location and the location’s pedagogical context, goes beyond the scope of this study. However, this is a very interesting point and we will mention it to our discussion section for future research.

In relation to the education field and the autonomy regarding the materials, we will try to capture this by coding based on the “Intervention type” as follows:

9. Intervention type: We will extract information regarding the type of intervention by using the coding system of comics as main teaching material (=1) - referring to studies that used comics and text as the main medium to educate the participants - and comics as supplementary material (=2) - referring to studies that used comics and text as a complementary medium to the existing course or text material.

**Review by Pavol Kačmár, 19 Apr 2024 15:29**

I would like to express my gratitude to the authors for their effort in revising the proposal and incorporating suggestions.

I have no further input on how the proposal could be improved and I believe that the present version of PCI RR - entitled Learning from comics versus non-comics material in education: Systematic review and meta-analysis - met stage 1 criteria and could be recommended.

I eagerly await the the study findings, and I wish the authors all the best.

Best regards, Pavol Kačmár, PhD.

Response: Thank you for your feedback. We appreciate your insights and are pleased to know that you are satisfied with the revisions made in response to your suggestions.