Clearing House Unterricht

Short Review

Self-explanation as a learning strategy: How can teachers support students?

Teaching-learning research assumes that learners gain a deeper understanding of content when they themselves explain and develop concepts, facts, and contexts. Teachers or lecturers can stimulate learners with different prompts for such self-explanations. In their meta-analysis »Inducing self-explanation: A meta-analysis«, Bisra and colleagues (2018) investigate whether these prompts actually lead to a deeper understanding of learning content. They come to a clear conclusion.

INTRODUCTION. Previous research has shown that students learn much more effectively when they check their understanding spontaneously and on their own initiative on a regular basis and try to explain connections to themselves. As a result, they develop a deeper understanding and generally achieve better learning performance.

META-ANALYSIS AT A GLANCE

Focus of the study	Effectiveness of self-explanation prompts
Target group	School students and adult learners
Average effect size	Medium overall positive effect ($g = 0.55$)
Further findings	The finding is stable across different contexts and forms of implementation

Students often have the tendency to simply memorize the content of procedural steps. However, they often do not understand how individual steps build on one another or the meaning behind certain terms. Thus, they do not develop a deeper understanding of the content. Teachers can deal with this situation in different ways: they can offer students explanations or specifically encourage them to explain concepts and connections to themselves.

In their meta-analysis, Bisra and colleagues examine this issue: Do students benefit from self-explanation prompts? Or do such prompts tend to overwhelm students and thus not contribute to learning as efficiently as assumed?

SELF-EXPLANATIONS

Self-explaining is a cognitive activity designed to help learners develop a deeper understanding of the learning content. In contrast to receiving instructional explanations from the teacher, learners develop and explain terms, facts, and connections to themselves.
For example, they create links between task content and their own prior knowledge, become aware of which individual steps are necessary to solve a task, or detect which argumentative structures (e.g., thesis, evidence, or counter-thesis) are contained in a text passage.
Some learners show this behavior spontaneously, while others need encouragement through questions and other prompts. Such prompting can be used before, during, or after working on tasks. These prompts include formulations such as »Explain this concept«, »Justify this decision«, or »Which solution step will you use and why?«. The central point is that these prompts do not contain any additional factual information or explanations.

WHAT IS THIS STUDY ABOUT? The meta-analysis addresses the question of whether students are better able to remember, understand, and apply learning content to new circumstances if they are encouraged to explain this learning content to themselves when working on tasks. From the point of view of learning psychology, better performance through self-explanations should result from students use of their existing knowledge to acquire new content, process it more deeply, and make better connections.

The meta-analysis is based almost exclusively on experimental primary studies. These compare the learning performance of students who receive written self-explanation prompts for tasks with students who work on the same task but do not receive any self-explanation prompts. In the control groups, students instead receive:

- tasks without additional prompts,
- additional content explanations (= instructional explanations), or
- prompts for reviewing content, creating summaries, or explaining something to someone else.

This makes it possible to clarify whether self-explanation prompts are only more effective when there are no other prompts in comparison, or whether they are also superior to other forms of prompts. In addition, moderator analyses can be used to determine whether the effectiveness of self-explanation prompts depends, for example, on the subject, or on the timing (e.g., whether the prompt was given before, during, or after completing the task).

In total, the researchers were able to identify 64 suitable studies from 1993 to 2013. This includes data from 5,917 learners. Moreover, 41 experimental comparisons come from mathematics and science, 13 experimental comparisons from secondary education and 18 experimental comparisons from European countries.

WHAT DID THIS STUDY FIND? Across all studies, the meta-analysis revealed a significant overall mean effect of $g = 0.55$ (confidence interval $g = 0.45$ to $g = 0.65$) in favor of working on tasks with self-explanation prompts. On average, students showed better learning performance in remembering, explaining, and applying content when they received self-explanation prompts than when they worked on the tasks entirely without prompts. To a lesser extent, this was also true in comparison to content-based explanations (= instructional explanations) or other prompts offered by the teacher. An overview of all types of prompts investigated can be found in the overview of all individual findings.

Furthermore, the moderator analyses showed only a few statistically significant differences in the strength of the effects. It should be emphasized, for example, that prompts which encouraged students to explain concepts were significantly more effective than metacognitive prompts which encouraged them to explain their planning or their performance on the task. Overall, the findings provide a consistent picture: working on tasks with self-explanation prompts is more conducive to learning than working on tasks with other types of prompts or no prompts at all.

