Master thesis

Jigsaw method, metatextual knowledge, and prior subject knowledge in multiple documents reading comprehension

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Date: 6 June 2019

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Dankwoord

Circa een jaar geleden stond ik gespannen klaar voor het startschot van mijn thesis. Gemotiveerd om dit avontuur aan te gaan, maar ook onzeker of ik mij hierdoor heen kon slaan met mijn recent geconstateerde blessure. Mijn motivatie was daarom om niet als eerste de finish te behalen, maar om mijn persoonlijke record te verbreken. Dit resulteerde in een ware ontwikkeling op zowel wetenschappelijk, als persoonlijk vlak. Allen die mij hierbij gecoacht, aangemoedigd en gesteund hebben wil ik hierbij graag bedanken.

Allereerst wil ik mijn begeleiders Eliane Segers en Alieke van Dijk bedanken. Eliane, bedankt voor je steun en vertrouwen tijdens het proces. Op de momenten dat ik onzeker was, gaf jij mij het vertrouwen dat het goed ging komen. Bedankt voor je begeleiding en geduld bij het structureren van de thesis en het analyseren van de onderzoeksresultaten. Alieke, bedankt dat je deur altijd voor mij open stond voor vragen of om te sparren. Met jouw kennis inspireerde, motiveerde en stimuleerde je mij tijdens het proces.

Daarnaast wil ik de betrokken docent, roostermaker en de respondenten van het ROC van Twente in Almelo bedanken voor het meewerken, meedenken en het bijdragen aan dit onderzoek. Zonder jullie had deze thesis niet kunnen worden geschreven.

Ook wil ik graag familie en vrienden bedanken. Laura, hartelijk dank voor het delen van jouw ervaringen en tips. Daarnaast wil ik je bedanken dat je altijd voor mij klaar stond in deze periode. Koen en Jean-Paul, bedankt voor jullie kritische blik en advies. Mijn ouders Dick en Rina en mijn vriend Mario bedankt voor jullie onvoorwaardelijke steun tijdens het proces. Tot slot wil ik Fleur, Lianne en Annefleur bedanken voor hun vertrouwen en support.

Milou Morren

Abstract

This study investigated the effects of the cooperative jigsaw method, metatextual knowledge, and prior subject knowledge on multiple documents reading comprehension. In total, 49 students of secondary vocational education participated in this study and were divided in a jigsaw condition and an individual condition. The participants were tested on metatextual knowledge, prior subject knowledge, multiple documents reading comprehension, and quality of jigsaw cooperation. The materials consisted of four texts on broiler chicken, with different arguments for or against this. The results showed that reading just one text and next cooperate through the jigsaw method with students who each read another text, resulted in comparable multiple documents reading comprehension (as measured via content elements and main messages) as individual reading of all four texts. Furthermore, metatextual knowledge and prior subject knowledge did not have an effect on multiple documents reading comprehension, neither in the jigsaw nor the individual reading condition. It can be concluded that jigsaw is a promising method for multiple documents reading comprehension assignments, as it results in comparable multiple documents reading comprehension compared to an individual reading method where students have to read more documents and lack learning advantages on a social level.

Keywords: multiple documents reading comprehension; jigsaw; metatextual knowledge; prior subject knowledge

1. Introduction

In the current information and knowledge society, there is a high increase in rate of knowledge production and dissemination through modern technologies. As a result, people often need to read multiple documents to gain a complete understanding of an issue or to find an answer to their question (Stadtler & Bromme, 2014). This also plays a role in education, where students are increasingly required to handle and interpret information from multiple documents in reading assignments (Gil, Bråten, Vidal-Abarca, & Strømsø, 2010; Rouet & Eme, 2002). However, secondary vocational education students (in Dutch called mbo-students) experience problems in multiple documents reading comprehension. They experience information overload when they receive high amounts of textual information from multiple documents. Furthermore, they find it difficult to integrate textual information in one broad understanding about the subject described in multiple documents (Groeneveld & Van Steensel, 2009). These problems could be explained by having low metatextual knowledge and/or having low prior subject knowledge. Metatextual knowledge is knowledge about features of texts and reading strategies (Rouet & Eme, 2002), and prior subject knowledge refers to knowledge about a particular topic prior to reading the text (Kostons & Van der Werf, 2015; Ozuru, Dempsey, & McNamara, 2009).

Bråten, Anmarkrud, Brandmo, and Strømsø (2014) explain that problems with multiple documents reading comprehension could be solved with instructional methods that target students' strategic processing and foster beliefs, orientations, and knowledge that underlie multiple documents reading comprehension. Examples of such methods are explicit instruction of integration, modeling of integration, uses of graphic organizers, summarization and annotation of single texts, and cooperative discussions with multiple texts (Barzilai, Zohar, & Mor-Hagani, 2018). Cooperative methods specifically seem promising, because they enable students to enhance their reading comprehension through sharing knowledge and learning from each other (Aronson & Patnoe, 2011).

One cooperative method that could be useful for multiple documents reading comprehension is jigsaw, where groups divide one overall assignment in multiple information sources or topics (Aronson & Patnoe, 2011). Specifically, in jigsaw an assignment or task is divided over group members who share knowledge from their source or topic (Amador & Mederer, 2013; Aronson & Patnoe, 2011; Oshima, Oshima, & Fujita, 2018). Hereby, students are able to use each other's knowledge to "get the whole picture" (Aronson & Patnoe, 2011, p. 27) instead of building on their individual knowledge, including metatextual and prior subject knowledge (Ozuru, Dempsey, & McNamara, 2009). The interactions with group members within the cooperation are key for making sense and giving meaning to information of multiple documents (Van Rijk, Volman, De Haan, & Van Oers, 2017). Through jigsaw, students are able to understand an issue from different perspectives with reduced cognitive effort (Aronson & Patnoe, 2011; Mayer, 2014).

