

## ENHANCING DEEP COMPREHENSION IN HIGH SCHOOL STUDENTS THROUGH THE USE OF GRAPHIC ORGANISERS

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### Abstract

Reading comprehension is acknowledged by the European Commission as a citizenship right (Recommendation 2006/962/EC) and one of the goals of the 2030 Agenda; however, OECD PISA data show that scores on reading tasks have been steadily declining over the past 15 years, and in 2022 the average reading performance dropped by 10 points, that means half a school year (PISA, 2023). The present project aims to investigate the relationship between the use of cognitive strategies that support students in reading and information processing and deep comprehension of a text, with the aim of guiding the student towards achieving meaningful learning (Ausubel, 1968). Results in a reading comprehension test from a sample of 45 11th-13th graders don't show any difference between a control group with no given material nor instruction and two experimental groups provided with a guided or expert-made map. However, answers from a qualitative self report show a higher cognitive engagement when using a map, and students reported they perceived the use of a conceptual map as beneficial. According to the literature, we hypothesise that graphically visualising concepts may be beneficial when the task is complex, but may harm learning and comprehension when the task is perceived as easy, since it can add cognitive demand, increasing the students' cognitive load.

**Keywords:** *Reading comprehension, meaningful learning, visualisation, conceptual map, graphic organisers.*

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### 1. Introduction

Reading comprehension is acknowledged by the European Commission as a citizenship right (Recommendation 2006/962/EC) and one of the goals of the 2030 Agenda; however, OECD PISA data show that scores on reading tasks have been steadily declining over the past 15 years, and in 2022 the average reading performance dropped by 10 points, that means half a school year (PISA, 2023).

The aim of the presented project is to stimulate reflection with a view to the development of meaningful learning and metacognitive skills - learning to learn - of students. The purpose of education is to train strategic readers (Gentile, 2017), who are able to deeply understand the meaning by achieving a stable representation of what they read (Gentile, 2017), practising strategies autonomously, reflecting on their reading, making connections with their prior knowledge, using images and illustrations (Ruiz, 2015), to make connections with their own lives and give meaning to what they learn. In fact, deep comprehension is a fundamental condition of learning (Vezzani, 2023), understood as the result of mental representations generated from the systematic organisation of information (Seel, 2003; Clement & Rea-Ramirez 2008; Schnotz, 2014) through the identification of key concepts and the integration of these with prior knowledge. It requires cognitive patience (Wolf, 2018) and it is possible to hypothesise that it can be facilitated by tools for the development of cognitive strategies that enable students to process, visualise and relate information, so as to create mental models of the learned topics (Seel, 2003), such as graphic organisers and conceptual maps, i.e., «graphical tools for organizing and representing knowledge» (Novak, Cañas, 2008).

### 2. Research

The present project aims to investigate the relationship between the use of cognitive strategies that support students in reading and information processing and deep comprehension of a text, with the aim of guiding the student towards achieving meaningful learning (Ausubel, 1968). According to literature, it is

possible to hypothesise that comprehension can be facilitated by tools for the development of cognitive strategies that enable students to process, visualise and relate information, so as to create mental models of the learned topics (Seel, 2003; Schnotz, 2014). To investigate this hypothesis, we carried out exploratory research developed around the following research question:

*RQ: Is it possible to enhance students' comprehension using specific cognitive strategies, such as graphic organiser or conceptual maps?*

## 2.1. Sample

The sample consisted of 45 students from 11th-13th grades of an Italian high school.

The students were divided into three groups: a control group (no material group, NM; n=15), to which no instructions nor support material were given, and two experimental group, one provided with a conceptual map made by an expert (expert map group, EM; n=15) and one provided with a blank conceptual map to fill following specific guiding questions (guided map group, GM; n=15).

## 2.2. Materials

For each group, a file was prepared with instructions, passages, comprehension questions, text, and a qualitative questionnaire concerning the use of reading comprehension strategies. The two experimental groups were given concept maps: the EM group (expert map) was given a complete concept map, while the GM group (guided map) was given an empty concept map, to be completed after reading the text by following the guiding questions on the arrows.

Three passages on philosophical topics were selected for research, specifically passages on philosophers studied throughout the year. For class three, a passage on Plato's political theory was chosen, taken from M. Vegetti's Introduction to the Republic. For class four, a text on the development of the modern state in Hobbes' theory was chosen, taken from Bobbio's monographic volume. For class five, a text on radical evil in Kant was chosen, taken from K. Jaspers. The passages were followed by 11 questions, 10 multiple-choice and one open-ended asking the student to write a summary of 10-15 lines. We chose to use multiple-choice questions to test comprehension of the text to ensure that the comparison between the various groups was as rigorous as possible but, in order to have more feedback on true comprehension and to neutralise any bias arising from closed answers, it was decided to have the students also write a summary.

