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Children's high-level writing skills: Development of planning and revising and their contribution to writing quality

Teresa Limpo[1]*, Rui A. Alves[1] and Raquel Fidalgo[2]

[1]University of Porto, Portugal
[2]University of León, Spain

Background. It is well established that the activity of producing a text is a complex one involving three main cognitive processes: Planning, translating, and revising. Although these processes are crucial in skilled writing, beginning and developing writers seem to struggle with them, mainly with planning and revising.

Aims. To trace the development of the high-level writing processes of planning and revising, from Grades 4 to 9, and to examine whether these skills predict writing quality in younger and older students (Grades 4–6 vs. 7–9), after controlling for gender, school achievement, age, handwriting fluency, spelling, and text structure.

Sample. Participants were 381 students from Grades 4 to 9 (age 9–15).

Method. Students were asked to plan and write a story and to revise another story by detecting and correcting mechanical and substantive errors.

Results. From Grades 4 to 9, we found a growing trend in students' ability to plan and revise despite the observed decreases and stationary periods from Grades 4 to 5 and 6 to 7. Moreover, whereas younger students' planning and revising skills made no contribution to the quality of their writing, in older students, these high-level skills contributed to writing quality above and beyond control predictors.

Conclusion. The findings of this study seem to indicate that besides the increase in planning and revising, these skills are not fully operational in school-age children. Indeed, given the contribution of these high-level skills to older students' writing, supplementary instruction and practice should be provided from early on.

Thirty years ago, Hayes and Flower (1980) introduced the first cognitive model of written composition. Still today, this is one of the most prominent models within the cognitive approach to writing. One of the reasons for its long-standing impact was the identification of the cognitive processes involved in writing a text (Alves & Haas, 2012). From thinking-aloud protocols analysis, Hayes and Flower (1980) inferred three writing processes, namely planning, translating, and revising, which recursively interact during skilled writing. Although these processes were subsequently elaborated, they continue to represent the core cognitive component in more recent cognitive writing models (Berninger & Winn, 2006; Hayes, 1996, 2012; Kellogg, 1996).

*Correspondence should be addressed to Teresa Limpo, Faculdade de Psicologia e de Ciências da Educação, Universidade do Porto, Rua Alfredo Allen, 4200-392 Porto, Portugal (email: tlimpo@fpce.up.pt).

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The present study investigated the development of planning and revising skills in Grades 4–9 and analysed the contribution of these high-level skills to writing quality. In what follows, we define planning, translating, and revising processes and outline how students' planning and revising skills contribute to the quality of their texts.

High-level writing processes

The planning process involves generating and organizing ideas and setting goals (Hayes & Flower, 1980). As planning can occur before or during translating, a distinction was made between advanced and online planning (Berninger & Swanson, 1994). The central function of planning, even in adults, is generating content (Torrance, Thomas, & Robinson, 1999). Writers plan their text by extracting information from the task environment and by searching for content in their long-term memory. When necessary, this generated material is (re-)organized in a writing plan that guides text production. During planning, writers also formulate goals for their texts and delineate conceptual plans to achieve them (Hayes & Flower, 1986).

Based on research on developing writing, Berninger *et al.* (1992) proposed two components of the translating process: text generation and transcription. Text generation is the transformation of ideas into language representations in the working memory. Transcription is the transformation of those representations into written language, which includes the low-level skills of spelling and handwriting.

The revision process can be activated at any point during writing to evaluate and introduce changes at the word, sentence, or text level (Chanquoy, 2009; Fitzgerald, 1987). The timing of revision in relation to translation allowed the distinction between online and post-translation revision (Berninger & Swanson, 1994). Revision involves two subprocesses: Problem detection, which includes schema-guided reading and text evaluation, and problem correction, which involves the selection of a revising strategy and its implementation (Butterfield, Hacker, & Albertson, 1996; Hayes, 2004).

Berninger and colleagues conducted cross-sectional studies from Grades 1 to 9 (age 6–15) and found that planning, translating, and revising had different rates of development (Berninger, Cartwright, Yates, Swanson, & Abbott, 1994; Berninger, Whitaker, Feng, Swanson, & Abbott, 1996; Berninger *et al.*, 1992). Transcription and text generation were the first to emerge, followed by online planning and online revision (Grades 1–3). The last processes to develop were advanced planning and post-translation revision (Grades 4–6), which were only fully operational by Grades 7–9.

Planning skills and writing quality

Several correlational studies have analysed how students' pre-planning skills are related to their compositional quality. In the studies reviewed below, pre-planning skills were assessed through the complexity of students' written plans (see Hayes & Nash, 1996 for a review on planning measures). Outlines and graphic organizers were considered as the most advanced form of pre-planning.