Even though jigsaw seems promising for multiple documents reading comprehension, teachers at school scarcely use the method for reading assignments (Jansen van Rosendaal, 2018; Van Elsäcker, 2002). As students are required to comprehend information from multiple documents, more insights are needed into the effects of jigsaw on multiple documents reading comprehension (see Bråten, Braasch, & Salmerón, 2016; Ghaith & El-Malak, 2004; Slavin, 2015; Zuo, 2011). Therefore, this study aimed to provide more insights into the effects of the cooperative jigsaw method, metatextual knowledge, and prior subject knowledge on multiple documents reading comprehension. The results could provide researchers with more understanding of multiple documents reading comprehension, and the effects of jigsaw, metatextual knowledge, and prior subject knowledge on this. Furthermore, the study could provide practitioners with insights on how to support students' multiple documents reading comprehension.

1.1 Multiple documents reading comprehension

Multiple documents reading comprehension refers to the mental representation and understanding of an issue based on information from multiple text-based documents (Strømsø, 2017). Forming a mental representation about an issue using multiple documents is more complex than when doing this using a single document. To form a mental representation about an issue by using a single document, the reader

must visually process the described words, identify their phonological, orthographic, and semantic representation, and connect them to understand the underlying meaning of the sentence (Perfetti & Stafura, 2014). This meaning must then be integrated across sentences, in which the reader must use relevant prior subject knowledge about the subject, generate inferences, identify the text structure, and take the author's goals and motives in account (Graesser, 2015). In forming a mental representation of an issue by using multiple documents, the reader also has to go beyond within-document integration. Specifically, he or she has to compare, contrast, corroborate, and connect the content of multiple documents in a mental representation (Ferguson, Bråten, Strømsø, & Anmarkrud, 2013). Perfetti, Rouet, and Britt (1999) refer to this mental representation as "the documents model". The documents model consists of an intertext model and a situation model. The intertext model contains the obtained information about the relationships among and within the documents and the events described within each document. The situation model combines the information about the topic or situation described in the multiple documents (Perfetti et al., 1999). In multiple documents reading comprehension, the reader must connect the intertext model and situation model, note and elaborate upon the perspectives discussed in multiple documents, and draw connecting inferences among them (Ferguson et al., 2013).

Multiple documents reading comprehension tasks are important to facilitate a deep and integrated text understanding from multiple documents (Gil et al., 2010). According to the MD-TRACE model of Rouet and Britt (2011), multiple documents reading comprehension tasks must require students to construct a task model, determine the information requirement to perform the task model, select, process, and integrate information from multiple documents, construct the final task model, and finally assess the quality of the final task product to facilitate multiple documents reading comprehension (Rouet & Britt, 2011). Earlier studies have shown that argumentation tasks facilitate multiple documents reading comprehension by helping students to interpret, understand, and integrate information of multiple documents and by stimulating a generally deeper engagement with information described in multiple documents (Britt & Rouet, 2012; Le Bigot & Rouet, 2007; Nussbaum, 2008; Wiley & Vos, 1999). With argumentation tasks, the extent to which students are able to comprehend information from multiple documents and to make connections between this information are made visible (Diakidoy, Ioannou, & Christodoulou, 2017; Wiley & Vos, 1999).

1.2 The effects of metatextual knowledge and prior subject knowledge on multiple documents reading comprehension

Individual variation among readers may impact to what extent the reader is able to connect the intertext model and situation model, to note and elaborate upon the perspectives described in multiple documents, and to draw connecting inferences among them (Kintsch, 1998; Snow, 2002). Two relevant reader characteristics in multiple documents reading have been identified: metatextual knowledge and

prior knowledge about the subject of the text (Kostons & Van der Werf, 2015; McNamara, Ozuru, & Floyd, 2017; Rouet & Eme, 2002).

Metatextual knowledge is defined as "the knowledge a person possesses about texts and text comprehension activities" (Rouet & Eme, 2002, p. 121). For example, it refers to knowledge about the functions of structural text features (Brand-Gruwel & Stadtler, 2011; Rouet & Eme, 2002) and reading strategies (Potocki, Ros, Vibert, & Rouet, 2017). Metatextual knowledge allows readers to understand the organizational structure of a text and to see how viewpoints are presented, developed and illustrated (Horning, 2011). Hereby, it permits students to regulate their reading of multiple documents to improve comprehension (Kozminsky & Kozminsky, 2001).

Prior subject knowledge, or topic-relevant prior knowledge, refers to "readers' pre-existing knowledge related to the text content" (Ozuru et al., 2009, p. 228). Prior knowledge about a subject influences the reader's ability to give meaning to information, as readers are able to compare their prior subject knowledge to new information (Anderson, 2004; Kozminsky & Kozminsky, 2001; McLaughlin, 2012). Furthermore, when readers have prior subject knowledge, they are more able to associate, connect, and understand information elements (Kostons & Van der Werf, 2015). This knowledge helps readers in connecting information from multiple documents to construct one broad understanding about the particular subject (Kostons & Van der Werf, 2015; Kozminsky & Kozminsky, 2001; McNamara, 2001). Therefore, prior subject knowledge is considered to be an important predictor of multiple documents reading comprehension (Shapiro, 2004; Rouet & Britt, 2011). In fact, most definitions of reading comprehension involve the interaction between the text and readers' prior subject knowledge (Alfassi, 2004; Meneghetti, Carretti, & De Beni, 2006; Tarchi, 2010).

1.3 Jigsaw method to support multiple documents reading comprehension

Aronson (1978) developed "the jigsaw classroom" as a cooperative learning method (see also Aronson & Bridgeman, 1979). In jigsaw, a complex learning task or subject is divided in different topics over group members within mixed-topic cooperation groups. Hereby, group members obtain information about one of the topics, making themselves expert on that topic. The knowledge of all different topics is necessary to complete the whole learning task successfully. This means that group members are dependent on each other's knowledge to perform the whole learning task (Aronson & Patnoe, 2011; Johnson, Johnson, & Stanne, 1989; Mayer, 2008). Therefore, the jigsaw method is often compared to a puzzle, whereby all different puzzle pieces are necessary to complete the whole puzzle (Hertz-Lazarowitz, Kagan, Sharan, Slavin, & Webb, 2013; Van Dijk, 2017; Van Keulen & Koster, 2006).

