New Perspectives in Science Education
International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION


An Investigation into the Pedagogy that Maltese Chemistry Teachers Adopt at Secondary School Level

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Abstract

This paper reviews the study carried out by Borg (2021) [1] which addresses an underexplored area of science education in Malta - the perspective of local secondary school educators on chemistry teaching. The study investigated the different pedagogical approaches used by Maltese Chemistry teachers at the secondary school level. Additionally, their views and attitudes towards teaching the subject were explored, including the opportunities and challenges encountered in the classroom. Student-centred (SC) pedagogies have been repeatedly linked with deeper learning and an improved interest in science. For example, Inquiry-Based Learning (IBL) actively engages students in the thinking and learning process through real-life tasks and problems. The Context-Based Approach (CBA) uses a real-life context as the starting point for the topic or lesson to orientate and motivate students and goes beyond providing examples as illustrations or applications [2]. These teaching methods do not only develop students' understanding but also enhance students' attitudes towards science [3]. As in other European countries, the chemistry curriculum and the pedagogical approaches used in the chemistry classroom in Malta are mainly traditional and limited to knowledge transmission [1],[4]. Moreover, the current chemistry syllabus at the secondary level (SEC) is abstract; one that promotes memorization and is not pertinent to students' everyday lives [1],[4]. A mixed methods research design was adopted during the study. An online survey and semi-structured individual interviews carried out with five different teachers from different schools were used to generate data. Results demonstrated that the teachers' methods of instruction are significantly influenced by their personal beliefs on teaching chemistry, as well as on how their pedagogical approaches affect their students' learning. Although the collected data showed evidence of teachers' knowledge and use of SC pedagogies, it was revealed that teacher-centred approaches remain widely used in the Maltese chemistry classroom. The Chemistry teachers were particularly concerned about the abstract and content-laden SEC Chemistry syllabus and the issue of assessment, where Malta's examination system mainly encourages educators to teach to the test.

Keywords: *chemistry, secondary school, teachers, pedagogical approaches*

1. Introduction

Student-centred (SC) pedagogies have been repeatedly linked with deeper learning and an improved interest in science. However, several reports claim that chemistry curricula and pedagogies adopted in the chemistry classroom in Malta and other European countries are often traditional [5],[6]. These curricula tend to put content first and applications a poor second [7]. They are packed with knowledge that students need to learn, limiting the time available for practical work and for a deep “understanding of the process and nature of science” [9]. Moreover, research has shown that chemistry teaching is often perceived as ‘‘unpopular and irrelevant in the eyes of students’’ and ‘‘does not promote higher-order cognitive skills’’. The pedagogy adopted ‘‘is not changing, because chemistry teachers are afraid of change and need guidance’’ [7].

Malta’s current chemistry syllabus at the Secondary Education Certificate level (SEC) is presented as a ‘‘rather fragmented body of knowledge that is abstract, encourages memorization and is irrelevant to students’ everyday lives’’ [1],[4]. It mainly targets students who need to be prepared for further specialisation in chemistry. The content and pedagogy associated with such curricula are criticised since they fail to engage and inspire learners with further study of the subject [5]. The concerned stakeholders have often expressed the need for curriculum reform that provides “chemistry students and teachers with time and space to engage with the subject, encourages SC learning and includes practical work as an integral part of the programme”. [4]. The Maltese National Curriculum Framework,

NCF) [8] published in 2012 was a breath of fresh air. It led to the development of the Learning Outcomes Framework (LOF) for the different subjects studied at compulsory school level. This includes a new program for chemistry which recommends the use of IBL and emphasises the need to render chemistry relevant to students' lives.