In Grades 2 and 4, it was found that students' plans did not predict writing quality (Olinghouse & Graham, 2009). Likewise, in Grades 4–6, pre-planning skills were not related to writing performance (Whitaker, Berninger, Johnston, & Swanson, 1994). Only in Grades 7–9, the plan generated before writing was positively correlated with compositional quality (Berninger *et al.*, 1996). Thus, while younger students were able to make written plans, only older students seemed to use them to guide text production

(Limpo & Alves, 2013). This might have happened because younger students' written plans tended to be very similar to their texts, which means that they are not differentiating planning from translating (Bereiter & Scardamalia, 1987).

There is strong evidence that planning instruction is a way to promote students' writing performance (for meta-analyses, see Graham, McKeown, Kiuhara, & Harris, 2012; Graham & Perin, 2007). Harris, Graham, and Mason (2006) demonstrated that children as young as 7 years of age can beneficiate from interventions targeting planning skills. Second graders with difficulties in learning to write were taught a general planning strategy and genre-specific strategies for narrative and expository writing in tandem with self-regulation procedures. Using these strategies, students were able to write longer and better texts than controls. The advanced plan might have functioned as an external memory where children stored their ideas. Moreover, it might have freed up cognitive resources for the other higher level writing processes by reducing children's need to plan during writing (cf. Kellogg, 1988).

Revising skills and writing quality

Among other factors, the influence of students' revising skills on writing quality depends on writers' developmental level and the nature of the revision (mechanical vs. substantive). It seems that young writers' revisions have a limited impact on text quality (Fitzgerald & Markham, 1987; MacArthur, 2012). Indeed, only in Grades 7–9, text revision led to an improvement at the word, sentence, and text levels (Berninger *et al.*, 1996). A possible reason for this is that younger students focused on mechanical and local problems, while older writers also considered meaning and global problems (Graham, Schwartz, & MacArthur, 1993; MacArthur, Graham, & Harris, 2004). Nonetheless, a robust result about revision is that meaning errors are harder to detect and correct than surface errors for school-age children, as well as for adults (Butterfield, Hacker, & Plumb, 1994). Several explanations have been proposed (for a review, see MacArthur, 2012). Writers may lack the knowledge of appropriate evaluation criteria or may have a limited conception of revision as proofreading (Graham *et al.*, 1993). It might also be that they have deficient reading strategies (McCutchen, Francis, & Kerr, 1997) or that substantive revisions place large demands on working memory (Hacker, 1994). Regarding revision subprocesses, it was suggested that younger students struggle more with detecting errors than correcting them. Indeed, Beal (1990) showed that students in Grade 4 detected less meaning errors than children in Grade 6, even though fourth graders were as likely as sixth graders to correct the errors adequately once they were detected.

Several studies have analysed the impact of revision instruction on writing performance, and results are generally positive (for meta-analyses, see Graham, McKeown, *et al.*, 2012; Graham & Perin, 2007; but see Torrance, Fidalgo, & García, 2007). De La Paz, Swanson, and Graham (1998) taught a modified version of the *Compare*, *Diagnose*, and *Operate* strategy (CDO strategy; developed by Scardamalia & Bereiter, 1983) to eighth graders with learning disabilities. This revision routine prompted students to deal first with global problems and then with local ones. Students using the CDO strategy improved not only their revising behaviour but also the quality of their texts. The authors suggested that the strategy encouraged them to consider the whole text and provide them an executive support to manage the revision process.

The present study

Covering a large developmental window (Grades 4–9, with about 60 students per grade), this study examined the development of planning and revising and the contribution of these skills to writing quality. Compared with previous studies also focused on the development of high-level writing skills (e.g., Berninger *et al.*, 1996; Whitaker *et al.*, 1994), the main contribution of our work is twofold. First, we used more controlled and comprehensive measures of planning, revising, and text quality. Planning skills were studied in narrative writing, whose underlying schema is expected to be already acquired by Grade 4 (Berman & Slobin, 1994). Given the wide range of grades assessed, the use of this genre minimized potential differences across grades due to declarative knowledge, which could impact students' planning behaviour. Students' revising skills were analysed considering the nature of revision (viz., mechanical vs. substantive) and the underlying subprocesses (viz., detection vs. correction). Students were also asked to revise a provided text and not their own texts (for a methodological discussion on the study of revision, see Butterfield *et al.*, 1994). This enabled us to remove the effect that differences among writers' texts would have on revision. To control for the influence of topic knowledge on substantive revision (McCutchen *et al.*, 1997), the provided text was a fictional narrative requiring no prior topic knowledge to be understandable. Regarding writing quality, all texts were evaluated by means of a holistic scale considering ideas quality, organization, sentence structure, and vocabulary.