Finally, a qualitative questionnaire was prepared on the use of any reading comprehension strategies, the difficulty of the task and the effectiveness of the use of the maps provided. The students in the two experimental groups were asked whether or not they found the map useful and to explain why; the students in the control group were asked to list which strategies they had used (if any). Finally, all three groups were asked to express the difficulty of the passage and questions by rating them on a 4-point Likert scale, where 1=not at all, 2=a little, 3=quite a lot, 4=very much.

## 2.3. Procedure

The study took place over the course of one school day. The students were asked to read the passage and answer the comprehension questions and the final evaluation questionnaire in a time frame of one and a half hours. The activity was introduced by giving the students instructions that were also written on the sheets as follows:

*"Read the text carefully. After you have finished reading the passage, answer the comprehension questions. The questions are multiple choice, i.e., there are answer alternatives from which you have to choose only one. After answering the questions, write a summary of 10-15 lines. Finally, fill in the final questionnaire, but only after you have completed the text comprehension part. If there are words you do not know, circle the word.*

*Be careful: once the test has started, you will not be able to receive any help." The two test groups were instructed to help themselves to the map provided (EM) or to "Read the text carefully, keeping the question paper in view. Underline phrases or expressions that may provide clarification, answers or definitions. Fill in the map by following the indications on the connecting arrows" (GM).*

## 3. Results

### 3.1. Quantitative data

The students' tests were scored by awarding one point for each correct multiple-choice answer; for the score of the summaries, one point was awarded for each conceptual core cited by the student, which had been previously identified in the texts. This score was then reported in tenths.

The data were reported in a table and processed on Jamovi. The sample does not comply with a normal distribution (Shapiro-Wilk  $p < 0.001$ ), so the Kruskal-Wallis non-parametric one way of variance

test was run to analyse the difference between the groups, the results of which are shown in table 1. In-between groups comparisons of scoring are also shown (table 2).

Table 1. Results of the Kruskal- Wallis variance test of the scores in the reading comprehension tasks.

Kruskal-Wallis			
	$\chi^2$	df	p
Essay - scores	2.513	2	0.285
questions - scores	0.423	2	0.810

Table 2. Pairwise comparison of the scores in the reading comprehension tasks.

Pairwise comparisons - Essay - scores				Pairwise comparisons - questions - scores			
		W	p			W	p
no material	expert map	2.385	0.210	no material	expert map	-0.6626	0.886
no material	guided map	1.385	0.590	no material	guided map	-0.9010	0.800
expert map	guided map	-0.235	0.985	expert map	guided map	-0.0909	0.998

### 3.2. Qualitative data

Graphic 1. Answers to the question: Was the map useful?

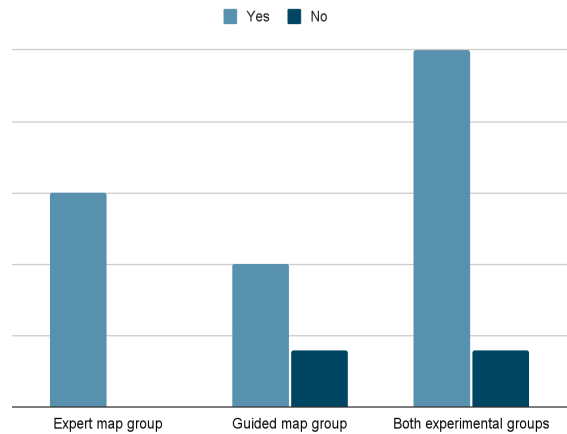


Table 3. Answers to the question: Was the map useful? With explanations of reasons.

Was the use of the map beneficial?	Reasons:
Yes	<ul style="list-style-type: none"> <li>• Summary function</li> <li>• Anticipatory function</li> <li>• General frame of the text</li> <li>• Visualisation and organisation of concepts and logic connections</li> <li>• Correction of mental models</li> </ul>
No	<ul style="list-style-type: none"> <li>• The text was easy</li> <li>• Added cognitive load</li> </ul>

Graph 1 shows the answers of the students in the two experimental groups (29, because one student did not answer) to the question concerning the usefulness of concept maps and Table 3 shows the reasons given by the students in this regard. Finally, as regards the response to the Likert scale concerning the difficulty of the passage and the questions, almost all the students stated that both were not very difficult (2). Among the used strategies, the control group listed rereading, connecting previous knowledge, highlighting key concepts, dividing paragraphs and creating a conceptual map.