The jigsaw method could be an effective method for multiple documents reading comprehension in several ways. First, as jigsaw group members are dependent on each other's knowledge, they become each other's resources instead of competitors (Aronson & Patnoe, 2011; Johnson, Johnson, & Stanne, 1989; Mayer, 2008). This resource interdependence encourages them to

take an active part in their individual learning and to take a prominent and active role in the group process to share their knowledge actively with their group members (Aronson & Patnoe, 2011; Hertz-Lazarowitz et al., 2013). When students take such an active role in their learning process and knowledge sharing, it benefits their reading comprehension (McLaughlin, 2012). Second, the interaction with group members helps students to make sense of and give meaning to information of multiple documents. As students actively share knowledge, they are encouraged to think about and express their views and ideas, which helps them to make sense of a subject (Van Rijk et al., 2017). In these interactions, both the sharing and receiving of knowledge benefits the learning process and achievement (Webb, 1982, 2008). Third, the jigsaw method helps students to see the subject from multiple perspectives, as group members share their different views from their expertise within the cooperation (Mayer, 2014). Hereby, the group members are able to construct a broader understanding about the subject, and enhance their knowledge to a greater extent (Barrett, 2017; Heltemes, 2009; Nelson, 2008). Fourth, students have to invest less cognitive effort and overcome less individual working memory limitations in comparison to individual reading. In jigsaw, task-relevant information is divided among group members, which provides a larger reservoir of cognitive capacity (Kirschner, Paas, & Kirschner, 2009; Mayer, 2014). This so-called "distribution benefit" (Mayer, 2014, p. 547) could prevent students' experienced information overload and improve reading comprehension.

1.4 The present study

The above overview of the literature indicated that students experience multiple documents reading comprehension as a challenge, which could be explained by a lack of metatextual knowledge and prior subject knowledge (Kostons & Van der Werf, 2015, Rouet & Eme, 2002). The cooperative jigsaw method could be a promising method in multiple documents reading comprehension (Kazemi, 2012; Meng, 2010). The division of sources or topics of the overall assignment reduces cognitive effort of students (Mayer, 2014). The resource interdependence encourages group members to interact with each other to share knowledge (Aronson & Patnoe, 2011). This interaction helps students in making sense and giving meaning to the issue described in the multiple documents (Van Rijk et al., 2017). Furthermore, it helps understanding the issue from different perspectives (Aronson & Patnoe, 2011). The present study aimed to provide more insights into the effects of jigsaw, metatextual knowledge, and prior subject knowledge on multiple documents reading comprehension. The study hereby also considered the interaction effects of jigsaw and metatextual or prior subject knowledge on multiple documents reading comprehension. Based on the literature overview, two hypotheses were proposed:

Hypothesis 1: Performing a multiple documents reading comprehension task by the cooperative jigsaw method results in better multiple documents reading comprehension (expressed in content elements and main messages) compared to performing the same task individually.

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Hypothesis 2: Performing a multiple documents reading comprehension task with metatextual knowledge and prior subject knowledge results in better multiple documents reading comprehension (expressed in content elements and main messages), which is more prominent when the task is performed individually compared to cooperation by jigsaw.

To examine hypotheses 1 and 2, an experimental study was conducted in which students were asked to execute a multiple documents reading comprehension task individually or with the jigsaw method. The subject of the documents was broiler chicken. This subject was chosen, because it involved conflicting views and arguments. Hereby, the subject could provide a challenge to integrate all views and arguments in one coherent representation. Prior to the multiple documents reading comprehension task, the metatextual knowledge of the participants, and their prior subject knowledge about broiler chicken were measured. After the multiple documents reading comprehension task, the quality of the jigsaw cooperation was measured. The design of the present study is visualized in Figure 1.
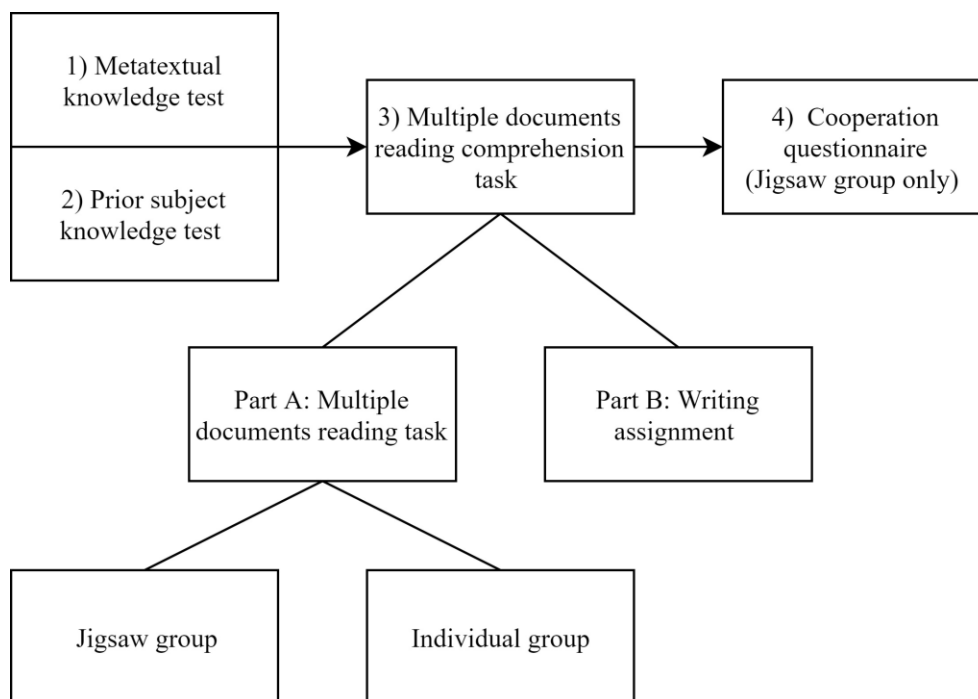

Figure 1. Overview of the study design

2. Method

2.1 Participants

Students that followed a social care education at ROC of Twente, a school for secondary vocational education, were approached to participate in the study. In total, three classes were involved in the study. From these three classes, all 59 students were approached to participate. However due to illness, only

49 participants were able to join the study. From these 49 participants, 10 (20%) were male and 39 (80%) were female. Their ages ranged from 16 to 24, the average age was 19.