Second, we examined the incremental validity of planning and revising in predicting writing quality in Grades 4–6 and 7–9, which to the best of our knowledge, had not been tested. This kind of analysis provides additional evidence of the contribution of high-level skills to writing because it tests their unique contribution over well-known predictors. Given the complexity of writing, demonstrating the incremental validity of these skills is a way to highlight their importance to educational researchers and practitioners. Indeed, this study's findings may be relevant to guide writing instruction by informing about appropriate periods to target a particular writing process.

In this study, students from Grades 4 to 9 were asked to plan and write a narrative. Also, they were asked to detect and correct mechanical and substantive errors in the same genre. Our first aim was to trace the development of planning and revising. Due to instruction and maturation, we expected that planning would increase from grade to grade (Hypothesis 1; Alamargot & Fayol, 2009). Similarly, we expected that mechanical and substantive revision would increase throughout schooling (Hypothesis 2). Furthermore, according to the literature on revision, we predicted that student's ability to correct errors would be higher than students' ability to detect them (Hypothesis 3).

Our second aim was to examine the contribution of high-level writing skills to writing quality in Grades 4–6 (age 9–12) versus Grades 7–9 (age 12–15). Separate regression analyses were conducted to predict writing quality for the two grade groups. Six control variables and five high-level writing variables were included in the regression model. Three control variables were non-writing: gender, school achievement, and age. Several studies have found that girls surpass boys with respect to writing performance (for a review, see Gelati, 2012). Because writing plays a key role in students' assessments at school, those with better grades would probably write qualitatively better texts. Age was introduced as a control variable because to obtain more reliable and powerful regression models, students in Grades 4–6 and 7–9 were grouped. This split was also based on the fact that from Grades 6 to 7, children change from the second to the third stage of basic education. The writing-related control variables were as follows: handwriting fluency, spelling, and text structure. It has been demonstrated that transcription skills are largely

associated with writing quality (Berninger & Swanson, 1994; Graham, Berninger, Abbott, Abbott, & Whitaker, 1997). The text structure variable was included as a measure of students' knowledge about the characteristic elements of narrative texts. It was found that genre knowledge predicted writing performance (Olinghouse & Graham, 2009). The high-level writing variables included story planning and four revision variables: Mechanical detection, mechanical correction, substantive detection, and substantive correction. We expected that high-level skills would predict compositional quality above and beyond control variables in Grades 7–9, but not in Grades 4–6 (Hypothesis 4). This hypothesis was based on the previously surveyed research, which supported a larger contribution of high-level writing skills in older than younger students.

Method

Participants

The participants were 419 Portuguese native speakers in Grades 4–9. Five students with special education needs, 14 students who missed one of the two administration sessions, and 19 students who did not follow task instructions were excluded from the analyses. Demographic data from the remaining 381 students are presented in Table 1.

Setting

Basic education in Portugal lasts 9 years and comprises three stages: Grades 1–4 (age 6–10), Grades 5–6 (age 10–12), and Grades 7–9 (age 12–15). Crucial differences between stages are as follows: Stage 1 is provided in primary schools, and only one teacher is responsible for teaching the four main courses; Stage 2 is provided in basic schools, and

Table 1. Demographic data for the participating students by grade

	Grade					
Measure	4	5	6	7	8	9
Gender (*ns*)						
Girl	26	23	45	28	30	39
Boy	32	30	20	41	31	36
Age (in years)						
M (*SD*)	10.0 (0.4)	11.0 (0.6)	12.1 (0.5)	13.0 (0.4)	14.0 (0.4)	15.0 (0.5)
Range	9.4–11.0	10.4–13.0	11.4–12.1	11.9–14.4	12.7–15.3	14.4–16.8
Mother's educational level (%)						
Grade 4 or below	25.9	9.4	18.5	14.5	9.8	14.7
Grade 9 or below	34.5	52.8	46.2	46.4	34.4	52.0
High school	19.0	22.6	16.9	20.3	26.2	14.7
College or above	20.7	7.5	16.9	17.4	27.9	16.0
Unknown	0.0	7.5	1.5	1.4	1.6	2.7
School marks[a] (1–5)						
$M_{Portuguese}$ (*SD*)	3.83 (0.96)	2.96 (0.68)	3.37 (0.74)	2.96 (0.63)	3.34 (0.91)	3.11 (0.80)
$M_{Mathematics}$ (*SD*)	3.67 (0.98)	3.02 (0.67)	3.12 (0.84)	2.91 (0.68)	3.18 (0.79)	2.95 (0.79)
$M_{History}$ (*SD*)	4.03 (1.03)	2.91 (0.69)	3.68 (0.85)	3.30 (0.67)	3.69 (0.85)	3.25 (0.70)

Note. [a]The average mark of these courses was used as a measure of students' school achievement.

children have one teacher for each of the nine courses; finally, Stage 3 is provided in basic or secondary schools, and students have 11 courses.

