Effects of Redundancy and Paraphrasing in University Lessons: Multitasking and Cognitive Load in Written-Spoken PowerPoint Presentation

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ABSTRACT

This paper is about the use of a widespread teaching tool: the slide presentation used in face-to-face, system-paced university lessons. It is produced by lecturers to support students’ comprehension during listening; nevertheless it poses elaboration requests to the audience which should be taken into consideration at the planning stage and in formulating its verbal content. The paper reports the results of a survey conducted with 163 University students who were asked to listen to a lecture accompanied by a PowerPoint presentation, prepared according to the most frequent formats. The written presentation had 3 degrees of concision/redundancy: it had a fully redundant with the oral message, partially redundant (main points in key words), or had a different linguistic form (paraphrase of the message). Furthermore, information in written text and spoken message could have had the same order or they could be scrambled. The results showed that, subjectively, students judged comprehensible every kind of presentation. However, learning tests demonstrated that paraphrasing negatively affected learning, while changes in the order of presentation did not, at least in the synthetic main point – key word presentations. The study suggested that the concise, only partially redundant, presentation is the one which leads to better results, both in the ordered and in the scrambled version.

Keywords: Conciseness, Learning, Paraphrase, PowerPoint, Redundancy, Scrambling

INTRODUCTION

This research studies the effectiveness of a very common technology, that is, the deck of slides presented during a lecture with a presentation manager such as PowerPoint. PowerPoint (ppt) is one of the most popular tools which allowed the diffusion and development of digital literacy. Its diffusion was contemporary to the diffusion of word processing since the 1980s (Dobson & Willinsky, 2009). Used also by teachers in
schools, ppt e wp became standards – as they are available on almost every pc, they are easy to be used and do not ask for a specific training. However, they are not exempt from criticisms. About ppt, for example, it was said that it fragments thought, makes it impossible to present data with efficacy, forces to use templates which don’t correspond to the text’s conceptual structure. As Tuftee wrote (2003) http://www.wired.com/wired/archive/11.09/ppt2.html the PowerPoint style routinely disrupts, dominates, and trivializes content.

Parallel to these criticisms published on the web, on the same web we may find guidelines, advices and also researches on the conditions which may have a positive or negative effect on comprehension of presented information. Conditions which may regard very obvious deficiencies such as poor readability, due to insufficient size of characters or to the low-contrast text-background. But they may also concern aspects more complex and less intuitive, such as the redundancy between text and message information, the interference between written and spoken information, the request to implement complex search to connect the sentences heard with a specific part of the text presented on the screen.

Some of these aspects are under consideration in this paper, which has the aim to examine the effect of redundancy and concision, of changes in linguistic formulation and order of presentation.

First we will describe a framework which tries to explain the ppt producer’s and receiver’s intentions and objectives. Next we will identify some of the factors that may affect ppt effectiveness and will describe the research conducted.

**DOES POWERPOINT PROMOTE LEARNING?**

As a starting point, it seems appropriate to analyze the point of view of teachers and learners about the usefulness of PowerPoint. From a recent study of Cantoia et al. (2011) we obtain a description of the intentions and objectives of the teachers. The sample interviewed in their survey – a group of University teachers – states that they use it with the intention of promoting the understanding of their lessons. The interviewed teachers also said to prefer concise formats, partially redundant with the spoken message, as these formats should facilitate the identification of the structure of the lesson. The aim seems to be to give a cognitive guidance, by which, according to Richard Mayer, one wants to make sure that the audience members build appropriate knowledge in their memory (Atkinson, 2004).

With regard to opinions and behaviors of students, it is possible to refer to researches showing that students prefer classes where there is a presentation with ppt compared to transparencies or absence of every presentation tool (Bartsch & Cobern, 2003; Blokszijl & Naeff, 2004). In fact they find classes which use ppt more compelling, clear and organized (Apperson, Laws & Scepansky, 2004). They also prefer when content is organized in a synthetic way with the use of graphs, diagrams and bullet points (Cantoia et al., 2011).

