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Reading and writing to learn in secondary education: online processing activity and written products in summarizing and synthesizing tasks

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Abstract The research reported here employed a multiple-case study methodology to assess the online cognitive and metacognitive activities of 15-year-old secondary students as they read informational texts and wrote a new text in order to learn, and the relation of these activities to the written products they were asked to generate. To investigate the influence of the task, students were required to perform two different tasks which differed in complexity and familiarity. The first task was reading a single text and making a written summary of it, while the second consisted in reading two texts and making a written synthesis of them. To gather information about how students construct meaning from informational texts, we asked students to think aloud as they read and wrote in order to provide us with information about their comprehension and composition processes. We also examined their reading and writing activities during the tasks. The results show that to a large extent secondary school students lack the cognitive and metacognitive processes that would enable them to make strategic use of reading and writing. They also show that, although there are no major differences in the way secondary school students tackle these different tasks, those who create the most elaborate products evidence a more recursive and flexible use of reading and writing. The most obvious conclusion as far as the repercussions of these findings are concerned is that there is an urgent need for work on tasks of this kind in the classroom.

Keywords Online processing · Reading · Secondary education · Summary task · Synthesis task · Writing

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For several decades, it has been held that one of the main aims of secondary education consists in educating students in the competences and strategies that will enable them to continue learning autonomously (Marchesi & Martín, 2002; OCDE, 2005; Pozo & Monereo, 1999). These include reading and writing competences.

The reading competences of Spanish secondary school students fall far short of those of competent readers who are able to use this tool for knowledge acquisition. According to the findings of the PISA 2003 report, in the best case scenario, 47% of Spanish 15-year-old students attain the reading competences that will allow them to carry out elemental tasks that involve the processing of written texts; 30% are able to perform reading tasks of a moderate difficulty; while just 23% -less than one in four- possess the reading competences required to cope comfortably with complex tasks and texts (Solé, 2005). It does not seem too much to suppose that, if written composition strategies had been assessed, the results would have been no better.

The overall goal of the study described here was to gain a better understanding of the difficulties 15-year-old Spanish secondary school students encounter when faced with tasks involving reading and writing to learn. This was done by examining the processes as well as the products, comparing performance on two different tasks and simultaneously studying the reading and writing processes using integrated analysis categories.

The types of processes and strategies the subjects set in train when they read and write have generally been explored separately. According to previous research, competent readers (for a review see Pressley & Afflerbach, 1995) actively engage in meaning-construction processes: they pay selective attention to the information in the text, predict, paraphrase, go back when they fail to understand something, make inferences to explain the connections between ideas and interpret what they read, try to integrate the different parts of the text, ask themselves questions, re-read and reflect on what they read. Moreover, they exercise metacognitive control over their understanding: they are aware of the demands of the task and the progress they have made, monitor the comprehension they achieve as they go along and take steps to solve the problems they detect, make value judgements on the content and style of the text, and experience strong emotional reactions. In a similar way, competent writers become recursively involved in planning, translating and revising what they have written in so far as they approach the task of composition as a complex process requiring the solution of the content problem ("what to say") and the rhetorical problem ("how to say it"), adopting what Bereiter and Scardamalia (1987) call the "*knowledge transforming*" approach as opposed to the "*knowledge telling*" approach. Planning and revising the text imply the use of a variety of self-regulation procedures such as setting goals, finding information, going over notes, making rough drafts, evaluating, organizing and transforming ideas, and monitoring (Graham & Harris, 1994).

A lot of research has been done on the comprehension difficulties experienced by readers of different ages and educational levels (e.g., Cornoldi & Oakhill, 1996). In this context, some work has been conducted on school students' meaning-construction processes when reading informational texts such as those found in content-area learning materials, for example, texts in science or social studies. Coté, Goldman, and Saul (1998), for instance, carried out a study with children aged 9- to 12-years old and found that the most frequent processes were paraphrasing

sentences, connecting sentence information to prior knowledge, and attempting to resolve comprehension problems, most of them single-word or sentence problems. Less frequent were the attempts to make connections among different sections of the passages. This study's results pointed out that children tended to emphasize local processing.

Studies have also been made of the processes performed by very young and novice writers, and those who have difficulties in producing written compositions. The results of this research show that such subjects tend to act according to a *knowledge telling* model (Bereiter & Scardamalia, 1987) and display very little self-regulation of their writing processes (Graham & Harris, 1996, 2000). Novice writers and writers with difficulties pay little attention to the rhetorical goals, organization of the text, audience needs and the restrictions imposed by the topic; they scarcely plan and, when they do, they confine themselves to making local plans; they start writing immediately, limiting themselves to generating ideas associatively; and they do not usually revise the texts they produce or revise only very superficial aspects of it (adding words or phrases, or changing words) whose repercussions on the quality of the composition are generally minimal.

Although research has been done on reading and writing processes separately, many academic tasks can be regarded as "hybrids" of the two, in so far as students are asked to produce a new text on the basis of reading one or more source texts (Spivey, 1997). Some research supports the thesis that reading and writing are more powerful tools for learning when used together than when used separately (for a review see Tierney & Shanahan, 1996). However, not all tasks involving reading and writing help to produce the same type of learning or have the same epistemic potential (Langer & Applebee, 1987; Tynjälä, 2001). Tasks which may be classified as hybrid include writing a summary of a single text and writing a synthesis of multiple texts. Both tasks involve writing a new text by selecting, organizing, and connecting contents from the source texts (Spivey, 1997). A discourse synthesis task is therefore similar to a summary, but cognitively more demanding. In preparing a summary it is possible to keep the same organizational pattern as that employed in the original text, thus producing a reduced isomorphic version of the text. Synthesizing several texts, however, requires elaborating an integrating idea or "superproposition" from different "macropropositions" of multiple textual sources (Segev-Miller, 2004a), and taking decisions regarding the organizational structure to adopt in order to integrate the information from the different sources (Flower et al., 1990; McGinley, 1992; Spivey, 1997). It might be said that writing a synthesis of multiple sources requires knowledge-transforming to a greater extent than making an isomorphic summary of a single source.