Other local studies revealed that Maltese chemistry teachers tend to favour teacher-centred (TC) pedagogies and activities that restrict exploration [6],[9]. Moreover, despite the reported advantages of the use of SC approaches, in a study about Maltese chemistry teachers' views on the use of the Context-Based Approach (CBA), teachers expressed concerns such as the lack of examples of real-life applications or contexts, and constraints due to time and assessment, with the biggest challenge being the fear that students may learn less than they do through traditional teaching and will then perform less well in examinations. [10]

2. Research Questions

This paper presents the study carried out by Borg (2021) which investigated the different pedagogical approaches used by Maltese chemistry teachers at the secondary school level [1]. Additionally, their views and attitudes towards teaching the subject were explored, including the opportunities and challenges encountered in the chemistry classroom.

The main research questions behind this study were:

- What pedagogical approaches do secondary school Maltese Chemistry teachers adopt in their classrooms?
- What are the benefits and challenges (or limitations) faced by these teachers when teaching chemistry?

3. Methodology

The study utilised a mixed-methods approach, combining both quantitative and qualitative data to ensure increased validity and reliability of the findings (triangulation of data) [15]. An online survey coupled with online semi-structured individual interviews were the two main study tools adopted.

3.1. Data collection

At the time of study, the survey was distributed to a total of 65 chemistry teachers teaching in various secondary state and non-state schools in Malta and Gozo. A total of 41 responses were collected, yielding a margin of error of 9% at a 95% confidence level. Convenience sampling was used to invite teachers for the online interviews and a total of five interviewees from different schools were recruited as described in Table 1. These teachers were assigned pseudonyms (as codes) so as not to divulge their real identity. The number in parentheses represents the respective interviewees' years of teaching experience. The interviews were audio-recorded, and transcripts were prepared soon after the interviews. Thematic analysis of the transcripts provided insight into teachers' views in relation to the research questions.

Interview Number	Teacher (Pseudonym/Code)	Secondary School	Years of Teaching Experience
1	CES(20)	Co-Ed State	20
2	CES (12)	Co-Ed State	12
3	BC(4)	Church (Boys)	4
4	GC(7)	Church (Girls)	7
5	CEI(6)	Co-Ed Independent	6

Table 1: Description of the interviewees

4. Results and Discussion

4.1. Teachers' pedagogical approaches in the chemistry classroom

From the survey results, Figure 1 shows that the same number of teachers (14.6%) always adopt the traditional (lecture) method and IBL whereas slightly more teachers (19.5%) stated that they use the CB approach. 41.4% of teachers always or often' resort to traditional teaching in the classroom while a staggering 51.2% prefer IBL rather than traditional pedagogy. Hence, IBL is the most popular pedagogy used by the sample population. An equal number of teachers (9.8%) claimed that they never use the traditional method and PjBL. PjBL is the least popular SC pedagogy implemented in the chemistry classroom.

