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Chemistry Textbooks (CTB) have long been a source of interest and concern among chemistry teachers. However, little is known of how secondary school students use CTBs in their study. The aim of this survey was to examine for a sample of 7031 middle (50.7%) and high school (49.3%) Portuguese students: (i) what activities from CTBs are highlighted during their study; (ii) what are the characteristics of CTBs which they privileged.

The results suggest that CTBs are differently used by students from different grade levels. Nine grade students (14 year-olds) stressed the importance of the communication aspects of CTBs (e.g. drawings, colours...) far more than students from higher grade levels. The verification format of study, in which pupils focuss on activities directed to the strict content presented by the teacher during the lesson, seems to be the predominant one, in particular for higher grade levels. Twelfth grade students (17 year-olds) in particular, do not seem to have developed independent ways of learning (f.i. further readings) which are so necessary in College or University, more than their peers have.

Implications of the results for pre-service and in-service training of chemistry teachers are discussed.

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1 - Introduction

Chemistry textbooks (CTBs) have long been a motive of interest and concern among chemistry teachers and curriculum developers (1 to 5). This is because CTBs are widely used by students as a primary source of information in chemistry instruction. Also, many chemistry teachers design their courses around CTBs. For example, in Portugal, 38.5% of secondary chemistry teachers reported in a previous study that they use CTBs frequently to plan instruction (1). As Yager put it, "The major curriculum decision that most teachers make is the choice of a textbook...Textbooks determine the order, the examples, the applications of science topics..." (2, p.140).

Generally speaking, most of the reported studies in the field of chemistry (science) textbooks and chemistry (science) reading focussed on the teacher (3) or the textbook itself (4;5) as the main variables. Little is known of how secondary school students use CTBs though it seems reasonable to assume that a better knowledge of this issue may give chemistry teachers useful clues on how to help students to study chemistry more effectively: "Students would learn more about characteristics of a textbook if they were taught how to analyse their own books rather than completing workbook pages" (6).

Improvements in this field depend heavily on the answers to three main questions: Q1) What activities are highlighted during study from CTBs; Q2) What are the characteristics of CTBs which are privileged; Q3) What are the study strategies used, in particular, metacognitive and cognitive skills used.

In this report only the first two questions will be examined with a sample of 7031 middle and secondary students. Hopefully, insights obtained in these two domains may provide valuable information for the training of chemistry teachers both in pre-service and in-service courses. It may also help curriculum developers and publishers to design materials which meet students' preferences more closely.

2 - Method

Middle school students (51.7%) were from grade 9 (14 year olds); secondary school students were from grade 10 (17.2% - 15 year olds), grade 11(19.7% - 16 year olds) and grade 12 (11.4% - 17 year olds). A sample of the items (Yes/No format of the questionnaire used in the survey is presented in tables I and II). The instrument was previously validated by experienced teachers and science education researchers. A pilot study took place before the final version was administered in 1989 to middle and secondary school students from schools randondly selected from all over the country.

3 - Results

3.1 - The pattern of the results concerning Question 1 (Table I) suggests that in their study students focussed on activities which may be considered as a verification of the strict content introduced during the lesson, e.g., the "study of the content" (presented by the teacher) and the "resolution of exercises". Conversely, "further readings" and "home experiences" were two activities which were rated well below. On the whole, this verification format of study is consistent with recommendations made by Portuguese chemistry teachers to their students concerning the use to be made of CTB (1).

It's open to further investigation whether there is a clear implication between these two sets of results. For example, the focus on the resolution of exercises may well be the consequence of homework assignments.

Further analysis of the results show that the salience on the verification format of study is reinforced with increasing grade level. Students from grade 12 in particular (probably because of the pressure to prepare for their entry examination to University), seem to be much more concerned with the essential information needed for "getting through" (Fig.1).

3.2 - Data presented in Table II, concerning Question 2, show how differently students from different grade levels rated CTB characteristics.

The main trend identified suggests that 9th grade students stress the importance of the communication aspects (drawings, colours,...) of CTBs far more than 12th grade students do. For the latter students, the main concern seems to be the content dimension. In particular, the items "solved exercises"

and "answers to the exercises proposed", both providing immediate feedback, were those most frequently chosen by 12th grade students. This configuration of results is consistent with results referred to in 3.1.

Comparison with results from teachers preferences of CTB characteristics (1) show that students from late grade levels are those who have closer views e.g., the content dimension is the more salient one. For example, this dimension was rated by 76% of Portuguese chemistry teachers as "very important" whereas only 50% rated the communication dimension similarly.

4 - Conclusions

The main conclusion of this study is that there is no such thing as unique approach used by students from different grade levels to the use of CTBs.

The verification format of study seems to be predominant, in particular for higher grade levels. This result is not consistent with expectations of an increased responsability of students from higher grade levels for their own learning. Twelfth grade students in particular were expected to concentrate substantially more than the other students on complementary reading (presented in a given CTB or from other text materials). This seems to be a required condition for the development of study skills so necessary in College or University.