Summarizing and synthesizing differ not only in regard to their degree of complexity, but also the extent to which students are familiar with such tasks. According to the results of a previous study (Solé, Mateos, Miras, Martín, Castells, & Cuevas, 2005), whereas 70.5% of 15–16-year-old secondary students said they had made summaries based on a single source, only 16.7% said they had made syntheses based on several texts.

As has been seen, the cognitive and metacognitive processes set in train during reading and writing have generally been studied separately. There has been far less

research aimed at studying online processing activity during tasks involving both reading and writing. One such line of research addressed the summarizing strategies employed by very young students (Brown & Day, 1983; Kirkland & Saunders, 1991). In relation to synthesizing strategies, although there is a body of research that considers the strategies used by students while reading multiple texts (e.g., Bräten & Stromso, 2003; Hartman, 1995; Hynd-Shanaham, Holschuch, & Hubbard, 2004) and also a separate body of research that has addressed the strategies used by students during writing from multiple texts (Flower et al., 1990, McGinley, 1992), in most cases the participants were university students. Very little work has hitherto looked at synthesizing strategies used by students at the secondary educational level, and what has been done in this regard has for the most part inferred the processes employed from the written products that were generated (Spivey & King, 1989; Stahl, Hynd, Britton, McNish, & Bosquet, 1996).

However, this type of inference may lead to the available knowledge and the effort put into the performance of the task being underestimated (Flower et al., 1990). Indeed, Flower et al. (1990) have argued against the frequency hypothesis, according to which the number of times a specific process is used is supposed to correlate with the type or quality of the product, holding, on the contrary, that processes should be conceived as strategies and that the use of strategies is not directly correlated with results, such as the type or quality of the text generated, but with goals, plans and representation of the task. In this respect, Coté et al. (1998) failed to find any significant correlation between the percentage of times students performed specific processing activities while reading a text and the number of ideas and the coherence of their subsequent memory of it. Processing activities must be considered in relation to each another. This means that elaborations will not necessarily lead to a coherent and integrated mental representation supporting good-quality learning outcomes if they are accompanied by a large number of unresolved comprehension problems and little monitoring. Other authors, such as Rijlaarsdam and van den Bergh (1996, 2006), have stressed the importance of written composition process dynamics and suggest the need to take into account not only the different types of cognitive processes that take place, but also the moment and sequence in which they occur during composition. In short, there does not appear to be a direct relationship between the quality of the written product and the quantity and quality of the online processes set in train during reading and writing.

Bearing in mind the contributions mentioned above, in this study we set out to examine secondary school students' cognitive and metacognitive processing strategies during two "hybrid" reading and writing tasks of different degrees of complexity and familiarity (summarizing and synthesizing) and the relationship of these processes to their written products. More specifically, we tried to answer the following three research questions:

(1) What is the nature of the cognitive and metacognitive activities secondary students engage in while performing "hybrid" reading and writing tasks?
(2) Do the demands of the hybrid task –summarizing a single text vs. synthesizing multiple texts-change the nature of students' processing?

(3) How do students' processing activities during reading and writing relate to the quality of their written products?

Method

Participants

Participants were nine 15-year-old secondary school students, comprising 3 girls and 6 boys, from a class at a state-run secondary school situated in a middle or lower-middle class area of Madrid. The subjects were selected from the class they belonged to in school on the basis of their reading comprehension and written composition skills as measured by the IDEA language learning assessment test (González Nieto, 2002), and their academic performance in social sciences as determined by their grades. Nine students were selected taking into account the average scores for the class as a whole. Two of those selected achieved the highest scores in both criteria, two obtained high scores in social sciences and low scores in reading and writing skills, two obtained low scores in social sciences and high scores in reading and writing skills, and three had low scores in both criteria. We found no clear relationship between either reading and writing skills or academic achievement, on the one hand, and processing or product measures, on the other. Accordingly, the reading and writing skills and academic achievement variables are not discussed further.

Tasks and Materials

In order to situate our study in a more authentic context than is usual in this type of research, both the tasks and the texts employed were chosen from among the activities set by the social sciences teacher in the context of two different teaching units.

The summarizing task was carried out in the context of a teaching unit on the subject of cities; the aim of which was for students to learn how cities have evolved through history. The text chosen for the task was one describing the physical aspects of the medieval city (adapted by the students' own teacher from Chueca, 1970). It was 261 words long.

The synthesis task was carried out in the context of a teaching unit on the subject of population; the aim of which was to examine the phenomenon of immigration in Spain. Two texts were chosen for this task. One was adapted from a textbook (Zárate & Sánchez, 2003), and an article in a newspaper (Piquer, 2000), and contained 204 words. The other was adapted by the students' own teacher from Riera (2002) and had 238 words. The contents of the two texts complemented each other. The first one set out the different reasons why immigration tends to be seen as a negative phenomenon from the standpoint of the host country, while the second introduced some of the reasons why immigration is beneficial and necessary for host countries.