#### 4. Discussion

The research hypothesis stated that there could be a significant difference between the scoring depending on the material used. However, the Kruskal Wallis test reports a p value  $>0.05$  and a chi-square of 0.4 for questions and 2.5 for essay, i.e., smaller than the critical value, and therefore the null hypothesis cannot be rejected, i.e. we cannot state that there is a significant difference in the results between the three groups. This result is also easily explained in light of the results from the qualitative questionnaire. As a matter of fact, almost all of the students stated that the text to be read was indeed easy, making the use of additional strategies superfluous if not actually counterproductive because, we can assume, easy tasks increase the cognitive load rather than reduce it. Furthermore, students who were not provided with material for the graphic organisation of topics still used strategies for working and organising the text, such as underlining main concepts, dividing them into paragraphs and schematizing concepts. Many students who were not given instructions created their own concept maps.

One aspect that remains interesting, however, concerns the answers to the questions on the usefulness of the map found by the students. The answers are interesting mainly for two reasons: firstly, the substantial difference between the usefulness found in the pre-made maps and in the guided maps, and secondly, the difference in use with respect to the school year attended. Although therefore the test results do not show a clear difference between the control group and the two experimental groups, the students nevertheless benefited from the map, which in the case of the already completed map was found useful in all cases, and in the case of the guided map was found useful in 71% of cases, a positive percentage overall but one that shows a difference with the previous one. In fact, completing the guided map turned out to be an additional task for some students, rather than a facilitative exercise for understanding the text; Furthermore, in 11th grade only one student found the map useful, in 12th grade some found it useful and others did not, in 13th grade all found it useful and this allows us to hypothesize that the usefulness of the guided map is also linked to the degree of experience of the students who use it, both with respect to the use of strategies for the graphic organisation of contents and with respect to the familiarity of the contents in question. In fact, while 11th graders began this year to deal with philosophy topics, 13th graders have already been dealing with it for three years.

With respect to the use of the maps, guided or already compiled, the students expressed that they found a benefit for the following reasons: The use of the conceptual maps played the role of graphic anticipator, allowing the students to know in advance the contents they would be confronted with in the text; it provided them with a way of visualising key concepts quickly and in an organised manner, also highlighting the logical connections between them; it acted as a self-test and finally it helped them to «refine and in some cases correct the mental scheme» that the students constructed autonomously following the reading of the text.

The use of conceptual maps, therefore, although it did not lead to significant differences in scoring - also because the students in the control group performed excellently by obtaining very high scores - was perceived by the students as facilitating the comprehension of the contents, the identification of the main junctions of the text read and in the recognition of the logical connections between them, in order to better understand the text and better elaborate a discourse on it.

Overall, therefore, what seems to emerge from the results of this preliminary exploratory study is that visually organising the content to be learned facilitates its comprehension, although this seems to be true predominantly in the case where the source content is actually difficult, otherwise the creation of concept maps or graphic organizers is perceived as an additional task and as increasing the cognitive load.

#### 5. Conclusion

The question we asked ourselves in developing this research concerned the possibility of using concept maps - or more generally strategies that allow the visualisation and integration of concepts and the logical connections between them - to facilitate comprehension and learning. The quantitative results did not allow us to reject the null hypothesis, i.e., to confirm what we hypothesised, but the qualitative results

did highlight some interesting aspects concerning the usefulness of using strategies for the graphic and visual organisation of contents such as concept maps, as discussed in the previous section.

The results on the one hand allowed us to align ourselves with the scientific literature on the subject (Mayer, 2014; Sweller, 2011; Renkl, & Scheiter, 2017) on the other hand to elaborate parameters from which to develop future research. The one presented here is in fact a preliminary exploratory study, which allowed us to identify critical points on which it is appropriate to work in order to verify the starting hypothesis. First of all, seeing the variation in the responses on the usefulness of the guided map among the various classes, it is conceivable that experience in using certain strategies may be an important variable in determining the effectiveness of map use and it is therefore appropriate to specifically instruct students before having them confronted with maps that might otherwise be perceived as difficult and confusing. Furthermore, the ease of text perceived unanimously by students invites us to test the hypothesis that graphic organisers and similar strategies are useful depending on the difficulty of the task at hand. A further limitation of the study, found through the answers to the qualitative questionnaire, concerns the timing of the presentation of the tasks: in the present study, the students were given a single packet containing all the tests, without specifying whether or not they could go back over the text and the tasks: many of the students in the control group reported that they read the text several times, going back over it even after reading the questions: In order to test whether or not consulting or creating a map following the reading of the text can play a facilitating role, it is worth considering separating the reading of the text and the performance of the test with the comprehension questions, letting the students answer only with what they have learnt and not with the text under examination.

On the basis of the results obtained and the criticalities that emerged, it is therefore possible to develop a more in-depth protocol, which also provides for a longitudinal check on the students' learning, also in relation to a path of explanation on the use of certain strategies for organising and visualising content, strategies that were in any case on the whole appreciated by all the students who participated. This path, which is planned to be implemented starting from the next school year, will make it possible to verify the hypothesis underlying this research in a more thorough and rigorous manner.

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