Teachers should be aware of the different approaches used by students while studying from CTBs so as to be more critical when discussing with their students how to analyse and use their CTBs, particularly in the context of home study. They should also help their students to develop attitudes and skills to study in an independent way from several text materials. Pre-service and in-service chemistry teacher education courses should explicitly address these issues providing adequate background and experiments for student teachers/teachers.

Table I - Uses of CTBs by students during home study (% of Yes responses/grade level)

Do you use your CTB,	9th	10th	11th	12th
i) to study the content introduced during the lesson	82.1	80.5	81.0	89.9
ii) as further reading	60.9	59.3	58.6	61.7
iii) to solve exercises	79.8	84.0	88.5	89.6
iv) to carry out experiments as suggested in the textbook	23.6	15.1	13.8	9.9

* non respondants were 7% (on average)

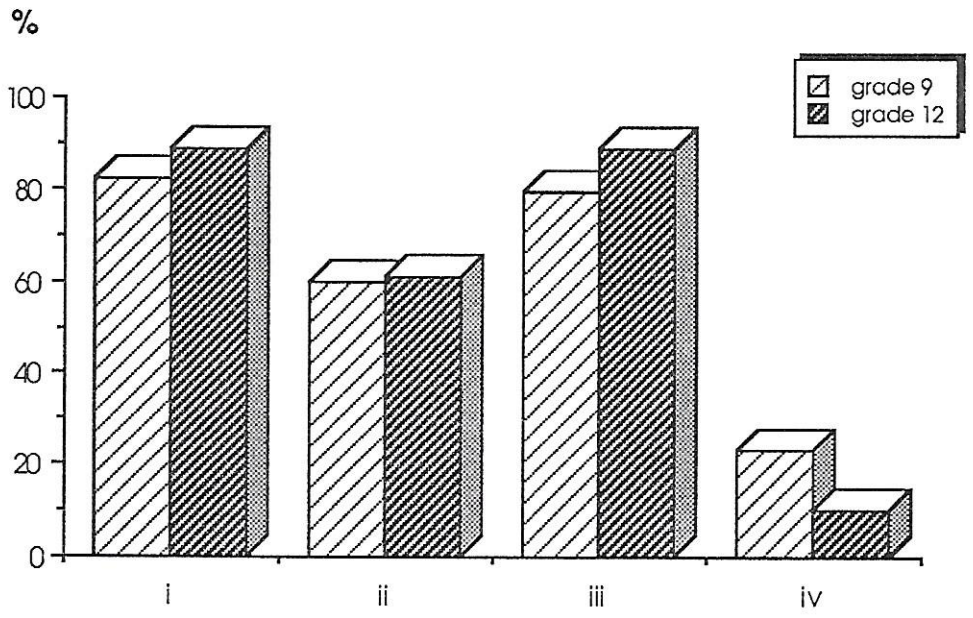

Fig. 1 — Uses of CTBs and grade level

Table II - Characteristics of CTBs (% of Yes responses/grade level)

In your opinion CTBs should have,	9th	10th	11th	12th
• a lot of drawings/illustrations	79.4	76.7	74.7	70.2
• several colours	66.4	64.0	64.4	55.3
• complementary readings	86.3	85.2	86.5	85.0
• solved exercises	63.4	76.1	91.2	91.9
• exercises without solution	81.4	87.5	89.0	89.6
• answers to the exercises proposed	79.6	87.6	93.0	93.7
• suggestions for home experiments	79.8	76.1	75.5	68.0
• historical information	75.5	68.8	71.7	65.7

* non respondants were 3% (on average)

REFERENCES

[1] CACHAPUZ, A., MALAQUIAS, I., MARTINS, I. P., THOMAZ, M. F., COSTA, N. (INEA group), 1989. "O Ensino-Aprendizagem da Física e Química: resultados globais de um questionário a professores". Monografia, Universidade de Aveiro.

[2] YAGER, R., 1983. "The importance of terminology in teaching K-12 science" J. of Res. in Sci. Teaching, 20, 577-588.

[3] YORE, L., 1991. "Secondary science teachers attitudes towards and beliefs about science reading and science textbooks". J. of Res. in Sci. Teaching, 28, 55-72.

[4] CHIAPPETA, E. and FILLMAN, D., 1989. "Examination of high school chemistry textbooks". Paper presented to the 62nd NARST Conference, San Francisco, USA.

[5] SOONG, B. and YAGER, R., 1989. "An analysis of the most used science textbooks in secondary school in the United States". Paper presented to the 62nd NARST Conference, San Francisco, USA.

[6] SIMPSON, M., 1984. " The status of study strategy instruction: implications for classroom teachers". Journal of Reading, Nov., 136-142.