Familiarity with the passage topics was assessed by asking prior knowledge questions before the tasks were performed. For the purposes of this study, we concluded that the topic of the passage used for the summary was relatively unfamiliar to students, whereas the topic of the passage used for the synthesis task was relatively familiar to them.

Design and Procedure

The research questions were investigated employing a multiple case-study methodology, as employed by other authors who have carried out research in this field (McGinley, 1992).

Each participant performed the summary task first and the synthesis task second, at two different times during the year (in March and May). Both tasks were presented to the whole group in class during the time allocated to introducing the corresponding teaching unit. The participants in this study performed both tasks in the school library in two individual sessions that were video-taped in the presence of one of the researchers. The length of the sessions varied between 20 min and 1 h.

In the case of the first task, the students were told they would be reading a single passage and writing a summary of it, and in the case of the second task, that they would be reading two texts and writing a synthesis of them, in order to learn the contents of the lessons studied in class. The participants were told to read out loud and engage in a concurrent think-aloud task as they read and wrote. Instructions for the think-aloud procedure explained that the experimenter wanted to find out about the way students read and write. The students were asked to talk aloud and say everything they were thinking while performing the task. The experimenter told them that to help them think aloud, they would be probed occasionally with neutral questions such as "What are you thinking now?" Students who did not comment spontaneously or whose comments required clarification were probed when necessary with this kind of prompt.

Prior to reading the target passages, each participant received training in the think-aloud procedure and practiced it while reading a training passage. To facilitate thinking aloud during the training phase, the experimenter probed frequently with neutral prompts.

A video camera recorded the contents of the texts and the sheets used by the participant during reading and writing, and the voices of the participant and the experimenter, so that verbal comments could be matched to the portion of the text to which they applied. The reading and writing activities performed were also recorded as indicators of the processes set in train during the performance of the tasks.

Scoring

Think-aloud protocols

The videotaped comments were directly coded using subtitling software ("Subtitle Workshop" version 2.03. Programmed by DekSoft. Copyright 2001–2003

URUSoft). In segmenting the think-aloud protocols, we built upon the work of Coté et al. (1998) and defined our unit of analysis as an "event" which was "a comment or set of comments on the same core sentence or group of sentences in the context of the reading or writing procedure associated with those comments" (p.14). This unit of analysis corresponds to the coarse-grain size used by Chi and colleagues in coding utterances in verbal protocols (Chi, de Leeuw, Chiu, & Christian Lavancher, 1994).

The utterances were coded using a category scheme based on previous research findings (Coté et al., 1998; Flower et al., 1990; McGinley, 1992; Pressley & Afflerbach, 1995). The specificity in our case consisted in the production of a single category scheme for both reading and writing in accordance with our view of the hybrid nature of the summarizing and synthesizing tasks involving them.

Each event was assigned to one of the categories according to the predominant character of the comment. The major event categories were: task analysis, planning, meaning construction, monitoring and evaluative and affective reactions (see Table 1 for definitions and examples). On occasion, an event was put into more than one category. Usually when this happened, the event was a monitoring comment closely followed by an elaboration.

Task analysis events included reflecting on task demands and evaluating task difficulty or interest.

Planning comments were of several types: setting goals, local planning and global planning (the reading or writing procedure, the content to be written, the audience, etc.)

Meaning construction events included restatements of a sentence or of a previously generated idea, paraphrases, elaborations consisting in relating content to personal knowledge, elaborations consisting in drawing conclusions (synthesizing, generalizing as well as extending beyond the text) and integrations (connecting different parts of the source text and connecting parts of the two source texts in the synthesis tasks). Inappropriate elaborations were also coded.

Monitoring events were confirmations of reading comprehension or composition task progress, confirmations of important ideas, comments indicating comprehension or composition difficulties, and comments indicating attempts to resolve comprehension or composition problems.

The last major event category included *value judgements* on the content and style of the texts and *emotional reactions.*

The category labeled "other" included comments in which the participant made a statement such us "I'm not thinking anything", or it was difficult to tell what the content of the utterance referred to, or the participant described what he or she was doing, almost always in response to a prompt by the experimenter. Comments in this category were not included in the analyses.

Two independent raters coded each event and the type of each event in the total of the protocols and agreed on 82%. Differences were resolved in discussion.

Table 1 Reading and writing event categories: descriptions and examples

Category	Description	Event example
Task analysis		
Reflecting on task demands	Analyzing the problem (purpose, audience, contents and structure of the writing or reading)	
Evaluating task difficulty	Evaluating the text / contents / task in regard to its difficulty or interest	(After rereading a fragment of the source text) "I don't know, this paragraph is the oddest".
Planning		
Global planning	Planning and choosing the purpose, audience, contents, and structure of the writing, or the reading and writing procedures, in regard to units longer than a paragraph	(Before starting to read) "First I'm going to read the whole text to then get the ideas"
Local planning	Planning and/or choosing what or how to write the next clause of a sentence, or the reading and/or writing procedures, in regard to units no longer than a paragraph	(After rereading a fragment of the source text) "I'm going to read the first paragraph"
Meaning construction		
Restating	Repeating literally what has just been read. Copying the source text, copying the rough draft	(While writing) "The most important streets were in the center and spread out radially"
Paraphrasing	Repeating/copying what has just been read in other words	(While writing) "Radiocentric is the way medieval cities are organized: streets are formed starting from the center"
Elaborating	Connecting ideas or concepts in the text to examples from the student's own experience or knowledge	(After writing "streets are formed starting from the center") "Like in Spain; all the roads start in Madrid, or a lot of them"
Drawing conclusions	Constructing a conclusion, explanation or prediction, or a synthesis or generalization that goes beyond the information provided by the text	(While writing) "They are sited on the hills because they are high and you can see the enemy"