In preparation, the researcher divided the initial group of 59 students in two conditions: the jigsaw condition (N = 28) and individual condition (N = 31). The participants were not equally spread over the two conditions, because the number of participants in the jigsaw condition needed to be divisible by four as the jigsaw groups in this study consisted of four people. The researcher assigned the participants to a condition by dividing them alternately using an alphabetic list of names. The participants of the jigsaw condition were divided over seven jigsaw groups, again based on alternate use of the list of names.

During the experiment, 10 participants were not present that were originally assigned to the jigsaw condition (N = 3) or individual condition (N = 7). When participants from the jigsaw condition were absent, new members for their group were selected from the individual condition poule. Hereby, the same selecting strategy was used as before, where participants were alternately selected with an alphabetic list of names. In total, three jigsaw groups were adjusted, or in other words, their missing group members were replaced with participants from the individual condition. No groups were eliminated, which means that there were still seven jigsaw groups. The final 49 participants were divided among the jigsaw condition (N = 28) and individual condition (N = 21). The descriptive statistics of participants' characteristics are shown in Table 1.

Table 1.

Participant Characteristics

	All participants (N=49)	Jigsaw condition (N=28)	Individual condition (N=21)
Age in years	19.04 (M)	18.79 (M)	19.38 (M)
	1.84 (SD)	1.52 (SD)	2.18 (SD)
Gender			
Female	39 (80%)	22 (79%)	17 (81%)
Male	10 (20%)	6 (21%)	4 (19%)

2.2 Materials

2.2.1 Metatextual knowledge test

To measure the metatextual knowledge of the participants, the metatextual knowledge test of Potocki, Ros, Vibert and Rouet (2017) was used, after it was translated to Dutch. The test consisted of 15 multiple choice questions related to reading strategies ("How do you…") and characteristics of texts ("What is…''). The metatextual knowledge was measured by calculating the total score of the correct answers on these questions. Potocki et al. (2017) had a Cronbach's alpha of $\alpha = .69$ when they used the test with 40 students. However, the Cronbach's alpha in this study was only $\alpha = .27$. Three items were deleted to improve the alpha to $\alpha = .54$. As this score was still below the threshold of .7, the internal consistency was insufficient (George & Mallery, 2003). This means that the test was not reliable. Therefore, the results of the metatextual knowledge test need to be interpreted with caution.

2.2.2 Prior subject knowledge test

The open recall test by Gijlers, Weinbergen, Van Dijk, Bollen, and Van Joolingen (2013) was used to measure participants' prior subject knowledge about broiler chicken. In the open recall test, the participants had to write or draw as much information as they could within three minutes. The prior subject knowledge was measured by calculating the total score of correct and new items. An item was coded as correct when it consisted of truthful information. An example of a correct item was that a broiler chicken is used for fast food (see Wakker Dier, 2019). An example of an incorrect item was that a broiler chicken lays eggs, as broiler chickens are too young to lay eggs (see Martin, 2013; Jozzie, 2013). An item was coded as new when the participant had not mentioned a specific topic before. For example, when the participant mentioned fast food once, this would count as a new item. When a participant also mentioned synonyms for fast food, these items would not be coded as new. Practical examples, such as McDonalds for fast food, were counted as new items. The interrater agreement of the test was measured by coding 10 percent of the data by an independent second coder. The average weighted Cohen's Kappa score was $\kappa = .97$. As this score was above .81, the strength of agreement was perfect (Landis & Koch, 1977). This means that the test was reliable.

2.2.3 Multiple documents reading comprehension task

In the multiple documents reading comprehension task, four contrasting texts about broiler chicken were used with an average length of 179 words. The texts were original parts of articles of the animal welfare organization Wakker Dier in the Netherlands, an online Dutch library, an online Dutch health blog, and the Dutch weblog The Daily Standard (see Appendix A-D). In selecting these texts, the reliability of the texts and reading level of the participants, as indicated by their teacher, were taken into account. The participants received these texts on paper with font style Calibri and font size 11, to assure that the lay-out of the articles was comparable and would not influence the results.

2.2.4 Writing assignment

The writing assignment consisted of an argumentation task to measure multiple documents reading comprehension. Argumentation tasks make visible to what extent people comprehend information from multiple documents and make connections between the information (Diakidoy et al., 2017; Wiley & Vos, 1999). In the current study, the argumentation task was executed in the form of a writing assignment to challenge the participants to gather and organize knowledge obtained from the multiple documents reading comprehension task (Durst & Newell, 1989; Hebert, Simpson, & Graham, 2013). This helps students to transform and integrate information (Hemmerich & Wiley, 2002; Voss & Wiley, 2001; Wiley, 2001; Britt, Wiemer-Hastings, Larson, & Perfetti, 2004) and to self-explain information from texts (Chi, De Leeuw, Chiu, & LaVancher, 1994). In the writing assignment, the participants were asked to substantiate their opinion about broiler chicken with the information that they had obtained during part A of the multiple documents reading task (see Figure 1).