Regarding the teaching of writing in Portugal, a gradual shift from a product- to a process-oriented approach has been occurring (Álvares Pereira, Aleixo, Cardoso, & Graça, 2010). For instance, in a recent reform of the Portuguese language curriculum (Reis *et al.*, 2009), the explicit teaching in planning, translating, and revising processes is deemed as a critical component of writing instruction. Although writing is the preferred learning and assessment tool across courses and schooling, explicit writing instruction only occurs in Portuguese language classes.

Procedure

This study is part of a larger research project investigating writing development. Students performed several tasks, but only those relevant to this study are described next. Data collection occurred in classroom groups with 20–25 students during two 45-min sessions in the month of May. Students started each session by planning and writing a story about the following topic: 'Tell a story about a child who lost his/her pet'. The experimenter gave students 3 min to plan the text, that is, to write down everything that could help them to write the text (for a similar procedure, see Berninger *et al.*, 1996). Then, students had 8 min to write it. Anytime, a student stopped writing he or she was prompted to continue. Given the wide range of participants' grade level, the duration of the planning and writing tasks was chosen to allow all students to generate and develop their ideas without fatiguing the younger ones. After the writing task, in the first session, participants performed the alphabet task (Berninger *et al.*, 1992). They were asked to write the lower case letters of the alphabet for 15 s, legibly and as quickly as possible. In the second session, participants were asked to revise a story in which we implanted six mechanical errors (two errors of three kinds: Spelling, punctuation, and syntax errors) and six substantive errors (two errors of three kinds: missing, inconsistent, and out-of-sequence sentences). This task was completed in two phases. First, students marked everything they thought was not right (detection phase). Second, the experimenter gave them the text with all target errors marked and students corrected them (correction phase). In both sessions, two adults were always present in the room to guarantee that experimental procedures were carried out as intended and that students did not look at their peer's sheets, particularly in the revision task.

Measures

Handwriting fluency

To assess students' handwriting fluency, we counted the total number of legible letters of the alphabet written in the right sequence for 15 s.

Spelling

The percentage of words spelled correctly in the story was used as a measure of spelling skills.

Text structure

Texts were scored to determine whether they included the characteristic elements of a story. Eight narrative elements were considered: characters, time, space, initiating event,

attempt, internal response, consequence, and reaction (based on Stein & Trabasso, 1982). For each element, one point was awarded if it was present.

Planning

A rating scale ranging from 1 (*low*) to 6 (*high*) was used to assess students' planning skills. Scores 1 and 2 were attributed to plans that represent no pre-planning and minimal pre-planning, respectively. Plans summarizing the text received a score of 3, and plans with topics slightly elaborated in the text received a score of 4. Scores 5 and 6 were attributed to plans with emergent subordination (i.e., rudimentary macrostructure) and structural relationships (e.g., graphic organizers) respectively. This scoring scale was based on those developed by Whitaker *et al.* (1994) and Olinghouse and Graham (2009).

Revision

Four measures were extracted from the revision task. The number of mechanical errors accurately detected or corrected was used as a measure of mechanical detection and mechanical correction, respectively. The number of substantive errors accurately detected or corrected was used as a measure of substantive detection and substantive correction, respectively (maximum of 6 points per score).

Writing quality

Two pairs of graduate students, blind to study purposes, rated writing quality by means of a scale ranging from 1 (*low*) to 7 (*high*). Raters were told to consider ideas quality, organization, sentence structure, and vocabulary and to give the same weight to these factors. To control for expected differences between grade levels, one pair of judges rated all texts from Grades 4 to 6, and the other pair rated all texts from Grades 7 to 9. To avoid biased judgements, all texts were previously typed and corrected for spelling, punctuation, and capitalization errors (Berninger & Swanson, 1994). Inter-rater reliability using Cohen's weighed Kappa for writing quality was .78 and .84, respectively, in Grades 4–6 and 7–9. Thus, the final score was the average for the two judges.

Measures reliability

At each grade, a second judge rescored the tasks for 20% of the students. Inter-rater reliability, using Cohen's weighed Kappa, for text structure, planning, and revision was .98, .88, and 1.00, respectively. Inter-rater reliability for the alphabet task and spelling, using intraclass correlation coefficient, was .991 and .997, respectively.

Results

Data analyses encompassed two phases. In the first phase, analyses of variance (ANOVAs) were conducted to analyse the development of planning, as well as mechanical and substantive detection and correction across schooling. In the second phase, regression analyses were performed to examine the contribution of planning and revising skills to writing quality.