Table 1 continued

Category	Description	Event example
Inappropriate elaborations	Constructing a wrong conclusion or explanation, or one that is irrelevant since it is unrelated to the text that has been read	(While reading, after a prompt) "The markets always used to be held in places where there were the most people to do the buying and selling and then they always used to be in the town centers"
Intra-integrating	Establishing connections between various ideas in one text	(While reading, after rereading a fragment of the source text) "People think they are growing a lot and that's bad for the country, but it's not so bad because Spanish workers don't want these jobs"
Inter-integrating	Establishing connections between ideas in two texts	(While reading, after rereading a fragment of one of the source texts) "They're needed even though people think they're negative and the only country that gains is the one the people originally come from"
Monitoring		
Task progress/ Comprehension check	Supervising comprehension / composition: confirming a prediction or expectation, confirming something that was already known. Evaluating the progress of the task or the appropriateness of the text already written	(While writing, after rereading a fragment of the source text) "Oh, I know. This is... Vitoria and Pamplona are examples of radiocentric towns"
Detection of main ideas	Confirming the identification of main ideas or important information	(While writing, after rereading a fragment of the source text) "I don't think the bit about hills and steep places is important here; only the bit about the physical appearance of a medieval city being based on the fact it had to defend itself"
Detection of difficulties	Formulating comprehension problems (a word or phrase not understood, conflict with previous knowledge, etc.) or composition problems (not knowing what to write and/or how to write it)	(After reading "Vitoria and Pamplona, in Spain, are outstanding examples") "Outstanding examples of what? I don't know"
Problem-solving strategies	Verbalizing the use of problem-solving strategies	(While writing) "I'm going to read it again, as I can't remember it any more"

Table 1 continued

Category	Description	Event example
Emotional Reactions & Value Judgements		
Emotional Reaction	Reacting in a personal and affective way. Judgements regarding the student's own competence, or references to personal or emotional states	(While reading) "I feel sorry for them, because if they're starving in their country..." (While writing) "As I don't do this very often, I find it hard"
Value Judgements	Judgements to do with the contents or the formal features of a text, or with the author's stance or style	(While reading, after reading the figure for the increase in immigrants in the last few years) "What a massive jump in foreigners!"

Reading and writing activities

The video-taped reading and writing activities associated with verbal comments were also coded. The reading and writing activity categories included: global rereading of the source texts, local rereading of the source texts, global reading of the text produced, local reading of the text produced, problem-solving activities (i.e., rereading or asking the researcher after having detected a problem), underlining, taking notes, reading written notes, sketching an outline, making a rough draft, editing and reformulating. Only those activities performed at least once by one of the students were included in the analysis.

Written products

Written summaries and syntheses were categorized into four levels on the basis of the following criteria: selection of the main ideas; integration (coherence and cohesion mechanisms); elaboration; and misinterpretations (see the specification of these criteria in Table 2).

The texts in the lowest category (1) were fragmentary or list-like, with no organization, failed to include the overall theme and the main ideas or were a copy of the original text, and included incorrect ideas. The texts in the intermediate-low category (2) were still fragmentary, but included some of the main ideas, some paraphrases and only a few inappropriate or irrelevant ideas. The texts in the intermediate-high category (3) included most of the main ideas, but still not the overall theme, displayed a certain organization, and included sufficient, although not always appropriate, coherence and cohesion mechanisms; although they included mainly paraphrases, they also included some elaborations and did not include irrelevant ideas. The texts in the highest category (4) had an overall theme and were organized with evident coherence and cohesion mechanisms, included paraphrases and appropriate inferences, and did not contain any incorrect ideas. Written syntheses were categorized also in regard to the degree to which the ideas of the two source texts were integrated. Three types of synthesis were distinguished: those that basically included ideas from a single text (type 1); those that combined ideas from both texts, either by juxtaposing summaries of each of them, or by alternating ideas from each one, without integrating them in either case (type 2); and those that connected the ideas from both texts by means of an integrating idea (type 3). Two raters categorized all of the participants' texts, with 85% agreement between them. Disagreements were resolved in discussion.

Results

We address each of the questions posed by this study in turn. Processing activities and reading and writing activities during summarizing and synthesizing were examined at the level of aggregated multiple case-study data. Relationships between

Table 2 Quality criteria for the written products generated by the students

Criterion	Category			
	Level 1	Level 2	Level 3	Level 4
Selection of the main ideas	Fails to include the topic and lacks the main ideas	Fails to include the topic	Fails to include the topic	Includes the topic
	Contains irrelevant ideas	Includes almost all the main ideas	Includes almost all the main ideas	Includes all the main ideas
		Contains some irrelevant ideas	Contains no irrelevant ideas	Contains no irrelevant ideas
Integration: coherence and cohesion	List of ideas: Clearly insufficient coherence and cohesion mechanisms	List of ideas:	Coherent text:	Coherent text:
	Literal copy of sources	Some coherence and cohesion mechanisms	Includes sufficient, although not completely adequate, coherence and cohesion mechanisms	Sufficient and adequate coherence and cohesion mechanisms
Elaboration	Copying and some paraphrasing	Copying and paraphrasing	Copying, paraphrasing and may include some relevant elaboration	Paraphrasing and relevant elaboration
Misinterpretation	Contains wrong ideas	Contains some wrong or irrelevant ideas	Contains no wrong or irrelevant ideas	Contains no wrong or irrelevant ideas

processing activities and reading and writing activities and the written products were examined at the level of individual cases.