To measure multiple documents reading comprehension, first the data of the writing assignment were coded on content elements and main messages, based on the study of Ferguson et al. (2013). Content elements consisted of perspectives that were discussed in the multiple documents, and the main messages consisted of general inferences of the multiple documents. The interrater agreement of the described content elements and main messages was measured by coding 10 percent of the data by an independent second coder. The average weighted Cohen's Kappa score was $\kappa = 1$. As this score was above .81, the strength of agreement was perfect (Landis & Koch, 1977). This means that the test was reliable.

Second, the equality scores of the content elements and the equality scores of the main messages described in the writing assignment were calculated by the formula of Van Dijk (2017): $\sqrt{((25 - x1)^2 + (25 - x2)^2 + (25 - x3)^2 + (25 - x4)^2)}$. Hereby, the equality scores of the described content elements were calculated based on their proportional part relative to all content elements of each document. The equality scores of the main messages were calculated based on their proportional part relative to the main messages of all documents together. In both cases, a perfect proportional distribution would mean a distribution of 25% per document. The equality represented the sum of the deviation from this 25% per document. Finally, the equality scores were decoded, so that an equality score of 100 would be a perfect score. The higher the equality score, the higher the extent of equal distribution of information from multiple documents described in the writing assignment.

2.2.5 Cooperation questionnaire

Cooperation between group members is an important element of jigsaw (Tarhan & Sesen, 2012). To evaluate the quality of cooperation of the jigsaw groups, the study used the cooperation questionnaire by Gommans, Segers, Burk, and Scholte (2015). This questionnaire measures the experienced extent of cooperation satisfaction (to which the cooperation was satisfying for the participant), dominance (to

which there were dominant group members within the cooperation), and mutual listening (to which group members listened to each other's suggestions within the cooperation). These three aspects of cooperation satisfaction, mutual listening and low dominance are considered to be important conditions of the cooperative jigsaw method (Adams, 2013; Hedeen, 2003; Leyva-Moral & Camps, 2016).

Because the traditional cooperation questionnaire of Gommans et al. (2015) focuses on cooperation in duos, the questions were adjusted to the group sizes within this study. Cooperation satisfaction, dominance, and mutual listening were assessed in respectively three, two and two 10-point interval scale questions (1 = not much/well, 10 = very much/well). The Cronbach's alpha of cooperation satisfaction was α = .58, dominance was α = .27 and mutual listening consisted of α = .92. In the case of cooperation satisfaction, one item was deleted to improve the alpha to α = .67. Mutual listening had an excellent internal consistency as the alpha score was above .9 (Streiner, 2003). However, as the scores of cooperation satisfaction and dominance were below the threshold of .7, their internal consistency was insufficient. This means that these components of the questionnaire were not reliable (George & Mallery, 2003). Therefore, results regarding cooperation satisfaction and dominance need to be interpreted with caution.

The results of this test were not used to test the hypotheses, instead, they were used to evaluate the quality of cooperation within the jigsaw condition. As cooperation satisfaction (77.14%) and mutual listening (86.05%) scored high and dominance (64.45%) scored moderate (see Table 2), we concluded that the jigsaw groups cooperated to a moderate satisfactory level.

2.3 Procedure

First, permission was obtained from the ethics committee of University of Twente to perform this study. The participants were asked to participate in this study by signing a consent form. In the consent form, the participants were informed about the research goal and anonymization of the data. Subsequently, the experiment started in which the participants first had to perform the metatextual test within 15 minutes. After that, they had to perform the open recall test about broiler chicken within three minutes. Next, the participants were split in the jigsaw condition and the individual condition. The researcher divided the participants in the jigsaw condition into groups of four participants. Every group received a package of in total four documents about broiler chicken, of which every group member had to read one of these documents individually within 5 minutes. Subsequently, they had to discuss the content of their documents with their jigsaw group within 10 minutes. At the same time, the participants of the individual condition had to read the same four documents individually within 15 minutes. After finishing the multiple documents reading task, all participants of the jigsaw condition and individual condition had to perform the writing assignment, in which they had to substantiate their opinion about broiler chicken based on the obtained knowledge during the multiple documents reading task within 15 minutes. Finally, the participants of the jigsaw condition needed to fill in the cooperation questionnaire

about their cooperation in their jigsaw groups, which lasted 5 minutes. An overview of the sequence of tests can be found in Figure 1.

3. Results

3.1 Descriptive statistics

To test the hypotheses, first the descriptive statistics of the metatextual knowledge, prior subject knowledge, content elements, main messages, cooperation satisfaction, dominance, and mutual listening were computed (see Table 2).

Second, Pearson's correlations were computed between condition (individual reading or jigsaw), metatextual knowledge, prior subject knowledge, content elements, and main messages. As can be seen in Table 3, prior subject knowledge correlated significantly ($p = .05$) with main messages when conditions (individual reading and jigsaw) were taken together for the analysis. Table 4 shows that when the two conditions were analyzed separately, the correlation was no longer significant (individual reading, $p = .47$; jigsaw, $p = .11$). No further significant correlations were found. Even though the correlations were not significant, it seems that metatextual knowledge and prior subject knowledge had higher positive correlations with multiple documents reading comprehension (as measured via content elements and main messages) in the individual condition compared to the jigsaw condition, except for prior subject knowledge on the described main messages in the multiple documents reading comprehension task.

Table 2.

Descriptive Statistics

Variables	Condition	M	SD	Min	Max
Metatextual knowledge	Individual condition	7.95 (1-12)	1.83	4	11
	Jigsaw condition	8.46 (1-12)	1.88	5	12
Prior subject knowledge	Individual condition	8.67 $(0 \rightarrow \infty)$	3.26	5	16

	Jigsaw condition	7.29 $(0 \rightarrow \infty)$	4.17	1	15
Content elements	Individual condition	41.18 (1-100)	20.70	13.40	71.14
	Jigsaw condition	46.87 (1-100)	19.08	13.40	82.68
Main messages	Individual condition	42.56 (1-100)	20.27	13.40	71.14
	Jigsaw condition	36.20 (1-100)	25.41	13.40	100
Cooperation satisfaction	Jigsaw condition	15.43 (1-20) 77.14%	1.75	13	19
Dominance	Jigsaw condition	12.89 (1-20) 64.45%	2.73	9	19
Mutual listening	Jigsaw condition	17.21 (1-20) 86.07%	2.27	13	20

Table 3.