Other studies also show that students learn more when the lecture is supported by a PowerPoint presentation than when it is not (Blokzijl & Andeweg, 2005; Paoletti, Rigutti, & Guglielmelli, 2008), although the results are not conclusive in all researches (Savoy et al., 2009). The conditional success of the ppt can be explained by the fact that it can act as an Advance Organizers (Ausubel, 1962; Mannes & Kintsch, 1987) when it provides a schematic and ordered overview of the content. In these conditions, the presentation may help in the identification of relevant information and of the structure and organization of the lesson (Clarke, 1992; Stull & Mayer, 2007). When it takes other forms, the result does not seem as favorable, instead.

Thus, it appears that there is some degree of agreement between lecturers and learners on the optimal form of presentation: one that shows the structure-organization of the lesson, with short, concise sentences or key points. The effectiveness of this form of presentation during
classes in which there is a double presentation (written text on the screen and spoken message) seems to be confirmed, for example, by the literature on The Redundancy Effect (Adesope & Nesbit, 2012; Mayer & Johnson, 2008; Paolletti & Rigutti, 2009) that we will describe later.

But this type of presentation is not the only format that can be observed in classrooms and was described in the literature on the subject. The literature (Farkas, 2005; 2006; Bohec & Jamet, 2008; Paoletti, 2012) refers to many types of presentation, including three which we will consider here as prototypical formats of text on slides:

1. The already described concise text: an outline of main points which summarizes key information.
2. A redundant text, which reproduces verbatim the oral message as it is read by the speaker.
3. A set of sentences and phrases which are not read verbatim, but are modified by the lecturer during the presentation: the lecturer re-implements/re-formulate the text on the slide, choosing a different verbal formulation, a loose paraphrase.

In this study, these formats were also encountered during a series of observations and informal interviews conducted in a pilot study. During this pilot study we discerned two interesting factors. First we noticed that the verbal-spoken formulation of the presenter may be more or less similar to the text written on the screen. The text on screen may be read verbatim, may be paraphrased closely (by glossing/expanding the main points) or may be paraphrased loosely (producing a very different text). Second we observed that, with the first and last kind of presentation (concise text, not verbatim sentences) sometimes the speaker gives the information a different order, moving inside the slide and among slides.

In this study we examined five different forms of presentation, assuming a positive effect on ease of processing and learning of similarity between written text and spoken message and of conciseness. More in particular, the factors we have studied are:

1. The conciseness of the written text.
2. The maintenance of the same order / sequence of topics.
3. The degree of correspondence between written and spoken linguistic formulation.

These are factors that affect the ability to process information, call into question the limits of our working memory and the inability to perform multiple linguistic tasks at the same time, as demonstrated, for example, by scholars of the Cognitive Load Theory.

COGNITIVE LOAD THEORY (CLT) VERBAL REDUNDANCY AND CONCISION

Cognitive load is a theoretical construct that refers to the demands placed on the limited capacity of working memory as learners process instructional information. Cognitive load researchers have used the term redundancy effect to refer to situations in which learning is hindered by the presentation of identical information in different formats (Chandler & Sweller, 1991; Kalyuga, Chandler, & Sweller, 1999; 2001; Mayer, 2005; Sweller, 2005).

Learning can be impaired because learners expend cognitive resources to elaborate and integrate a verbal text and a redundant diagram (Chandler & Sweller, 1991) or concurrent animation, narration, and on-screen text (Moreno & Mayer, 2002). In a related line of reasoning it was also predicted that concurrent spoken–written presentations might inhibit learning by inducing extraneous processing.

The reference to a recent meta-analysis by Adesope and Nesbit allows us to understand what consequences may have, in the context under consideration here - a University lecture - to listen to the message and read the text on the screen (Adesope & Nesbit, 2012). Data analysis in this meta-analysis investigated the effects of spoken-only, written-only, and spoken–written
presentations on learning, retention and transfer, in 57 studies, mostly on postsecondary students. The analysis performed lead to the conclusion that there are advantages when the presentation is redundant (written and spoken) and not just spoken. In other words, the expectation of students and teachers that it is beneficial to accompany the auditory presentation with a deck of slides is confirmed.

The effect is particularly significant when the presentation on the slide is concise (low-redundancy), when the learner is a light reader (but the effect is also present with good readers). In addition, the double presentation is particularly advantageous when it is continuous and system-paced, as in face-to-face lessons (the teacher talks and the learner listens and cannot stop, rewind and replay the presentation). The learner in this case (low-redundant written-spoken presentation) would benefit from the permanence of the written text to retrieve pieces of information already processes - if he has lost trace of them because of distraction or did not understood them (Adesope & Nesbit, 2012).