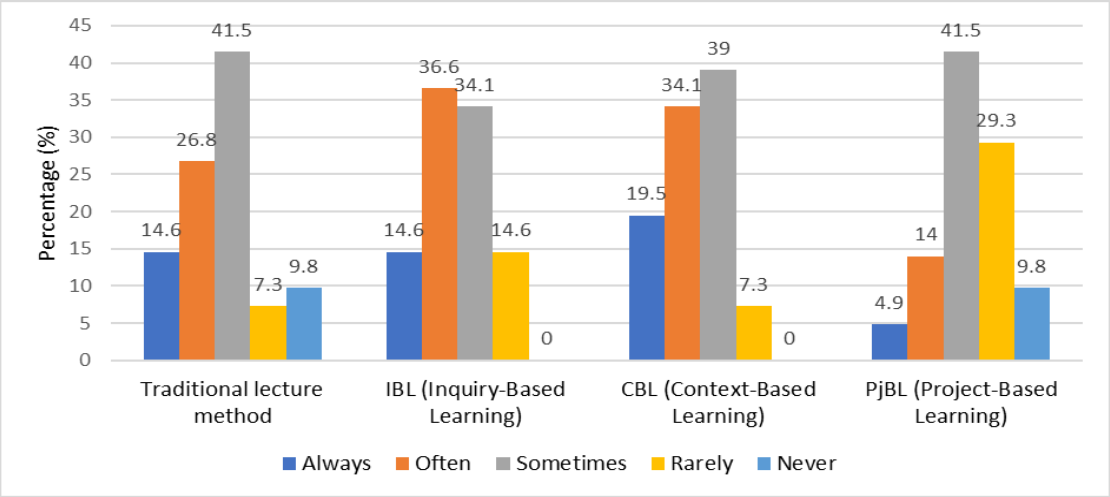

Figure 1: Teachers' responses to four different pedagogical approaches

From the interviews, CES(12) said that she often gives students an open-ended question (IBL) or a context (CBL) so that they would be able to ask questions and come up with the chemical concept, for instance she introduces her lessons with a question followed by a brief class discussion. She remarked that her teaching methods often correlate with the topic she is teaching. CEI(6) mentioned that since she has small classes, she adopts different pedagogical methods. She also emphasised that students learn best when the teacher ''creates a positive learning environment''. Given her mixed-ability classes, GC(7) claimed that she sometimes performs adaptive teaching, to meet the needs of the learner.

On the other hand BC(4) preferred using the traditional (lecture) method where often he ''explains a chemical concept and drills it with students to ensure their understanding''. BC(4) stated that he is aware that the lecture method and 'parrot-fashion' learning are ''not ideal approaches''; however, he remarked that the SEC Chemistry examination mainly tests recall and almost all the topics are abstract or theoretical, so he mentioned that ''it does not make sense to waste time on an influx of SC activities in class'' CES(20) and BC(4) remarked that they sometimes teach the chemistry topics 'Separation techniques' and 'Non-metals' by using the jigsaw method (a cooperative learning strategy) or are simply assigned for students to read at home. BC(4) stated that each topic in chemistry is unique and therefore ''the teacher must reflect and decide well before adopting a specific pedagogy''.

4.2: The criteria teachers consider when adopting their teaching methods

CES(20) stated that her teaching methods are influenced by the topic being covered in class, including student difficulties or misconceptions. CEI(6) and CES(12) use students' academic performance as a guide when adopting particular teaching methods. CEI(6) added that ''sometimes students are not yet ready for certain teaching methods given their intellectual ability. CES(12) and GC(7) mentioned that student learning styles can also affect the pedagogy adopted in the classroom. BC(4) claimed that, when learning chemistry, ''what works for one student might not work for another'', so the first thing that he does at the beginning of the scholastic year is to analyse what may work for every learner.

4.3: Teachers' views on the benefits of teaching chemistry

All the interviewees mentioned the advantages of an established positive learning environment. GC(7) stated that her students' constant participation and attention during the lessons boost her teaching.

CES(12) also claimed that when transmitting the passion for the subject to her pupils and ‘‘seeing the spark in their eyes is a reward itself’’; or when the bell rings and students want to continue with the chemistry lesson. BC(4) said that he appreciates when students thank him after the lessons, as for him, ‘‘this kind gesture is priceless mainly because students are appreciating the teacher’s efforts’’. CEI(6) mentioned that she loves when her students get that ‘‘eureka’’ moment implying that they have finally understood something. CEI(6) added that she appreciates her students’ interest when they research more information at home and then bombard her with questions the next day.

4.4: Teachers’ views on the challenges or limitations faced when teaching chemistry

From the survey results, Figure 2 shows that ‘disengaged learners’ and ‘students who do not complete their assigned work or revise content’ are the main challenges faced by 61% of teachers. These are followed by ‘students lacking prior knowledge or skills’ with 56.1% of the sample population significantly affected. Other challenges such as mixed-ability students and student misconceptions or difficulties significantly affect 46.3% and 34.1% of the sample population, respectively. Absenteeism is the least consequential limitation, as 61% of teachers claimed that they are ‘minimally' affected by absent learners. An equal amount of teachers (19.5%) are significantly and unaffected by absenteeism.