Correlation Matrix Both Conditions Together

		1	2	3	4	5
1	Condition	—				
2	Meta textual knowledge	.14	—			
3	Prior subject knowledge	-.18	-.08	—		
4	Content elements	.14	.11	.04	—	
5	Main messages	-.14	.05	.28*	.21	—

* $p < .05$

Table 4.

Correlation Matrix Jigsaw Condition and Individual Condition Separately

			Jigsaw			
			1	2	3	4
Individual condition	1	Metatextual knowledge	—	-.23	.08	.02
	2	Prior subject knowledge	.23	—	-.08	.31
	3	Content elements	.11	.32	—	.35

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| 4 | Main messages | .15 | .17 | .05 | — |

3.2 The effects of Jigsaw, metatextual knowledge and prior subject knowledge on multiple documents reading comprehension

To test hypotheses 1 and 2, a hierarchical regression analysis was conducted (see Table 5 and 6). In a regression analysis, residues are required to have a normal distribution (Ganzeboom, 2015). In this study, metatextual knowledge (Skewness .03; Kurtosis -.65), prior subject knowledge (Skewness .26; Kurtosis -.34), content elements (Skewness -.39; Kurtosis -.80) and main messages (Skewness -.24; Kurtosis -.85) were all normally distributed.

Hypothesis 1 states that performing a multiple documents reading task by the cooperative jigsaw method results in better multiple documents reading comprehension (expressed in content elements and main messages) compared to performing the same task individually. To test this hypothesis, in step 1, participants' condition (jigsaw or individual reading) was entered as independent variable to the dependent variables of content elements and main messages. No significant effects were found of condition on content elements ($p = .32$) or main messages ($p = .35$); the conditions were comparable in their multiple documents reading comprehension.

Hypothesis 2 states that performing a multiple documents reading comprehension task with metatextual knowledge and prior subject knowledge results in better multiple documents reading comprehension (expressed in content elements and main messages), which is more prominent when the task is performed individually compared to cooperation by jigsaw. To test this hypothesis, step 2 and 3 of the hierarchical regression analysis were conducted. In step 2, metatextual knowledge and prior subject knowledge were entered as independent variables to the dependent variables of content elements and main messages. No significant effects were found of metatextual knowledge on content elements ($p = .52$) or main messages ($p = .56$), and of prior subject knowledge on content elements ($p = .60$) or main messages ($p = .07$). Despite the significant correlation of prior subject knowledge and main messages, as described in the descriptive analytics, there was no unique prediction of prior subject knowledge on multiple documents reading comprehension when controlling for metatextual knowledge. In step 3, the interaction of condition and metatextual knowledge or prior subject knowledge was entered as independent variable to the dependent variables of content elements and main messages. No significant effects were found of the interaction of condition and metatextual knowledge on content elements ($p = .94$) and main messages ($p = .99$), and in the interaction of condition and prior subject knowledge on content elements ($p = .19$) and main messages ($p = .56$).

Table 5. *Hierarchical Regression Analysis Content Elements*

	ΔR²	B	SE (B)	β
Step 1	.02			
Condition		5.69	5.71	.14
Step 2	.01			
Condition		5.72	5.94	.15
Metatextual knowledge		1.02	1.58	.10
Prior subject knowledge		.41	.77	.08
Step 3	.04			
Condition		22.35	30.03	.57
Metatextual knowledge		.39	2.53	.04
Prior subject knowledge		1.96	1.42	.38
Metatextual knowledge x condition		.27	3.30	.06
Prior subject knowledge x condition		-2.26	1.71	-.55
Adjusted R²	-.04			

Table 6. *Hierarchical Regression Analysis Main Messages*

	ΔR²	B	SE (B)	β
Step 1	.02			
Condition		-6.36	6.74	-.14
Step 2	.08			
Condition		-4.61	6.78	-.10
Metatextual knowledge		1.06	1.81	.08
Prior subject knowledge		1.66	.88	.27
Step 3	.01			
Condition		-13.71	34.85	-.29
Metatextual knowledge		1.34	2.94	.11
Prior subject knowledge		.87	1.65	.14
Metatextual knowledge x condition		-.07	3.83	-.01
Prior subject knowledge x condition		1.16	1.98	.24
Adjusted R²	-.00			

4. Discussion

The aim of the present study was to investigate the effects of the cooperative jigsaw method, metatextual knowledge, and prior subject knowledge on multiple documents reading comprehension. The findings showed no effects of jigsaw on multiple documents reading comprehension. Moreover, no effects were found of metatextual knowledge and prior subject knowledge on multiple documents reading comprehension, which was comparable in a cooperative jigsaw and individual reading condition.

With respect to hypothesis 1, the findings showed no significant effects of the cooperative jigsaw method on multiple documents reading comprehension. This is in contrast with prior studies who showed that jigsaw improves students' reading comprehension compared to individual reading (e.g., Nurbianta & Dahlia, 2018; Sami Ali, 2001). An explanation could be that in jigsaw, students are dependent on their group member's capabilities in selecting relevant information from their text (see Griffin, Wiley, Britt, & Salas, 2017). When students are not able to select what information is relevant, their group misses out on knowledge that was relevant to share or receive (Garcia, Abrego, & Robert, 2017). Hence the students from this study may not have benefited from the jigsaw method, as they did not obtain the needed knowledge from their group members. Another explanation for our findings could be that the students lacked required social skills for the cooperative learning method. Jigsaw demands social efforts to communicate knowledge and coordinate actions with group members (Mayer, 2014). When participants have the required social skills, jigsaw is used more effectively (Shaaban, 2006) which leads to higher achievement and productivity in the groups (Johnson & Johnson, 2008).

