Article Critique

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**Manlove, S.; Lazonder, A. & de Jong, T.**
**Regulative support for collaborative scientific inquiry learning**
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*Article Summary*

Manlove, Lazonder and de Jong designed the study to identify if an online tool designed to support students' self-regulation promoted students' learning while working collaboratively on an inquiry task. This online tool was embedded together with a computer simulation-based learning environment. Therefore, the self-regulation scaffolds implemented through the online support tool aimed at helping students to: a) set goals that reflect the phases of scientific learning, b) form a strategic plan by setting sub goals, c) highlight strategies to achieve such sub goals, d) monitor progress by taking notes per each goal and sub goal, e) evaluate the inquiry learning process, and f) evaluate students' model utilizing a report template and standards implicit in goal hierarchies.

The researchers expected that groups who were provided with the support tool with the regulative directions embedded would achieve higher learning outcomes and produce more instances of planning, monitoring, and evaluation than the groups who were not provided with regulative directions. In order to test this conjecture the authors designed an experimental study with a posttest control group involving two conditions. Both conditions utilized the support tool called the Process Coordinator (PC). In the experimental condition regulative directions were embedded within the tool while in the control condition no regulative directions were embedded with the tool. The experiment was conducted over three weekly one hour lessons. The first lesson consisted of: a) a guided tour through the software called Co-Lab, b) an introduction to modeling, and c)

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instruction on how to plan, monitor and evaluate their learning according to the support tool they were assigned to. In the next two sessions students worked on the inquiry task. The communication among the groups was done through a chat tool.

Participants included 61 high-school students whose ages ranged from 16 to 18. These students worked in 19 triads and two dyads and the groups were randomly assigned to both conditions. At the end, due to technical difficulties and students absenteeism, incomplete data was withdrawn, consisting of three groups from the experimental condition and two groups from the control condition.

The instruments for collecting the data were the log files of the simulation tool. Models created by the students were used to identify their conceptual domain knowledge and the overall model structure was used to determine their scientific reasoning. In addition the logs from the chats were used to assess verbal interaction. While the models created by the students were analyzed in terms of descriptive and inferential statistics, the logs form the chats were analyzed through qualitative approaches.

The results obtained for model quality and planning actions were consistent with the researchers' expectations. The results were reported in terms of learning outcomes, learning activities, and correlations between learning outcomes and learning activities. In order to understand the results of those correlations, the researchers conducted qualitative analyses of verbal interaction. Finally, the authors provided a discussion comparing and contrasting their expectations with the findings, giving their interpretations and possible explanation of such results, discussing the limitations of their study, and highlighting future work. For a detailed summary of the researchers' data analysis process and findings see Appendix B.

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*Article Critique*

*Statement and Review of Literature*

Manlove and her colleagues tried to identify if an online tool designed to support students' self-regulation promoted students' learning while working collaboratively on an inquiry task. The authors introduced their ideas by providing a good overview on the research related to problems that students face while conducting inquiry learning tasks and some ways in which these problems can be addressed. The authors focused their rationale and justification for the need of this study in how can students' cognitive regulation be scaffolded by implementing models of self-regulation. The authors discussed the problem, the focus of the study, and the educational significance of such problem. In particular, the authors argued that "effectiveness of inquiry learning is challenged by intrinsic problems many students have with this mode of learning (p.87)." And based upon that problem the authors discussed how self-regulation models could help students overcome such difficulties. In particular, the authors identified four components of cognitive regulation: a) planning a series of experiments, b) monitor progress and comprehension, c) evaluation of inquiry learning processes, and d) evaluation of knowledge gain. Based on these principles the authors embedded scaffold in a simulation learning environment. The scaffolds were in the form of hints and they identified if the principles promoted students' regulatory activities.

The review of the literature was complete, well organized, and adequate to support and justify the need for this study. Furthermore, the authors concluded their review of relevant literature by discussing and justifying the self-regulation framework that was the basis for designing the intervention. All cited references were relevant to the

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problem under investigation and were analyzed, critiqued, contrasted and compared. For a general overview of the problem presented through the literature see Figure 1.