Development of planning and revising skills

To examine the development of planning skills throughout school years, we conducted a one-way ANOVA (see Table 2 for descriptive statistics). As predicted, we found significant effect of grade, $F(5, 375) = 18.33$, $p < .001$, $\eta_p^2 = 0.20$. Planned contrasts revealed a decrease from Grades 4 to 5 ($p = .002$, $d = -0.62$), an increase from Grades 5 to 6 ($p = .001$, $d = 0.72$), a stationary period from Grades 6 to 7 ($p = .33$, $d = -0.16$), and increases from Grades 7 to 8 ($p = .01$, $d = 0.42$) and 8 to 9 ($p < .001$, $d = 0.68$).

The development of mechanical and substantive revising skills throughout school years was analysed by means of two 2 (revision subprocess) × 6 (grade) ANOVAs, with repeated measures on the first factor (see Table 2 for descriptive statistics). Regarding mechanical revision, we found a main effect of revision subprocess, $\Lambda = .66$, $F(1, 375) = 192.53$, $p < .001$, $\eta_p^2 = 0.34$, and a main effect of grade, $F(5, 375) = 37.61$, $p < .001$, $\eta_p^2 = 0.33$. The interaction between these two variables was also significant, $\Lambda = .97$, $F(5, 375) = 2.46$, $p = .03$, $\eta_p^2 = 0.03$, and was examined with tests of simple main effects. We found that for all grade levels, students were better at correcting mechanical errors than detecting them, $\Lambda < .97$, Fs$(1, 375) > 10.29$, ps $< .001$, $\eta_p^2 > 0.03$. Furthermore, tests of simple main effects revealed significant differences across grades for mechanical detection, $F(5, 375) = 21.19$, $p < .001$, $\eta_p^2 = 0.22$, as well as for mechanical correction, $F(5, 375) = 29.58$, $p < .001$, $\eta_p^2 = 0.28$. These significant effects were followed up by planned contrasts. For mechanical detection, these tests

Table 2. Descriptive statistics for planning and revision measures by grade

	Grade					
Measure	4	5	6	7	8	9
Planning (1–6)						
M	2.57	1.83	2.63	2.42	2.98	3.81
SD	1.42	0.91	1.28	1.38	1.28	1.14
Me	2.5	2	2	2	3	4
Min–Max	1–4	1–4	1–4	1–5	1–6	1–6
Mechanical detection (0–6)						
M	1.64	1.08	1.58	2.17	2.18	3.15
SD	1.00	1.04	1.18	1.41	1.50	1.25
Me	2	1	1	2	2	3
Min–Max	0–3	0–4	0–5	0–5	0–5	0–6
Mechanical correction (0–6)						
M	2.26	2.11	2.71	3.07	3.70	4.27
SD	1.09	1.35	1.32	1.26	1.20	1.20
Me	2	2	3	3	4	4
Min–Max	0–5	0–5	0.5	0.5	0–6	0–6
Substantive detection (0–6)						
M	1.02	0.89	1.23	1.26	1.57	1.79
SD	1.00	0.91	1.13	1.02	1.44	1.18
Me	1	1	1	1	1	2
Min–Max	0–3	0–3	0–5	0–4	0–5	0–5
Substantive correction (0–6)						
M	1.10	1.13	1.60	1.51	1.77	1.96
SD	0.83	0.86	1.04	0.95	1.16	0.94
Me	1	1	2	2	2	2
Min–Max	0–2	0–3	0–5	0–4	0–4	0–5

showed a decrease from Grades 4 to 5 ($p = .02$, $d = -0.55$), which was followed by increases from Grades 5 to 6 ($p = .03$, $d = 0.45$) and 6 to 7 ($p = .007$, $d = 0.45$). Although these skills remained stable from Grades 7 to 8 ($p = .02$, $d = 0.01$), they clearly levelled up from Grades 8 to 9 ($p < .001$, $d = 0.70$). Similar tests showed that mechanical correction levelled off from Grades 4 to 5 ($p = .54$, $d = -0.12$), increased from Grades 5 to 6 ($p = .01$, $d = 0.45$), and levelled off again from Grades 6 to 7 ($p = .09$, $d = 0.45$). A growing trend was found throughout the next grades, with robust increases from Grades 7 to 8 ($p = .004$, $d = 0.51$) and 8 to 9 ($p = .009$, $d = 0.47$).