And if so far we talked about text-and-message redundancy, a similar effect also occurs when the presentation is threefold: message, text on the screen and image, as demonstrated by a research of Mayer and Johnson (2008). While large text next to an animation poses processing problems, short texts help to process the animation.

**SIMILARITY BETWEEN SPOKEN-WRITTEN TEXT: SCRAMBLING AND CHANGES OF LINGUISTIC FORMULATION**

When text and message are similar and redundant, because the same information is given in two formats, one can assume that one is supporting the other and that the double processing is not burdensome, indeed is beneficial (Principle of Multimedia Learning, most often verified with text and figure; Mayer, 2001).

But what happens when the text and the message do not look similar because they don’t have the same linguistic formulation and / or the same order / sequence of presentation? In our empirical observation we found that these changes in the spoken presentation (Paraphrasing and Scrambling) are frequent and are caused by many reasons - the ppt was prepared in advance, for other circumstances and reasons, it was prepared for distant students, who could not listen to the oral message - none of which is concerned with ease of processing.

Paraphrasing and scrambling are likely to be two factors which impose a cognitive load and prevent a smooth processing. In both cases, it is required to perform a search on the information displayed on the screen, while listening, to find the corresponding information (i.e., looking for the segment of the text corresponding to the spoken segment, evaluating the correspondence ...) and then a match between sources.

It is not impossible nor infrequent to carry out these multiple processing and indeed in other research settings these are text manipulations intentionally used to improve retention. For example, it has been suggested that changing the order of information could be a factor that prevents the superficial processing of the text, because it increases deep processing and then memory (Lockhart, Craik, & Jacoby, 1976). However this request seems to have a negative impact on the understanding of the less skilled readers and of those who have low prior knowledge (Mannes & Kintsch, 1987).

Changes in the linguistic formulation (paraphrasing) demand the learner to process two stimuli with the same content but with two different linguistic forms. We know that we can do it, because during the processing of a text, we normally lose its surface form and retain the cognitive content of the text, the mental representation of its meaning (Castelfranchi & Parisi, 1980). Recalling this content we cannot reproduce it verbatim: with the exact words, the exact syntax. The problem is that in a situation in which the learner wants to process a sentence (heard) and its paraphrase (written), he/she is located in front of two stimuli that compete for his/her limited attentional and processing resources and interfere.
The processing of scrambled and of paraphrased information is generally feasible, but it requires cognitive resources. It is possible that there is a breaking point, a threshold, beyond which the ppt presentation no longer favors listening and beyond which trying to use the text on the slide while listening to the message makes it more difficult to process the information. What we will try to assess is whether conciseness can at least partially reduce the processing difficulties, due to processing of paraphrased information and of scrambled information. By reducing the size of text segments that must be analyzed during listening, and therefore the amount of written text, conciseness might increase available working memory space and reduce cognitive load.

HYPOTHESIS AND EXPECTATIONS OF THE RESEARCH

In our expectations, the concise text which presents an outline of key points is the preferable presentation, because it shows which pieces of information are most relevant and how they are structured. A fully redundant deck of slides (like a prompter) is a format that does not create interference between listening and reading and so it may have some advantages compared to the third format – non verbatim sentences – which could be the worst condition, because it requires the elaboration of two interfering sources of information. Finally, processing may be negatively affected by a different ordering of topics between ppt and message.

We are accustomed with this kind of request: a speaker may in fact decide, during the oral presentation, to give a different emphasis and priority to some pieces of information by changing the order of presentation of topics. The same happens when the author of a book tells the story with flashbacks and changes in perspective (Kintch et al., 1977). However this may be a factor that makes it difficult to perform search and match activities in order to integrate message and text, especially when the text is verbose. The listener may try to shift attention from one source to the other. We guess that this attempt can only succeed up to a certain limit that is up to a certain amount of information.

The focus of this paper is therefore on the following question:

*What happens when the on-screen presentation does not correspond to the oral presentation of the lecturer, because the linguistic formulation is different and the order of presentation of the information does not match?*

**METHOD**

**Subjects.** 163 undergraduate students attending to 5 courses for the third year of two Faculty (Psychology and Education Studies) in northern Italy participated to the study. Every class/course was assigned to one of 5 experimental conditions. This procedure explain the slight differences between group numbers. Participation to the investigation was requested as a course assignment.