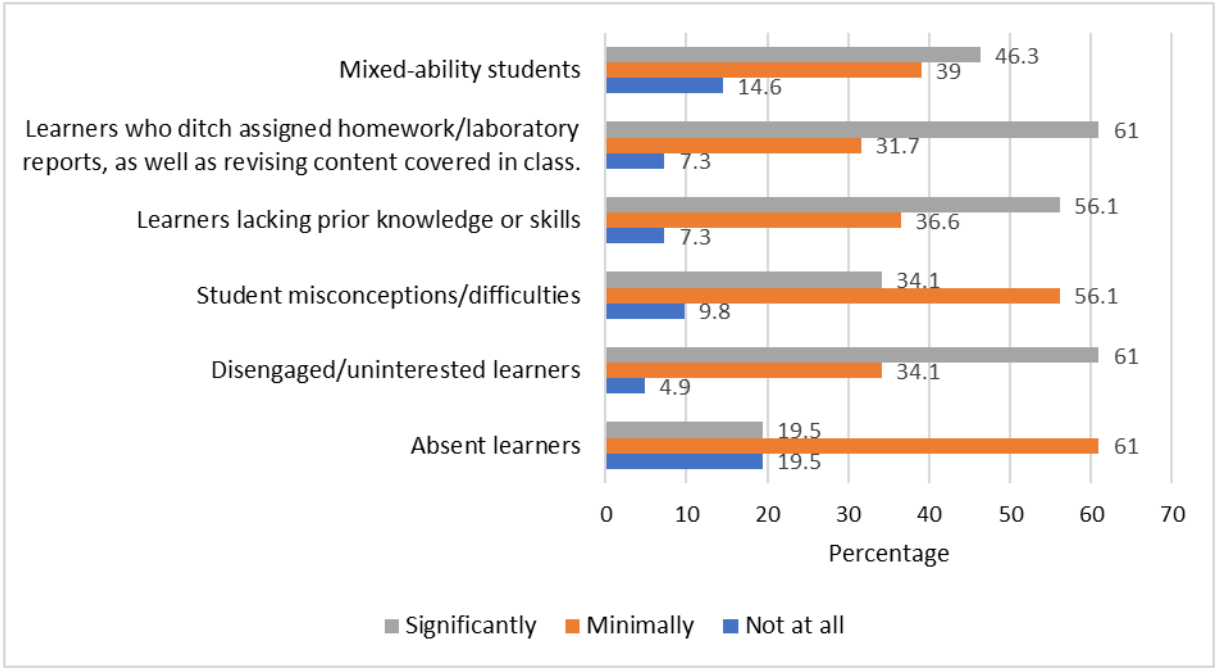

Figure 2: Teachers’ responses to the extent of some challenges when teaching chemistry

All the interviewees agreed that the current chemistry syllabus is too long and described it as “repetitive, not student-friendly and comparable to a crash course’’, where chemistry students do not find it meaningful. The teachers were highly concerned with the available time frame they have for revision after finishing the chemistry syllabus on time before the SEC examination. Besides this, the interviewees also stated that a good number of lessons are lost throughout the scholastic year due to school activities and holidays. They claim that ‘this is why a good chemistry teacher must plan and be flexible in his/her teaching methods’’. When asked about their use of SC pedagogies, all the interviewees agreed that ‘‘it is impossible to completely shift to these teaching methods in the chemistry classroom’’. They claimed that the current syllabus ‘‘encourages one to adopt a didactic pedagogy but pedagogical approaches such as IBL and the CBA must not be neglected’’.

5. Conclusion

The survey results revealed that most Maltese chemistry teachers prefer IBL rather than traditional pedagogy, which produced an interesting find to this study in contrast to other local studies [6] [9] [10].

Moreover, the interviews exposed that local chemistry teachers believe in the benefits of adopting SC pedagogies, like the increase in relevance of the subject to the students' everyday lives and the suitability for students with different abilities. However, the interviews also revealed that chemistry teachers should not entirely change their teaching methods which are working and giving reasonable examination results. These comments are understandable in an education system which is rather examination-oriented and with high-stakes examinations dominating much of what is done at school. The teachers' own experience of learning the subject has a strong influence on how they choose to teach it.

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