Concerning substantive revision, we found a main effect of revision subprocess, $\Lambda = .97, F(1, 375) = 12.86, p < .001, \eta_p^2 = 0.03$. Similar to mechanical revision, students were better at correcting substantive errors than detecting them. We also found a main effect of grade, $F(5, 375) = 9.41$, $p < .001$, $\eta_p^2 = 0.11$. Planned contrasts revealed that substantive revision remained stable from Grades 4 to 5 ($p = .76$, $d = -0.06$), increased from Grades 5 to 6 ($p = .01$, $d = 0.41$), and levelled off again from Grades 6 to 7 ($p = .84$, $d = -0.03$). Although there was a growing trend from Grades 7 to 8 ($p = .06$, $d = 0.25$) and 8 to 9 ($p = .18$, $d = 0.17$), the differences between these grades were not larger enough to be statistically significant. The interaction between revision subprocess and grade was not reliable, $F < 1$.

Contribution of high-level writing skills to writing quality

Table 3 shows means and standard deviations for the regression variables, along with their intercorrelations, for Grades 4–6 and 7–9. Regarding control variables, achievement was positively correlated with almost all variables in both groups. Age was also correlated with almost all other variables, but only in the older group. Transcription variables had higher correlations with each other than with other control variables. Revision variables were moderately correlated in both groups, but they were only correlated with planning in the older group.

To examine whether students' high-level writing skills made a unique contribution to writing quality, we conducted hierarchical regression analyses. Separate analyses by grade groups were conducted to predict writing quality (see Table 4). For both analyses, Step 1 included the six control variables, and on Step 2, the five high-level variables were added.

In Grades 4–6, the control variables significantly predicted writing quality, $R^2 = .27$, $F(6, 169) = 10.30$, $p < .001$. However, when the high-level variables were entered, there was no increase in the prediction of writing quality, $R^2 = .30$, $F_{change}(5, 164) = 1.25$, $p = .29$. Only age, achievement, handwriting fluency, and text structure significantly contributed to writing quality. In Grades 7–9, Step 1 of the analysis was significant, $R^2 = .32$, $F(6, 198) = 15.37$, $p < .001$. Moreover, there was a significant increase in the prediction of writing quality on Step 2, $R^2 = .38$, $F_{change}(5, 193) = 3.54$, $p = .004$. This means that 6% of the variance associated with writing quality was uniquely explained by high-level writing skills. Planning and substantive correction, along with gender, achievement, and text structure, significantly explained writing quality variability.

Discussion

The first aim of the present study was to analyse the development of planning and revising from Grades 4 to 9. We examined whether grade affected planning and whether grade and revision subprocess (detection vs. correction) affected mechanical and substantive

Table 3. Correlations, means, and standard deviations for regression variables by grade group

	1	2	3	4	5	6	7	8	9	10	11	*M*	*SD*
1. Age		−0.06	0.18	0.22	−0.001	0.35	0.22	0.31	0.14	0.15	0.17	14.00	0.95
2. Achievement	−0.27		0.29	0.29	−0.12	0.11	0.20	0.18	0.26	0.25	0.40	3.18	0.67
3. Handwriting fluency	0.34	0.15		0.32	0.06	0.13	0.25	0.13	0.14	0.21	0.31	20.93	5.43
4. Spelling	−0.04	0.25	0.26		−0.10	0.12	0.42	0.30	0.11	0.18	0.20	98.03	2.13
5. Text structure	0.21	0.06	0.23	−0.02		0.08	0.09	0.09	−0.01	−0.01	0.21	6.60	1.30
6. Planning	−0.02	0.27	0.15	−0.01	0.13		0.05	0.19	0.15	0.16	0.28	3.10	1.39
7. Mechanical detection	−0.07	0.34	0.13	0.20	0.03	0.10		0.37	0.12	0.36	0.20	2.53	1.45
8. Mechanical correction	0.09	0.34	0.15	0.27	0.06	0.09	0.32		0.06	0.25	0.18	3.70	1.32
9. Substantive detection	0.05	0.25	0.12	0.19	0.07	0.13	0.23	0.14		0.36	0.19	1.55	1.23
10. Substantive correction	0.18	0.25	0.28	0.16	0.12	0.11	0.14	0.24	0.43		0.32	1.75	1.03
11. Writing quality	0.28	0.24	0.34	0.11	0.31	0.06	0.03	0.23	0.22	0.24		3.84	1.44
M	11.07	3.41	14.64	95.72	6.50	2.37	1.45	2.38	1.06	1.30	4.35		
SD	1.02	0.83	5.09	4.13	1.35	1.28	1.11	1.28	1.03	0.95	1.20		

Note. Values below the diagonal are Grades 4–6 ($n = 176$), and correlations equal or above .15 are statistically significant ($\alpha = .05$). Values above the diagonal are for Grades 7–9 ($n = 205$), and correlations equal or above .14 are statistically significant ($\alpha = .05$).