**Material.** The subjects listened to a lecture (the spoken message remained constant in every condition) that reported a research on the requests of teenagers with respect to online newspapers (*Teens know what they want from online news: Do you?* Media Management Center, University of Illinois, 2009). The message was accompanied by a series of slides in one of 5 different conditions:

1. Fully redundant ppt (prompter condition).
2. Concise ppt (main points in bullet) with the same order of the message.
3. Concise ppt but with scrambling.
4. Non-verbatim sentences in the same order of the message.
5. Non-verbatim scrambled sentences.

**Measures and Procedure**

Immediately after the presentation of every slide, subjects were asked to assess its comprehensibility. The purpose of this question
was to have information on the learner’s ability to identify the conditions of difficulty and to identify those learners who might require a higher level of concentration.

After completing the reading/listening of the deck of slides, a distractor task was performed: the reading of one text on an unrelated topic. Students were asked to read a short text on Zoology and to answer to 10 comprehension questions (prove MT, Cornoldi, Pra Baldi, Rizzo, 1991).

Next, through a questionnaire, students underwent a test of:

- **Recall (open questions, 0-15 points):** the first test required the participants to recall the relevant elements mentioned in the presentation and the related advices on how to make a web page more readable,
- **Application/transfer (open question, 0-15 points):** the second test required that the participants used the learned advices to evaluate 2 homepages of online newspapers.

The total duration of the experiment was 40 minutes (20 minutes for the ppt presentation).

Evaluation was performed by the 3 researchers, who previously established common criteria. Doubt cases were solved by discussion.

**RESULTS**

We refer once more to our initial hypotheses, in which our expectations were that different types of presentation slides have varying levels of facilitation of understanding.

This is especially the case as:

1. The “Key Points” presentation is preferable, because it reduces cognitive load, shows which pieces of information are most relevant and how they are structured;
2. The “Fully Redundant” deck of slides (prompter) is a format that does not create interference between listening and reading and therefore could have some advantages for online information recovery;
3. The “Paraphrase” is the worst condition, because it requires the elaboration of two interfering sources of information.

We have also proposed the two formats (key points and paraphrase) in a scrambled form. In this case there was no correspondence in the order of presentation of the topics between the written text on the slide and the oral presentation. These conditions (scrambled) could create further problems for elaboration and understanding.

The first aspect examined concerned the perceived comprehensibility in the different conditions. Comprehensibility was examined by asking participants to judge the clarity of each slide immediately after its presentation using a ‘yes or no’ response.

Because the three decks differed in length (there were 10, 13, 16 slides in the concise, sentence, fully redundant decks, respectively), the length of the decks was taken into account by using averaged judgments or scores (Mannes et al. 1996). Therefore, for each deck, the judgments could range from 1 (perfect comprehensibility) to 0 (insufficient comprehensibility).

All the different types of presentations have been judged as highly comprehensible by learners (Table 1).

A more detailed examination shows that the group who was given the slides in the form of the Scrambled Key Point (SKP) claimed to perceive the slides as less understandable.

The analysis of variance when applied to differences between groups gave highly significant results (F4,158=10,888, p.>0,000001). The significance is due to the presence of the mentioned group (SKP). This fact is confirmed by the post hoc HSD per disequal N analysis: this group perceived the deck of slides as less comprehensible compared to all the other groups (p>.0,001).

This indicates that, as far as we consider the initial subjective judgment provided by the
learners, the presentation SKP (Scrambled Key Point: concise material that does not respect the sequential order of the message) is considered less understandable.

Next, we tested the efficacy of the different kinds of presentations with a Recall test, and an Application/Transfer test. Table 2 displays the average and standard deviation of the number of elements that have been recalled and the elements that were used to evaluate the layouts of the online newspapers during the transfer test.

At first, it should be noted that the same trend was found in all groups in the Recall and Transfer tests.

The data that emerges is the one of the best performance, which was given by the Scrambled Key-Point group, closely followed by the Key-Point group.

These data allow us to support the hypothesis that a concise written presentation helps the learners, causing them to get the best results out of all the groups tested.