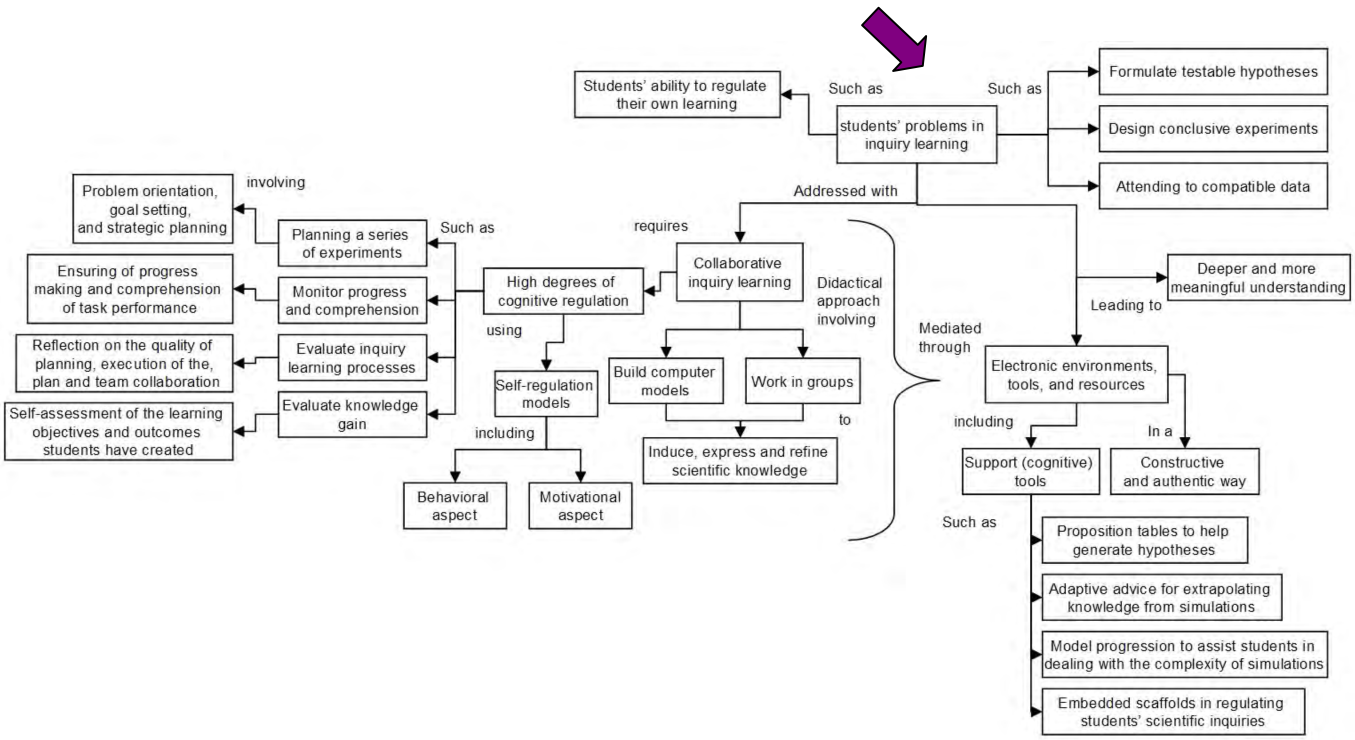


Figure 1: Overview of the Revision of Literature

*Methods*

The authors stated their testable research goals by stating their expectations of the relationships between the conditions, experimental, and control group. The authors presented a mixed methods study with a true experimental posttest-only control group as the quantitative component, and a grounded theory approach for the qualitative component. In this explanatory mixed methods design the quantitative data was collected first, and the qualitative data was used as an interpretation to help explain and elaborate the quantitative results.

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Quantitative component

Although because of technical difficulties and absentee students some incomplete data was not included; the sample size seems particularly appropriate for a quasi-experimental design. Due to limitations of the setting; namely a computer lab in a school, the sampling method seems to be a stratified sampling because the groups were already formed. The assignment to the two conditions was assertively done randomly. The only information the authors provided about their participants was their academic level and their ages; no further information was provided in relation to their background, gender, socioeconomic status, etc.

The data collection methods used by the researchers seemed quite appropriate. For identifying learning outcomes the researchers focused on students' models and for identifying students' learning activities the researchers focused on student's actions (through means of verbal interactions) associated with those activities. The authors provided a clear description of the purpose, content, and rationale for the selection the posttest instruments as well as the criteria for scoring them. In relation with reliability issues, the only information provided by the authors was the scores of inter-rater reliability.

For the case of validity issues, the design of the study did not control mortality due to the absence of pretest. However, the combination of random assignment and the inclusion of a control group served as a way to control for all sources of internal validity (except of mortality). Mortality then, was the major issue in terms of validity of the study because the sample sizes did not remain constant, and we don't know the reasons of students' absenteeism. The procedures for conducting the study were described in

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sufficient detail. They described the sequence and duration of each of the sessions as well as the activities conducted on each one. They also described the functionality of the simulation tool (Co-Lab), the functionality of the support tool (Process Coordinator), the description of how the regulative directions were embedded within the tool (treatment condition), as well as how these were employed in the study. In addition they provided the reader with screen-shoots of the software tool. In general, the authors provided enough information to allow the replication of this study.

Qualitative component

The qualitative data analysis was conducted to interpret, explain, and elaborate the quantitative results. Although descriptions of the qualitative method chosen were not given, it seems that the authors used a grounded theory approach. I inferred this approach because researchers referred to their analysis method as an iterative approach in which the data was first divided into units of analysis and then each unit of analysis was classified according to its function in the dialogue. I identified that the role of the researcher was more like an observer than a participant observer. The only participation the researchers had consisted of giving technical instructions on how to use the tool, but essentially the researchers did not take part of the interactions between groups through the chat tool. However, the authors did not make any comment regarding ethical issues, such as how the confidentiality of students was maintained and whether students gave consent to analyze their chat conversations.