Table 4. Regression model predicting writing quality by grade group

	Grades 4–6 (n = 146)			Grades 7–9 (n = 205)		
Predictor	*B*	*SE*	*t*	*B*	*SE*	*t*
Step 1						
Gender	−0.31	0.17	−1.86	−0.59	0.18	−3.34***
Age	0.28	0.09	3.16**	0.24	0.09	2.58*
Achievement	0.37	0.11	3.44***	0.76	0.14	5.39***
Handwriting fluency	0.03	0.02	1.77	0.03	0.02	1.84
Spelling	0.001	0.02	0.05	0.00	0.04	0.06
Text structure	0.19	0.06	3.11**	0.26	0.07	3.96***
Step 2						
Gender	−0.21	0.18	−1.20	−0.63	0.17	−3.64***
Age	0.24	0.09	2.65**	0.15	0.10	1.44
Achievement	0.35	0.12	2.92**	0.65	0.14	4.54***
Handwriting fluency	0.04	0.02	1.97*	0.03	0.02	1.50
Spelling	−0.01	0.02	−0.27	0.01	0.05	0.13
Text structure	0.19	0.06	3.06**	0.25	0.07	3.85***
Planning	−0.05	0.07	−0.70	0.16	0.07	2.43*
Mechanical detection	−0.13	0.08	−1.67	−0.03	0.07	−0.48
Mechanical correction	0.09	0.07	1.18	−0.04	0.07	−0.52
Substantive detection	0.14	0.09	1.52	−0.05	0.07	−0.61
Substantive correction	0.03	0.10	0.28	0.30	0.09	3.17**

Note. The gender variable was dummy coded (0 = girl; 1 = boy). [Note: Correction added on 3 June 2013 following initial online publication on 16 May 2013. On first publication, this mistakenly read '(0 = boy; 1 = girl)'; this error has been corrected in this version of the article.]
*p < .05; **p < .01; ***p < .001.

revision. The second aim of the present study was to analyse the contribution of students' high-level skills to writing quality, after controlling a set of variables writing and non-writing related.

The predicted growth tendency of the planning skills across schooling was found (Hypothesis 1). From Grades 4 to 9, there was an increase of 1.2 in story planning. Agreeing with Berninger and collaborators (Berninger & Swanson, 1994; Berninger *et al.*, 1996; Whitaker *et al.*, 1994), this finding suggests that pre-planning has already emerged in Grade 4 and continues to develop throughout the next school years. Nonetheless, it is worth mentioning that in Berninger and colleagues' studies and ours, the experimental procedure forced students to pre-plan. Hence, we cannot assume that they would do it in the absence of such instruction. Indeed, in the latter situation, 85% of sixth graders and 67% of eighth graders did not show explicit planning processes (Fidalgo, Torrance, & García, 2008; Torrance *et al.*, 2007).

Confirming Hypothesis 2, students' ability to revise increased from one grade to the next. Still, the pace of development was more pronounced for mechanical than substantive revision. Respectively, there was a growth of 3.5 and 1.6 points, from Grades 4 to 9, even though the performance of older students in revising substantive errors was poor. This result might be explained by a biased conception of revision towards surface features (Graham *et al.*, 1993), or it might have been the by-product of indicating errors' location. It has been shown that this procedure led seventh graders to focus on mechanical problems, at the expense of meaning problems (McCutchen *et al.*, 1997).

The finding that students were better at correcting than detecting either mechanical or substantive errors corroborated Hypothesis 3. At all grade levels, students were able to correct more errors than those they were able to detect. In line with the findings of Hacker, Plumb, Butterfield, Quathamer, and Heineken (1994), this result suggests that writers may have difficulties in detecting an error if they are not able to recognize the correct version of it. With a sample of high school students, they showed that the majority of detected errors were corrected. However, especially in the case of meaning errors, students' were able to correct several errors that had not been previously detected. This difference might have been magnified because in the correction task, students were cued by the indication of error location, but in the detection task, they were not. Probably, if this latter have been cued (e.g., by providing the number of errors or delimiting their location), the difference between the two revision subprocesses would be reduced. Nevertheless, the superiority of correction over detection is a consistent finding in the literature. Despite that, students' ability to detect errors can be improved by several means, such as instruction in the revision process (Fitzgerald & Markham, 1987), promotion of comprehension monitoring (Beal, Garrod, & Bonitatibus, 1990), or postponement of the revision process (Chanquoy, 2001).

It is noticeable that besides the growth pattern of planning and revising skills, some decreases and stationary periods were found from Grades 4 to 5 and from Grades 6 to 7. This might be the consequence of the transitions between the basic education stages of the Portuguese school system (see Methods section). These transitions are usually accompanied by increases in teachers' expectations and learning demands (Reis *et al.*, 2009), which can possibly defeat and weaken students' confidence on their academic skills. In the specific case of writing, it is likely that this lower sense of self-efficacy could negatively impact their performance. Indeed, it was shown that students' self-perceptions of their own writing competence is a strong predictor of various writing outcomes, above and beyond other motivational variables (Pajares & Valiante, 1997, 1999).