The Scrambled Key-Point version reveals a slight contradiction between the poor judgment given in the previous comprehensibility test and the results.

A possible interpretation of this is that the Scrambled Key Point condition initially requires an effortful reworking of material (short written main points that must be integrated with oral ones), that appears the most complex. However, integration was carried out and a deeper processing was performed as Lockhart et al. (1976) suggested. The results are evident in Recall and Transfer tests.

At about the same level were the results of the Fully Redundant presentation group. These students showed a good performance in the post test, along with a positive judgment of the comprehensibility given during the evaluation of the slide.

Instead, those who were given the Paraphrase submissions obtained the worst results both in the phase of Recall and of Transfer. Table

### Table 1. Perception of comprehensibility in different conditions

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Sd</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Points (KP)</td>
<td>0,9</td>
<td>0,07</td>
<td>32</td>
</tr>
<tr>
<td>Fully Redundant (FR)</td>
<td>1</td>
<td>0,04</td>
<td>33</td>
</tr>
<tr>
<td>Paraphrase (P)</td>
<td>0,9</td>
<td>0,12</td>
<td>41</td>
</tr>
<tr>
<td>Scrambled Key-Point (SKP)</td>
<td>0,8</td>
<td>0,08</td>
<td>25</td>
</tr>
<tr>
<td>Scrambled Paraphrase (SP)</td>
<td>0,9</td>
<td>0,11</td>
<td>32</td>
</tr>
<tr>
<td>All</td>
<td>0,9</td>
<td>0,10</td>
<td>163</td>
</tr>
</tbody>
</table>

### Table 2. Performance in test of “recall” and test of “transfer”

<table>
<thead>
<tr>
<th></th>
<th>Recall</th>
<th>Transfer</th>
<th>Tot. sub.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Sd</td>
<td>Mean</td>
</tr>
<tr>
<td>Scrambled Key-PointP</td>
<td>12,2</td>
<td>1,39</td>
<td>11,7</td>
</tr>
<tr>
<td>Key point</td>
<td>11,3</td>
<td>3,22</td>
<td>11,1</td>
</tr>
<tr>
<td>Fully redundant</td>
<td>11,1</td>
<td>3,65</td>
<td>10,5</td>
</tr>
<tr>
<td>Scrambled paraphrase</td>
<td>6,2</td>
<td>3,11</td>
<td>5</td>
</tr>
<tr>
<td>Paraphrase</td>
<td>5,9</td>
<td>2,44</td>
<td>4,7</td>
</tr>
<tr>
<td>All</td>
<td>9</td>
<td>3,97</td>
<td>8,2</td>
</tr>
</tbody>
</table>

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shows their inferior results as compared to the other groups. These data are in contrast with the initial judgments of comprehensibility. It is possible that the students have not perceived a greater difficulty than the one they perceive in their usual class experience. Evidently, the threshold beyond which the ppt is no longer a help and it becomes an obstacle was encountered. The anova confirmed the existence of significant differences between the 5 groups. The differences between conditions were significant both for the test of recall \( (F(4.158) = 36.041, p > 0.00001) \) and for transfer \( (F(4.158) = 34.768, p > 0.00001) \). The factor that has affected the quality of the performance was found to be the difference between the spoken-written linguistic formulation.

Groups with text paraphrased have obtained results statistically lower than all others, both in the case of the test of recall \( (p < 0.00001) \) and in the one of transfer \( (p < 0.00001) \). No significant difference due to changes in order of the information was found.

CONCLUSION

In this study we explored the effects of submitting a text written with PowerPoint along with a spoken message which could be redundant or with a different linguistic formulation, in order to find under what conditions a spoken-written presentation could favor the processing of the information presented during a lecture.

However, it is advisable to place method and results of our research in a broader framework, centered on the construct of Digital Competence. As we said in the introduction, the aim of this study was not to keep track of procedural knowledge and technical skills, such as those related to the readability of the slides. The objective of this study was to take a step towards the understanding of the factors underlying the use of this tool for information presentation and elaboration. We tried to get some insights on the mental models held by teachers and students (Norman, 1986, 1988).