With regard to hypothesis 2, the findings showed no significant effects of metatextual knowledge and prior subject knowledge on multiple documents reading comprehension, which was comparable in a cooperative jigsaw condition and an individual reading condition. This is contrary to findings of earlier studies who claim that metatextual knowledge and prior subject knowledge improve readers' multiple documents reading comprehension (Kostons & Van der Werf, 2015; Kozminsky & Kozminsky, 2001). One explanation could be that students were not able to activate metatextual knowledge and prior subject knowledge in the right way. According to Kostons and Van der Werf (2015), metatextual knowledge should be activated by asking students to write down in key words what strategies they had used while reading a text prior to the multiple documents reading comprehension test. They explain that if metatextual knowledge is not activated in the right way, it may be "less likely that students will use what they know during the learning task, leading to inferior text comprehension" (Kostons & Van der Werf, 2015, p. 266). In other words, students may not have been able to use their metatextual knowledge in their multiple documents reading comprehension, as this knowledge was not activated in the right way. Hattan, Singer, Loughlin, and Alexander (2015) claim that prior subject knowledge also needs to be activated appropriately before readers can use it. Students that have high prior subject knowledge are able to benefit from their knowledge in multiple documents reading comprehension if they activate it through perspective taking. In perspective taking, students must take

a certain perspective while reading a text (Wetzels, Kester, & Van Merriënboer, 2011). For example, when reading texts about broiler chicken, students could take the perspective of an environmentalist. As this study used no perspective taking exercises, the students with high prior subject knowledge may not have been able to use their prior subject knowledge to enhance their reading comprehension (Kostons & Van der Werf, 2015; Wetzels et al., 2011).

Interestingly, the effects of metatextual knowledge and prior subject knowledge were comparable in the cooperative jigsaw and individual reading condition. This was in contrast with prior studies who showed that students in jigsaw groups are able to use each other's knowledge to "get the whole picture" (Aronson & Patnoe, 2011, p. 27) instead of building on their individual metatextual and prior subject knowledge (Ozuru, Dempsey, & McNamara, 2009). An explanation for the contradictory finding could be found in the experienced moderate dominance (64.45%) of the jigsaw groups. According to Adams (2013), dominance of a group member is one of the possible risk factors in knowledge sharing with jigsaw. If there is a dominant group member within a jigsaw cooperation, other group members are often not allowed to share their knowledge before questions or comments are made by the dominant group member (Adams, 2013). Hence, in the moderate dominant cooperation of this study, the students may not have been able to benefit and learn from each other's knowledge, as dominant group members prevented this learning process. As a result, metatextual knowledge and prior subject knowledge had comparable effects on the cooperative Jigsaw and individual learning condition.

The present study has several limitations that need to be considered. First, the metatextual knowledge test and two components (cooperation satisfaction and dominance) of the cooperation questionnaire were not reliable. Therefore, the results of these tests need to be interpreted with caution. The tests may be unreliable due to the small sample size (see Vos, 2009). Therefore, future research is recommended to involve a larger sample size. Second, multiple documents reading comprehension was measured with a writing task. As a result, the test may have measured not only the extent of multiple documents reading comprehension, but also the participants' writing skills. Hereby, the writing skills may have influenced the scores of reading comprehension, as for example, students may not have been able to translate their knowledge into the writing assignment (Bolle, 2010). Future research is recommended to consider the advantages and disadvantages of different measure methods of multiple documents reading comprehension when they decide upon a method to use. Third, the study did not have a longitudinal design. Therefore, we could not conclude from the present study whether the jigsaw method or metatextual knowledge and prior subject knowledge were predictive for multiple documents reading comprehension. Future research is recommended to examine the effects of the cooperative jigsaw method, metatextual knowledge and prior subject knowledge over a longer period of time. Fourth, due to the small sample size and overrepresentation of females in this study, the findings cannot be generalizable to the whole student population (Vos, 2009). Future research is recommended to involve a larger sample size with greater gender diversity. Furthermore, scholars are advised to involve other students (different studies or study levels), from other educational institutions, from different

regions or countries, with different subject matters, to examine if the findings are generalizable across different settings.

Implications of the study are for the school environment. In current education, teachers scarcely use the jigsaw in their classes for multiple documents reading tasks (Jansen van Rosendaal, 2018; Van Elsäcker, 2002). Based on the findings of this study, teachers are advised to use the method more often. The jigsaw results in comparable multiple documents reading comprehension as individual methods, while the students read less documents. Therefore, jigsaw is an useful method to prevent students from experiencing information overload. Jigsaw also brings many learning advantages on a social level (see Van Dijk, 2017). When teachers decide to use the jigsaw method, it could be beneficial for them to invest in students' social and cooperative skills to ensure effective use of the method. For example, they could involve more cooperative reading assignments in their classes. Furthermore, it could be useful for them to appoint a leader within the groups that monitors the equal contribution of group members (see Adams, 2013). Hereby, they could prevent dominance in the groups that hinders knowledge sharing and multiple documents reading comprehension. Moreover, when teachers want students to use their metatextual knowledge and prior subject knowledge, they are advised to activate this knowledge with activating exercises. For example, they could ask students to write down in key words what strategies they use while reading a text to activate metatextual knowledge and they could ask students with high prior knowledge to take a perspective during reading a text (Kostons & van der Werf, 2015; Wetzels, et al., 2011). Hereby, students are more able to use and share their knowledge with group members, to enhance their multiple documents reading comprehension.

To conclude, the present study showed no significant effects of jigsaw, metatextual knowledge, and prior subject knowledge on multiple documents reading comprehension. From this study, it can be concluded that the cooperative jigsaw method is a promising method for multiple documents reading comprehension assignments, as it results in comparable multiple documents reading compared to an individual reading method where students have to read more documents and lack social advantages.