The regression analyses used to test whether students' high-level writing skills had an incremental effect on their writing quality verified Hypothesis 4. As expected, high-level writing skills did not predict writing quality in Grades 4–6, but they did in Grades 7–9. Given the poorly developed planning and revising skills of younger students, they might have adopted a knowledge-telling strategy to write the story. With this strategy, text production is guided by topic and genre cues with little influence of high-level processes (Bereiter & Scardamalia, 1987). The early acquisition of the narrative schema enables students to write by retrieving content, filling it within the narrative schema, and translating it into text (Olive, Favart, Beauvais, & Beauvais, 2009). Regarding older students, differences in writing quality were accounted for by their planning and revising skills, above and beyond other well-known predictors. This finding indicates that older students might have adopted a knowledge-transforming strategy to write the story, which involves the articulation of translation with planning and revising (Bereiter & Scardamalia, 1987). Older students' writing called for their planning and revising skills, respectively, to generate and organize ideas in a coherent way and to change these ideas in an attempt to clarify them to the audience.

It is noteworthy that with respect to revision, only substantive correction contributed to writing quality. On the one hand, it seems that writing quality is dependent upon writers' ability to focus on overall concerns at the text-meaning level, rather than on local concerns at the sentence and word levels. Indeed, it was shown that an increase in the amount of meaning, global revisions resulted in gains in compositional quality (De La Paz

et al., 1998), but an increase in the amount of surface, local revisions did not (Graham, 1997). On the other hand, the finding that substantive correction, rather than substantive detection, influenced the quality of students' texts might be explained by their poor ability to detect meaning errors. Yet, this is not to say that one of the subprocesses is more important than the other. Actually, writers must be able to detect not only flaws in the text but also elements that can be enhanced through rereading. Without this recognition, writers will not be able to introduce modifications that improve the text.

The presented findings should be considered in view of at least three limitations. First, the development of planning and revising skills was analysed cross-sectionally. Future research should explore the development of these skills longitudinally. Second, students in Grades 4–6 were grouped as well as students in Grades 7–9. Besides age was introduced as a control predictor, larger samples should be collected to analyse the contribution of high-level writing skills to writing at each grade level. Third, we did not analyse the online management of planning or revision. This analysis could deepen our understanding about students' use of these skills during text production as writing performance is also influenced by the interaction and temporal distribution of planning and revision in a writing session (Rijlaarsdam & Van den Bergh, 2006).

Educational implications

With respect to the teaching and learning of writing, the current study agrees with the position of many writing researchers that more needs to be done to support and foster the writing skills of school-aged children (e.g., Connelly & Barnett, 2009; Graham, Gillespie, & McKeown, 2012; Rijlaarsdam *et al.*, 2005). In particular, our results complement a large body of research (see Graham & Harris, 2009) by emphasizing the importance of fostering students' high-level writing skills throughout schooling.

We found that planning and revising progressively increased across schooling, which seems to indicate that school instruction supports their development. Even so, our findings suggest that there is room for improvement. Signalling the need to develop and test instructional programmes to supplement writing instruction in the general education classroom, we found that students' ability to plan before writing and to revise for meaning was not fully operational. This is problematic because these skills are critical in writing. Actually, planning and revising contributed to writing quality above and beyond a set of writing- and non-writing-related variables (viz., gender, school achievement, age, handwriting fluency, spelling, and text structure). The incremental validity of these high-level writing skills points out to the need of boosting them as a key way to improve developing writers' text production effectively and efficiently. The finding that these skills are predictive of writing quality in Grades 7–9 but not in Grades 4–6 makes us argue that they should be targeted in the initial stages of learning to writing. The lack of sufficient planning and revising abilities may, perhaps, explain why younger students are not using them in a manner that would aid text production. Nevertheless, the poorly developed high-level writing skills of novice writers do not seem to be only a question of maturation of executive functions. They might also sign that younger students are not benefiting from appropriate instruction. Consequently, efforts should be made to develop and provide teachers with evidence-based practices that they can use to support very young writers' planning and revising skills. Research has been providing evidence that not only older but also younger students can be successfully taught to employ their high-level writing skills to write qualitatively better texts. In a meta-analysis of writing instruction for students in Grades 1–6, Graham, McKeown, *et al.* (2012) found that the teaching of planning and

revising strategies is among the most effective writing interventions. A similar result was found in another meta-analysis with students in Grades 4–12 (Graham & Perin, 2007). Collectively, these findings and those of the present study highlight that among the plethora of skills involved in writing, those of planning and revision deserve a prominent place in writing instruction from early on.

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