We saw that the relationship between a slide and the oral message, which can occur with different forms, can lead to different consequences with respect to the availability of the message to the learner. Furthermore, we ascertained how shallow it is the awareness of the subjects involved. We wondered about how teachers can take care of this low awareness, in order to facilitate communication and to make less complex the task of listening / reading.

Teachers increasingly use ppt presentations to accompany their lessons. Students increasingly expect it, and it is important to understand which type of presentation can be useful and which ones can pose obstacles. The effort that we faced was to link the construct of Digital Competence to the Cognitive Load construct and Theory, present in the literature to which we have referred. This gave us some elements to identify and reflect on the conditions that may facilitate information elaboration. Literature (Adesope & Nesbit, 2012) presents us with a certain type of ppt as optimal: the concise, ordered, organized one.

As we have seen in our results, this form of presentation was the more productive. The consequence, in our opinion, is not to adopt only the presentation in Key-point, but to take care of listening / reading difficulties in order to promote the use of both sources (written and oral), and more generally could push learners to mobilize their cognitive, meta-cognitive and motivational resources in a productive way.

Our expectations were that the concise text - characterized by low redundancy with the verbal message - should have many advantages: it selects and highlights the most important information and the organization of topics in a concise Advance Organizer (Ausubel, 1962), it allows the learner to immediately identify the important information, distinguishing them from the details (Mayer, 2005; Sweller, 2005).

In a face-to-face presentation the concise text should be more effective than a fully redundant text, which can be useful only in special circumstances, such as when listening is made difficult by reading or hearing problem or by
the use of a foreign language (Clark & Mayer, 2002). The concise text should also be more useful than a presentation that paraphrases the linguistic form of the spoken message.

Sometimes PPT presentations do not follow the message sequencing and organization, use different wording, are not concise but dense of information and verbose. We hypothesized that, when one or more of these characteristics were present, it was effortful for the reader/listener to elaborate and integrate the two sources of information (Farkas, 2005; Paoletti, 2012). Audiences may find it disconcerting when presenters bypass points or when it is unclear which point is being glossed (Farkas, 2005).

We posed the question how burdensome and costly, in terms of cognitive resources, it would be to try to process an oral message while processing a non-identical written segment. We know from research on dual task and multitasking that we can learn to perform multiple tasks simultaneously, but that the double processing has a cognitive cost.

As we have seen in the results sections, some of our expectations were confirmed and some were contradicted.

This paper focuses on learning outcomes. However, it seems interesting to mention the judgments of comprehensibility made by the students during reading/listening the deck of slide. We wanted to know whether students knew how to distinguish the conditions under which the PPT favored the processing and understanding from those in which PPT made them more difficult. The first aspect examined concerns the comprehensibility perceived in different conditions, obtained by requesting to judge the comprehensibility of each slide immediately after its presentation.

As we have seen, all kinds of presentations were judged highly comprehensible by students, who were unable to anticipate the conditions that would lead to a bad performance (condition paraphrase) or to a good one (key point condition).

Moreover, analyses showed that the low-redundant condition (outline of key points) is the most effective with all the subjects, regardless of the correspondence in the ordering of the message/text. In concordance with the meta-analysis di Adesome e Nesbit, we found that, in comparison with verbatim, spoken-written presentations, presentations displaying key terms extracted from spoken narrations were associated with better learning outcomes and accounted for much of the advantage of spoken-written over spoken-only presentations. Paraphrasing had a negative effect. Scrambling had a negative effect when matched with paraphrasing.

These findings have significant implications for the design of multimedia materials.

The situation here described mirrors the presentation of a PPT in a face-to-face lesson. It is a situation that requires constant attention and concentration, giving little time to retrieve information not fully heard, understood or analyzed. In this situation, each element of disturbance is truly such, it interferes with the construction of a mental representation of the message. In different situations, in which the time factor is not so crucial – such as when the learner can have the file of the deck and listen to it and read it as many times as he/she wants - probably the difference between spoken-written texts is not so crucial.

We believe that the conclusion that can be drawn from this experience (although still in progress) is that, adding a text to a message can lead to advantages for the reader/listener, however it is advisable to take care of the relationship between written text and spoken message in order to help processing and understanding of new and complex ideas.

REFERENCES


ENDNOTES

1 The word PowerPoint has different meanings: it is the software produced by Microsoft, but it stands also for a whole category of software: presentation managers.

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