HOW DOES THE CLEARING HOUSE UNTERRICHT EVALUATE THIS STUDY? The *Clearing House Unterricht Research Group* evaluates the meta-analysis using the following five questions, guided by the Abelson criteria (1995):

How substantial are the effects? The average effect size is in the medium range ($g = 0.55$) according to the standard Cohen (1988) classification. This effect size means that slightly more than 70% of learners with self-explanation prompts performed better than the average outcomes of learners from control groups with other types of prompts or no prompts. This positive effect is stable across many different situations and conditions. At the same time, some studies showed that the effectiveness can also be significantly higher, for example, when learners are encouraged to explain concepts to themselves. A crucial factor in estimating effect sizes is that almost all studies (over 90%) have an experimental design. This makes them more reliable in ensuring that the effects are actually due to the self-explanation prompts and not to other study characteristics. However, the meta-analysis does not include information on which test instruments were used to measure the performances. This information would be helpful, as it is known from research that it often makes a difference whether standardized or non-standardized achievement tests are used (cf. Cheung & Slavin, 2016).

How differentiated are the results? The differentiated nature of the reported effects is estimated based on the school subjects, age levels, and the success criteria examined. The meta-analysis provides differentiated values on different subject areas (mathematics, science, social science, and computer science) and different age levels (primary, secondary, adult learners). Success criteria examined included recall, comprehension, transfer, and problem solving. However, differences among these three contexts were not significant, meaning self-explanation had similar positive effects in all three areas.

How generalizable are the findings? Self-explanation prompts can be used in a variety of ways and contexts. The numerous and varied moderator analyses demonstrate this flexibility (see overview of all individual findings). The moderator analyses also showed that, with few exceptions, no statistically significant differences were found. This suggests that the positive effect of such prompts can be well generalized.

Learners often approach the independent processing of learning content with different prior knowledge and abilities. In addition, different types of learning content can have different demands on the learner. However, it was not investigated whether and how prompts for self-explanation are related to individual learner prerequisites, or to the complexity of the learning content. In this respect, it would have been helpful to examine these factors as well.

What makes this meta-analysis scientifically relevant? This meta-analysis is scientifically significant. It is the first comprehensive analysis of studies on the effectiveness of self-explanation prompts. In addition, it offers an empirical contribution for answering important scientific questions from teaching-learning research, for example, the central question of whether it is actually more effective to let learners formulate explanations themselves instead of offering them additional explanations (= *coverage hypothesis*; cf. Hausmann & VanLehn, 2010). Although the meta-analysis can answer this question with »yes« in principle, important practice-relevant questions remain open for future research:

- Does the positive effect remain for learners with different competencies and for tasks of varying complexity?
- Do learners internalize self-explanation strategies when teachers prompt them to do so frequently and regularly at first, and then slowly phase them out as learners' expertise increases (i.e., fading)?
- Can digital applications that provide more individualized prompts further increase their effectiveness?

How methodologically reliable are the findings? The transparency and justification of the methodological approach only partially meets the standards criteria of common requirement guides (e.g., APA Metaanalysis Reporting Standards). All important details were reported about the statistical analysis. However, the authors did not adequately document the steps in the search, selection, and coding of primary studies. For more information on the assessment of the methodological approach, see our rating sheet.

CONCLUSION FOR CLASSROOM PRACTICE. Based on 20 years of research, this meta-analysis shows that students generally benefit from tasks that encourage them to explain things to themselves and to think more intensively about content connections.

The findings also show that prompts for self-explanation can also be more effective, on average, than when teachers explain facts to students. If the aim is for students to develop a deeper understanding of content, it is advisable for teachers and their design of learning materials to encourage students to first think more carefully for themselves. For example, they can explain to themselves what they understand about a certain concept.

In this context, however, the question remains open as to how self-explanations work with complex subject matter or with students who have little prior knowledge. Digital offerings with adaptive methods may be a helpful tool for the future. Further research in this area is needed to provide reliable answers.

EXAMPLE STUDY

The study by Eckhardt and colleagues (2013) demonstrates that prompts for self-explanation can be at least as effective as instructional explanations. The study focused on eighth-grade biology and included 124 student participants. In the topic area »Aquatic Ecosystem«, the learning objective was for students to understand the relationships between the evolution of hunter and prey populations. In line with inquiry learning, in a computer-based learning environment the students could make predictions about the development of the two populations. Using a computer simulation, they tested their predictions and were then able to interpret their results.

The study examined which type of support helped students most effectively, particularly with interpreting the results. The researchers distinguished between three types of support, with school classes randomly assigned to one of three study conditions:

- In the first condition, students were instructed to describe and interpret their results themselves (self-explanation prompt).
- In the second condition, the computer program issued a complete interpretation of the results to the students (predetermined explanation).
- In the third condition, there was no further assignment or assistance given for the task (unsupported).

All students worked with the learning material for a total of two 90-minute sessions. The results of the knowledge tests after the respective learning units showed that self-explanation prompts (condition 1) produced the best performance and that instructional explanations (condition 2) also led to better performance than in the condition which received neither explanations nor additional support (condition 3).

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LINKS.

To the meta-analysis from Bisra et al., 2018.

To the example study from Eckhardt et al., 2013.

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