Concerning the data analysis methods, from descriptions provided by the authors it seemed that they started their analysis by open-coding followed by axial coding. In

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addition the authors provided excerpts of students' conversations with the purpose of demonstrating their coding approach as well as a way to support their conclusions.

*Results and Discussion.*

The results section of this study was very well analyzed, organized, and presented. For the case of the quantitative component of the study the authors analyzed their results in terms of descriptive and inferential statistics. For the case of inferential statistics the authors used adequate tests in relation with the small sample size and in general the results of the study were reported in terms of p values. For the case of the Correlational portion of the study, the variables were carefully selected and the rationale for each was described. The conclusions then were presented in terms of degree of relationship between the variables instead of suggesting causal relationships. The qualitative portion of the study was utilized as a way to provide more insight of the quantitative portion; in which the authors identified that the use of the regulative condition reduced students' need to discuss about regulative aspects resulting in more opportunities for discussions related to the cognitive task.

In conclusion, throughout the results and discussion sections the authors compare and contrast their results with results found in other related studies and provided enough evidence and description of their rationale for their understanding of the data. In addition the authors provided enough tables showing clear results, figures demonstrating the software interfaces, and examples of models created by students. Finally, the authors discussed the results in terms of their testable conjecture, highlighting the limitations of the study, and providing recommendations for future work.

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Appendix B: Summary of Results

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| Description | Data Analysis Process | Results and Discussion |
|---|---|---|
| Learning Outcomes<br>Referred to students' conceptual domain knowledge and their scientific reasoning of the overall model structure.<br>Models created by the students were used as the data collection instrument<br>The learning outcomes were assessed from the number of correctly specified variables and relations in the models created by the groups. | For assessing knowledge: one point was awarded for each variable named correctly, one point was awarded if that variable was of the correct type, one point was awarded for each correct link between two variables, and up to two more points could be awarded for each correct link between two variables.<br>The Mann-Whitney U test was used to test between group differences. | Most of the groups were unable to attain complete models. However, after further analysis the authors demonstrated that the groups exposed to the online scaffolds on average achieved significantly higher model quality scores than those groups who were not exposed to the online scaffolds.<br>The authors concluded that providing regulative guidelines helped students create models of higher quality. |
| Learning Activities<br>Referred to students' actions associated with planning, monitoring and evaluation.<br>For assessing students' actions associated with planning the researchers focused on: a) viewing of specific goals, b) adding goals or sub goals, c) viewing hints and d) viewing the goal descriptions<br>For assessing monitoring the researchers focused on: a) adding notes to goals, b) marking goals complete, and c) checking the history<br>For assessing evaluation researchers focused on: a) generating the report and b) writing within the report | The analysis of the learning activities performed by students was done in terms of frequency of verbal actions related to planning, monitoring, and evaluation. Furthermore inferential statistics were conducted and results were reported in terms of P values. | The students exposed to the software scaffolds performed more actions associated with planning. The authors concluded that providing regulative guidelines helped students for planning purposes. The regulative directions in the regulated group gave them a head start devoting less time to develop task understanding and strategic plans.<br>Monitoring actions were performed less frequently by all students in both conditions.<br>Evaluating actions were almost not performed by all students in both conditions.<br>The authors concluded that this may be due to the lack of time to conclude the task.<br>Since models developed by students were not at the point to be evaluated, the researchers excluded the evaluation activities form the analyses.<br>The analysis of the instructional condition demonstrated that it had an effect on cognitive episodes of groups exposed to the scaffolds; while for the case of the groups not exposed to the scaffolds it did not have an effect.<br>In relation with the affective and procedural episodes, both were comparable across conditions. |
| Correlations<br>Correlational analyses were performed to reveal how model quality scores related to learning activities. | Correlational analysis were performed as well as significant tests were conducted. The results were reported in terms of P values | Model quality was not associated with the use of the software Process Coordination in both conditions in the activities of planning and monitoring.<br>Groups which engaged in more regulation of their group work also had lower model quality scores.<br>Groups with lower instances of regulation of the learning task talk tended to achieve higher model quality scores. |
| Verbal Interaction<br>This portion of the study was analyzed through qualitative approaches to provide more insight of the quantitative portion.<br>The logs from the chat tool were used as the data collection method. | The analysis was done using an iterative approach: the first unit of analysis was determined by segmenting chat messages into utterances (a collection of words with a single communicative function) then they created classifications according to its function in the dialogue (e.g. cognitive, regulative, affective, procedural, and off-task utterances)<br>With the initial coding the authors proceeded to group similar utterances into episodes. Regulative episodes were further subdivided as regulation for collaboration and regulation of the learning task. | For the case of the students exposed to the scaffolding hints, it was reduced the need to discuss about regulative aspects. As a result this created more opportunities for discussions related to the cognitive task. |