Processing strategies and task effects on specific processing activities

Table 3 shows the mean proportions and standard deviations of each type of event and of each type of activity for each task. As this is a study with a very small sample, it was to be expected that no statistically significant results would be obtained. Indeed, this is what the results showed when task-related differences were analyzed using the Wilcoxon non-parametric test for two related samples, a test based on assigning ranks to the differences between the two scores of each subject. In order to retain information about effects that might be subtle in the study reported here, but might nevertheless inspire future research with a larger number of subjects, we occasionally point out suggestive results that are in the .05 to .10 alpha range, as previous researchers in this area have done (Coté et al., 1998), and have an effect size above Cohen's criteria of .30 for a medium effect.

Reading and writing events

Task-related differences in the number of events are not statistically significant. An analysis of the verbal utterances emitted during the performance of both tasks shows that activities to do with meaning construction predominate, with monitoring processes a long way behind in second place, but students hardly explore or plan the task and also make very few value judgements and display very few emotional reactions. However, during synthesis an increase in value judgements was observed approaching statistical significance, $Z = -1.826$, $p = .068$, $r = -.43$.

Within the meaning-construction category, the most frequent operations are paraphrases, restatements and elaborations establishing links with the students' own experience or knowledge. However, the students seldom draw conclusions. There is a striking absence of attempts to integrate the different ideas of the source text during the making of a summary and a similarly striking low incidence of intra- and inter-text integration during synthesis. Nevertheless, intra-text integrations were more frequent during the synthesis than during the summary task, this being the only task-related difference in the processes which approaches statistical significance, $Z = -1.826$, $p = .068$, $r = -.43$.

Among the verbalizations to do with monitoring, those reflecting the detection of difficulties and the confirmation of understanding, or the satisfactory progress of the composition task, or the written product, predominate. However, the students do not tend to monitor their comprehension while they are reading. They raise problems mainly during the writing stage and these have to do more with what to say than with how to say it. The only adequateness criterion employed by these students is whether or not the source contents are included in their written product and whether this is linguistically correct. Barely 1% of the students' verbalizations had to do with the detection of important information (the main ideas) or problem-solving strategies.

Table 3 Mean proportions and standard deviations of each type of event and of each type of activity for each task

	Summary		Synthesis	
	Mean	ST. Dev.	Mean	ST. Dev.
Event category				
Task analysis	.047	.122	.006	.019
Reflecting on task demands	0	0	0	0
Evaluating task difficulty	.010	.021	.006	.019
Planning	.056	.098	.051	.079
Local planning	.032	.062	.006	.013
Global planning	.024	.041	.045	.081
Meaning construction	.631	.299	.548	.285
Restating	.073	.189	.152	.274
Paraphrasing	.249	.174	.159	.142
Elaborating	.209	.270	.083	.101
Drawing conclusions	.048	.074	.026	.060
Inappropriate elaborating	.052	.064	.017	.028
Intra-integrating	0	0	.060	.077
Inter-integrating	–	–	.051	.082
Monitoring	.267	.171	.288	.259
Progress of the task/Comprehension check	.106	.102	.138	.115
Detection of main ideas	.017	.039	.004	.012
Detection of difficulties	.131	.077	.132	.148
Problem-solving strategies	.015	.024	.014	.025
Emotional Reactions & Value Judgements	.030	.061	.106	.095
Emotional Reactions	.030	.061	.049	.064
Value Judgements	0	0	.057	.079
Activity category				
Global rereading of the source texts	.019	.045	.120	.129
Local rereading of the source texts	.400	.327	.460	.240
Global reading of the text produced	.051	.058	.044	.080
Local reading of the text produced	.111	.272	.163	.181
Problem-solving strategies	.156	.185	.138	.158
Editing	.152	.184	.060	.112
Reformulating	.110	.088	.016	.037

Note: The proportions were calculated over the total of verbalizations uttered and over the total of the activities performed for each subject on each task

Reading and writing activities

Task-related differences in the number of activities are not statistically significant. The activities carried out by the students while performing the tasks reflect the fact that both their reading and writing are mediated very little by the use of information-processing procedures. The pupils in this study did not make any written notes on

what they were reading, nor did they sketch an outline or make a rough draft of the text they were going to generate, and they scarcely underlined anything.

The most commonly employed procedures were local rereading of the source text and, to a lesser extent, local reading of the text produced, certain strategies aimed at solving a previously detected difficulty (on one occasion asking the researcher, on two occasions rereading and on another two reading in search of clarification) and certain modifications of the text produced. These amendments consisted in both the correction of formal aspects and reformulations affecting the sense of what had been written, but superficially (changing or adding a word, adding a phrase or paraphrasing a certain expression).

The only task-related differences approaching statistical significance and having a medium effect size were global rereading of the source texts, $Z = –1.826$, $p = .068$, $r = –.43$, and reformulating of the text produced, $Z = –1.826$, $p = .068$, $r = –.43$, with students engaging in more rereading and less reformulating on the synthesis than on the summary task.