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Appendices

Plofkipcampagne: Het leed van plofkippen moet stoppen

Plofkip is een eindeloos doorgefokt kippenras bedoeld om in slechts zes weken zo veel mogelijk vlees te produceren. Voor miljoenen kuikens is het een lijdensweg. Plofkip is het meest gehouden dier in Nederland.

Campagne Wakker Dier: stop de plofkip

Wakker Dier wil dat alle restaurantketens en A-merken geen plofkippen meer verwerken in hun producten. Ook de supermarkten moeten stoppen met de verkoop van plofkip. Ze moeten vervangen worden door kippen met minimaal één ster van het Beter Leven-keurmerk van de Dierenbescherming. Deze kippen zijn gezonder en groeien langzamer. Ook hebben ze frisse lucht en een overdekte uitloop naar buiten.

Het leed dat plofkip heet

Plofkippen lijden het meest in de vijfde en zesde week van hun leven. In de dichte stal heeft elke kip minder ruimte dan één A4. Ze kunnen vaak moeilijk lopen en staan krampachtig met gespreide poten te zoeken naar evenwicht. De dieren staan hun leven lang in hun eigen poep. Door de combinatie van een vochtige, zure vloer en te weinig beweging, ontstaan aan hun voetzolen pijnlijke zweren. Hun normale scharrelgedrag is onmogelijk geworden.

Source:

Wakker Dier (2018). Plofkipcampagne: Het leed van plofkippen moet stoppen. Retrieved from https://www.wakkerdier.nl/campagnes/plofkip/

Plofkip is beter voor het milieu dan biologische kip

Waar kies je als milieuvriendelijke klant voor? De plofkip of de biologische kip? Het antwoord is vreemd genoeg de plofkip. Bij productie van plofkippenvlees komen namelijk veel minder schadelijke gassen vrij en hoef er minder bos te worden gekapt.

Terwijl de plofkip uit de schappen van de supermarkt wordt gehaald, stijgt niet alleen het aantal personen dat vlees eet, maar eet men tegenwoordig door de groeiende welvaart ook steeds meer vlees per persoon. Voor de productie van biologische kippenvlees moeten meer bossen worden gekapt om landbouwgebieden vrij te maken. Voor de productie van 1 kilo vlees is namelijk 10 kilo landbouwgewas nodig. Hiervoor worden momenteel grote delen van het Braziliaanse regenwoud en andere bossen gekapt. Deze ontbossing veroorzaakt milieuschade en klimaatverandering en zo wordt de wereld steeds een stukje verder naar de ondergang geholpen.

Juist door de toenemende vraag naar vlees is het erg belangrijk om het produceren zo effectief mogelijk te maken en hierbij biedt de plofkip een oplossing. Voor 1 kilo plofkip is veel minder landbouwgewas nodig, waardoor er minder bossen gekapt hoeven te worden voor landbouwgrond.

Source:

Pernambuco (2012). Plofkip is beter voor het milieu dan biologische kip. Retrieved from https://dier-en-natuur.infonu.nl/milieu/103904-plofkip-is-beter-voor-het-milieu-dan-biologische-kip.html

Plofkip op je bord: een goed idee?

De textuur en de smaak van de plofkip verschilt van de langzamer groeiende kip. Dat zal je misschien wel eens geproefd hebben. Toch is er weinig verschil in voedingswaarde.

Wel is plofkip geproduceerd volgens de gedachte 'zoveel mogelijk voor zo weinig mogelijk'. Plofkip wordt daarom vaak ingespoten met water. Dit moet op het etiket van de verpakking aangegeven staan. Het is dus erg belangrijk dat als je geen water in je kip wilt, je het etiket van de verpakking leest voordat je de kip koopt. Het water verdunt de voedingswaarde van de kip, waardoor de kip wat minder totale voedingswaarde zal hebben dan de kip waar geen water is ingespoten.

Naast water, kan antibiotica in de plofkip zitten. Wanneer de plofkip ziek is, wordt het namelijk behandeld met antibiotica. Uiteindelijk eet jij de kip weer op, waardoor er dus een kans aanwezig is dat jij deze antibiotica ook binnen krijgt. Dit geldt niet alleen voor de plofkip, maar voor alle soorten kip die niet onder het biologische keurmerk vallen.

Source:

Van Loon, N. (2018). Plofkip: Weet jij wat je eet? Retrieved from
https://www.extragezond.nl/gezondheid/plofkip-weet-jij-wat-je-eet/

Niks mis met plofkip

Zowel op internet als op tv word je de laatste tijd doodgegooid met de anti-plofkipcampagne van Wakker Dier. Dat terwijl er eigenlijk niets mis is met de plofkip, of vleeskuikens zoals de benaming luidt.

Eigenlijk is de plofkip een prachtproduct, doordat de kip in vergelijking met de vleeskip twee weken en in vergelijking met de leghen tot 12 weken sneller groeit tot volwassen kip. De plofkippen hebben hierdoor minder voer nodig en de productiekosten van de plofkippen zijn veel lager in vergelijking met de biologische kip. Hierdoor kan de plofkip veel goedkoper in de schappen liggen van de supermarkt dan de biologische kip. De plofkip zorgt ervoor dat de steeds groter groeiende groep armen in Nederland ook een stukje vlees kunnen betalen, maar helaas heeft Wakker Dier daar een einde aan gemaakt.

Wakker Dier lijkt de kippen dus vooral te misbruiken voor een eigen promotiestunt. Weg goedkoop vlees, waardoor niemand er uiteindelijk op vooruit gaat, maar Wakker Dier wel een overwinninkje kan opeisen. En daar gaat het ze om.

Source:

De Groot, J. (2014). Niks mis met plofkop. Retrieved from

https://www.dagelijksestandaard.nl/2014/04/niks-mis-met-plofkip/