Written products

As can be seen from the Table 4, the summaries and the syntheses produced by the students were both of low (1) or medium-low (2) quality. Only two summaries and one synthesis could be classified as medium-high (3) or high quality (4) products. The Wilcoxon test shows that there are no significant differences between the quality of the products generated on the two different types of task. As far as the degree of integration was concerned, only in one case was there evident integration of the two sources on the synthesis task (type 3); five students produced an intermediate level of integration (type 2), four of whom combined ideas from both sources, but without linking them to each other, while the fifth juxtaposed summaries of the two sources; and the three other students essentially included ideas from a single source (type 1).

Table 4 Relationship between global approaches and the quality of the written products

Global approach		Quality		
		Summary	Synthesis	Integration level of synthesis
One: High recursivity	Case 1	3	4	3
	Case 2	4	2	2
	Case 3	2	1	2
Two: Low recursivity and no revision	Case 4	1	2	2
	Case 5	1	2	1
	Case 6	1	1	2
Three: Linearity	Case 7	1	2	2
	Case 8	2	2	1
	Case 9	1	1	1

Relationships between processing activities, reading and writing activities, and written products

As in previous studies (e.g., Coté et al., 1998; Flower et al., 1990; Rijlaarsdam & van den Bergh, 1996), we did not find a direct relationship between the type of verbalizations uttered by the students or the number of verbalizations in each category and the quality of the written products. This lack of correlation, however, may be due to the small size of the sample (nine students) and the large number of process categories considered. Moreover, since most of the products fell into the lower categories, there is very little variation, which makes it difficult to establish clear relationship patterns between the number of times a specific process is employed and product quality. However, analysis of the global approaches to performing the tasks revealed the trends described below. The global approach is defined not only by the type of processes employed during the task, but also by the order and sequence in which these processes occur. Bearing in mind the global approach adopted by the students in performing both tasks, three groups can be distinguished.

As can be seen in Table 4, the best products were generated by students belonging to the first group, which was characterized by the deployment of better processes. The global approach adopted by the three students in this group was characterized by high recursivity: *reading of the source text(s), writing while rereading the sources and revising of the text produced (reading the text produced and editing and reformulating it)*. Nevertheless, there are differences among them in regard to their processing patterns and in regard to their written products.

According to the criteria specified in Table 2, student 1 attained the highest level in both products: level 3 in the summary and level 4 in the synthesis. He was the only student who produced integrated synthesis (type 3). The verbalizations of student 1, though few in number, are characteristic of a competent reader and writer. While reading on the summarizing task, he related what he was reading to examples and analogies taken from his own previous experience, although he did not incorporate them into his text. These elaborations apparently functioned to help him to understand the text by integrating it with prior knowledge. However, in the immediate context of the writing task, he could clearly differentiate between what the text said and the prior knowledge he had used in understanding the text. As he read he picked out what he thought was most important; when it came to writing, he confined himself to rereading and paraphrasing the source text paragraph by paragraph. In tackling the synthesis, he planned the task globally, integrated ideas from one text and from both texts, monitored what he was doing, and made value judgements on and reacted affectively to the content of the texts. Monitoring events were present to a lesser extent, as he was extremely sure of what he was doing throughout.

Student 2 attained high quality on the summary (level 4), but medium-low quality on the synthesis task (level 2). Although, like student 1, she engaged in overall planning of the procedure to follow in producing the synthesis, the product was a combination of ideas taken alternately from each of the sources and lacked integration (type 2). Her monitoring verbalizations predominated during writing,

reflecting certain specific problems, but especially her lack of confidence in what she was doing. In her meaning-construction operations, she engaged in more paraphrasing than elaboration during both reading and writing. Lastly, she stands out among the other participants for the large number of affective responses to the contents of the texts.

The summary generated by student 3 was of medium-low quality (level 2) while the synthesis was of low quality (level 1). In the synthesis she juxtaposed ideas taken from the first source with ideas taken from the second source (type 2). Although this student's products were not good, her processes displayed a certain degree of planning and supervision. Her verbalizations reflected the activation of personal experiences and the detection of problems. On the summary task she verbally enunciated the main ideas before writing.

The other pupils studied did not differ in regard to their products, which were poor quality texts (rated with scores of 1 or 2), but in the way they approached the tasks. The second group of students, comprising another three pupils, is characterized by a low recursivity pattern and no revision: *they read the source text(s), read it/them again all the way through and then, at the writing stage, one paragraph at a time, and wrote without revising their final text*. Student 4 attained the lowest level on the summary (level 1) but medium-low level on the synthesis (level 2). Her synthesis consisted in an unintegrated combination of ideas from both texts (type 2). She established many connections with prior knowledge, but on the summary task revealed partial or incorrect understanding of the information in the text. That is why her product contained a lot of wrong ideas. She showed that she was aware of the processes she was using during both reading and writing (planning, detecting specific problems and resolving difficulties). She reread the sources to make sure she had gleaned all the ideas from them, but did not read or modify the texts she had produced. The other two (students 5 and 6), however, confined themselves to paraphrasing or repeating the source texts. The paraphrasing consisted of rewording only a clause or phrase in the sentence. Student 6, however, did not adopt the same approach to both tasks. He did not revise his product on the synthesis task, but did do so on the summary, making quite a few changes, although the reformulations consisted in adding something he had forgotten to put in. Their summaries were of low quality (level 1) and their syntheses were of medium-low quality (level 2) and low quality (level 1), respectively. Student 5 produced a synthesis which included almost exclusively ideas from a single source (type 1), whereas student 6 alternated ideas from both sources without connecting them to each other (type 2).

The products of the third group were no different in quality from those of the second, in spite of the fact that their global approach to performing the tasks was characterized by linearity. The third group *read the source text(s), then wrote on the basis of their memory of what they had read, hardly referring back to the source(s), and neither revised nor modified what they had written*. Student 7, whose products were of low quality on the summary and medium-low quality on the synthesis, and student 8, whose products were of medium-low quality on both tasks, activated various prior experiences and made a number of paraphrases during both reading and writing. The synthesis produced by student 7 consisted in an unintegrated

combination of ideas from both sources (type 2), whereas student 8's synthesis included essentially ideas from a single source (type 1). Student 9 verbalized only in response to prompts by the researcher and on several occasions manifested the scant interest he had in performing the task. The problems he raised during both writing and reading were fairly unspecific ("I haven't understood much", "I don't know how to go on", "I've forgotten what it said in the text"). His products were the worst, of low quality (level 1) on both tasks. Moreover, his synthesis included ideas from just one of the texts (type 1).

Discussion

In relation to the first research question concerning the nature of the cognitive and metacognitive activities secondary students engage in while performing "hybrid" reading and writing tasks, the results show that the predominant processes are related to meaning construction and, of these, paraphrase, restatements and elaborations linking the contents to previous knowledge are the most common. Generally speaking, the tendency to paraphrase sentences during writing is very strong. In the case of elaborations, the connections to prior knowledge referred to concrete and familiar objects and events, and were not very developed. So, although the students were trying to use prior knowledge to make sense of the new information, this did not lead them to the construction of new knowledge or to coherent text representation. As has already been seen, they hardly draw conclusions or link up information from non-contiguous parts of the text or from the different texts. These findings are similar to those obtained by Coté et al. (1998) and are also consistent with those obtained by Spivey and King (1989).

Monitoring activities are the next most frequent after meaning construction operations. However, the students studied tend not to monitor their comprehension during reading. They do not pose themselves specific problems of comprehension nor do they evaluate what they have understood. The only exceptions are students 2 and 3 who try to paraphrase what they regard as most important after a first reading. The problems the students pose while writing refer to what to say rather than how to say it. The problems they raise regarding what to say are not to do with how it meets certain goals or is suitable for a particular audience, but simply with whether it matches the contents of the source texts (whether they have said everything, whether they have left anything out) or with the length of the text produced (whether it is too long or too short). The predominant criteria employed by these students in determining the adequacy of their product are the degree to which it includes all the contents of the source text and whether the spelling is correct. In short, their biggest concern is to "tell" the contents of the source text.

As far as revising their products is concerned, the few modifications they make to the texts they produce are mostly superficial; they do not reorganize what they have written. Activities to do with reflecting on and planning the task are practically non-existent. On the few occasions the students manifest them verbally, the plans are very general. They do not take notes or make rough drafts either. Their composition processes, therefore, display the features of writers with difficulties (Graham

& Harris, 1996, 2000) and clearly fit the "knowledge telling" model (Bereiter & Scardamalia, 1987).

The limited self-regulation processes are accompanied by a local processing focus. Consistent with previous research (Coté et al., 1998), comments tended to elaborate, explain, paraphrase or confirm understanding of single sentences while actions tended to consist of local rereading of both the source texts and the texts produced by the students. In addition, students detected mainly comprehension and composition problems that focused on single words or single sentences. On the basis of these results, we may conclude that secondary school students lack the cognitive and metacognitive processes that would enable them to make strategic use of reading and writing.

In regard to the second research question, i.e., whether the demands of the hybrid task have a bearing on the processes employed, the conclusion is that there are no major differences in the way secondary school students tackle these different tasks. This can be seen both from the overall analysis of the cases studied and the cases taken separately, even though making a synthesis of more than one text is a potentially more demanding task than making a summary of a single text. Only certain small differences were found. On the synthesis task, students tended to express more value judgements, probably due to the topic, as immigration is a controversial subject in Spain. More integration events were observed on the synthesis than on the summary task. It was also found that the students engaged in more rereading on the synthesis task than on the summary task, probably due to the heavier processing load involved in dealing with two sources instead of one, and fewer reformulations of the text they produced, which may be explained by their greater familiarity with the topic of the texts used in the synthesis task.

The virtual absence of reflection on the task in hand, of planning, of detection of specific difficulties (of both comprehension and composition), and of problem-solving strategies on both tasks evidences or reveals major difficulties in making strategic, non-routine use of reading and writing as learning tools. This could be interpreted, as Torrance (1996) suggests, as meaning that during writing, self-regulation processes, planning and revision are necessary only when the task, or the type of writing, is unfamiliar. In this case, the students may have routinized the summarizing procedure, since it is one of the most common academic tasks at school. However, on this hypothesis, the students should have displayed a greater degree of planning and revision on the synthesis composition, which is a task with which they are not very familiar, but such a difference was not found. Perhaps the students' lack of experience in synthesizing more than one text may have increased the difficulty of the task and led them to approach it using the same procedures they employ when summarizing a single text, a task with which they are much more familiar.

Nevertheless, this general conclusion needs to be qualified in at least one important respect. In the case of the first group of students—the ones who employed more elaborate processes—certain differences did appear between the summary and the synthesis. Student 1, the most competent subject, was able to perform both tasks successfully. Student 2, on the other hand, did better on the summary than the synthesis. Her behavior pattern was quite similar on both tasks, but although she

tried to produce an integrated text on the synthesis task, she ended up by writing something very much like two juxtaposed summaries. This pupil set about relating the source texts to each other and had a good comprehension of the content of both of them. Nevertheless, it would seem that the difficulty of the task, which the students freely admit not being at all used to, is too much for them. These, however, are the only students who show some difference in regard to the processes they activate in their approaches to the two tasks. One possible explanation, we would venture to put forward, is that this happens precisely because they are the students with the highest level, which places them in a kind of zone of proximal development that enables them to tackle the tasks with a greater awareness of the specific demands made by each one, but, since they lack the resources to carry out the more complex one adequately, they end up by simplifying it. They perform the synthesis task employing the same processes as for the summary.

With respect to the third research question about the possible relationship between students' processing activities during reading and writing and the quality of their written products, although our data do not allow us to detect correlations, they do indicate that the best products tend to be generated by the students with a more recursive and flexible use of reading and writing, in accordance with previous research findings (Lenski & Johns, 1997; McGinley, 1992). The processing pattern, associated with more coherent and integrated written products, included appropriate use of prior knowledge and paraphrases, coupled with either an absence of comprehension problems or problem resolution.

On the other hand, the poorest products tend to be generated by the students who use reading and writing in a more linear and routine fashion (global approaches 2 and 3). The reasons for the poor-quality texts, according to our interpretation, are not the same in every case. In some cases it is because the students make errors of interpretation, sometimes due to a lack of comprehension, others because they activate inappropriate prior knowledge, and bring this confusion to the writing of their texts, leading them to include mistaken ideas, as happened with the subjects in the work of Coté et al. (1998). In another set of cases, this does not seem to be the main difficulty. Rather, the problem lies in the oversimplified manner in which the pupils approach the writing stage of making a summary or a synthesis, limiting themselves to repeating or paraphrasing the sources without revising the products they generate. These patterns are also reproduced by students who do detect certain problems, but fail to solve them, and by those who do not see any problems.

The conclusions set out here must certainly be taken with all the necessary caution in view of the limitations of the study in question. It is a case study that has enabled us to take a closer look at the processes students carry out when they have to read in order to make a written summary or synthesis, but the small number of students involved prevents us from attempting to generalize the findings. Further research should increase the sample size and study the development of strategic processing among students showing larger variation in achievement. Moreover, it seems desirable to assess students' evolving domain knowledge directly in follow-ups to this study.

The fact that both the texts and the type of summary and synthesis tasks were chosen by the students' own teacher had several consequences. On the one hand, it

ensured that the tasks set made sense within the general dynamics of the class and that the degree of difficulty of the task was regarded by the teacher as being within the students' capabilities, whereas research which exerts a more exhaustive control over the situation and its variables frequently fail to take such conditions into account. On the other hand, however, it generated variations in the familiarity of the topic and the level of difficulty of the texts used, which makes comparisons between tasks difficult. Our study therefore reveals the need to control these variables in order to ensure that both tasks are comparable. In this sense it would also be useful, in future studies, to look at the effect of varying the relationship between the texts, complementary vs. contrasting, on the synthesis task.

In relation to the method used to analyze online processing activity, while think-aloud protocols are considered one of the most effective tools we have for gaining access to the online cognitive processing of readers and writers, they have certain well-known limitations (e.g., Ericsson & Simon, 1993). It is obvious that the verbalizations uttered by subjects do not correspond directly to their cognitive processes. The think-aloud protocols obtained may not have adequately reflected the students' actual processing activity. In future research it would be useful to analyze the processes using other procedures, such as process logs (Segev-Miller, 2004b) or keystroke registration (Janssen, van Waes, & van den Bergh, 1996), and compare the data obtained by means of the different procedures.

Although the task performance approaches or patterns were analyzed in terms not only of the types of processes and activities occurring, but also the order and overall sequence in which they occurred, in a follow-up to our work it would be necessary to examine in greater detail the points during the composition process at which the different activities occur, as has been done in other research that has looked at the relationship between cognitive activity during the written composition process and the quality of the products generated (e.g., Braaksma, Rijlaarsdam, van den Bergh, & van Hout Wolters, 2004; Levy & Ransdell, 1996).

In spite of these limitations, we believe the results of this study are useful from the point of view of both basic knowledge and educational applications. In regard to the former domain, a joint classification of categories for analyzing reading and writing processes is put forward that incorporates several new features with respect to those that have hitherto been used separately for the two processes. In addition, the study strengthens the conclusions of other previous research with students of similar educational levels (e.g., Coté et al., 1998; Graham & Harris, 1996; Spivey & King, 1989) regarding their most characteristic difficulties. It also points to a suggestive hypothesis regarding the importance of a subject's competence level in explaining different ways of acting when faced with writing tasks of different complexity.

As far as the educational repercussions are concerned, the most obvious conclusion is the urgency of working on tasks of this nature in the classroom. The poor performance of secondary school students on these tasks may be attributed, in part, to the few opportunities they have to practice them. According to the findings of our previous work (Solé et al., 2005), pupils hardly ever make syntheses or perform other tasks in which they have to integrate the contents of more than one text. Moreover, they need to be taught to perform writing tasks of this kind,

overcoming the idea that pupils can already do them or, if they cannot, it is not the responsibility of the teachers to instruct them, except at all events those who teach language. In short, the findings point to a limited use of reading and writing as learning strategies in secondary education and the need to help improve students' academic literacy through the curriculum.

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