Students' Motivation to Learn Chemistry: The Greek Case

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Abstract

Students' motivation to learn chemistry and science in general is a complex construct that it can be conceptualized and assessed in at least five different dimensions. Research shows that motivation interacts closely with cognition and subsequently influences science learning and the level of scientific literacy. In this work, we make an attempt to identify factors that could positively influence students' motivation to learn chemistry by focusing on research findings that are relevant to the Greek student population. Our analysis of the existing literature shows that these factors could be organized into three main categories: teaching approaches, educational tools, and non-formal educational material and activities. In addition, recent studies related to probing Greek students' attitudes toward chemistry, indicate a low level of student motivation to engage in chemistry learning, a fact which could be related to the following issues: difficulty of the chemistry course, demanding curriculum in combination with little allocated teaching time, use of unattractive teaching methods, and lack of career opportunities. More in depth research is needed in order to directly assess students' motivation to learn chemistry and quantify the relative importance as well as interrelation of the influencing factors proposed in this work.

1. Introduction

Motivation to learn chemistry benefits all young students by fostering their *chemical literacy*, which is the capability to recognize chemical concepts as such, define some key-concepts, identify important scientific questions, use their understanding of chemical concepts to explain phenomena, use their knowledge in chemistry to read a short article, or analyze information provided in commercial ads or internet resources [1]. Chemical literacy is considered as a component of scientific literacy and the importance of all students becoming scientifically literate is advocated internationally [2,3].

In general, motivation is the internal state that arouses, directs, and sustains goal-oriented behaviour. In particular, motivation to learn refers to the disposition of students to find academic activities relevant and worthwhile and to try and derive from them the intended benefits [4]. Motivated students achieve academically by strategically engaging in behaviours such as class attendance, class participation, question asking, advice seeking, studying, and participating in study groups [5].

Motivation is a complex, multidimensional construct that interacts with cognition to influence learning [6]. In the context of *conceptual change theory* of learning, Dole and Sinatra [7] describe how both cognitive and motivational learner characteristics interact within a specific learning environment to support or hinder conceptual change. *Social cognitive theory* explains human learning and motivation in terms of reciprocal interactions involving personal characteristics (e.g., intrinsic motivation, self-efficacy, and self-determination), environmental contexts (e.g., high school), and behaviour (e.g., enrolling in advanced science courses) [8,9]. In studying the motivation to learn science, researchers examine why students strive to learn science, how intensively they strive, and what beliefs, feelings, and emotions characterize them in this process.

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Sanfeliz and Stalzer [10], like many high school science teachers, believe that one of their most important instructional responsibilities is to foster students' motivation to learn. According to Sanfeliz and Stalzer, motivated students enjoy learning science, believe in their ability to learn, and take responsibility for their learning.

Students are motivated by the relevance of science to their education and career interests. This implies that science teachers should make a special effort to connect science concepts to students' current and future lives by explaining the importance of scientific literacy, describing the many career opportunities in science, and inviting scientists from the community to participate regularly in school science activities [11,12]. Students' motivation responses can also be used to improve instruction when integrated into comprehensive science-assessment programs [11].

Glynn et al. [4] suggest that students conceptualize their motivation to learn science in terms of five dimensions: (a) intrinsic motivation and personal relevance, (b) self-efficacy and assessment anxiety, (c) self-determination, (d) career motivation, and (e) grade motivation. The students' *intrinsic motivation and personal relevance* dimension considers science intrinsically motivating (interesting, enjoyable, etc) when it is personally relevant (valuable, important, etc) and vice versa. The students' *self-efficacy and assessment anxiety* dimension describes those students who have high self-efficacy (I am confident, I believe I can,…), and as a result they are not anxious about assessment. The *self-determination* dimension refers to the control students believe they have over their learning of science. The students' *career motivation* dimension is measured by the career-related items and their *grade motivation* dimension by items involving grades (e.g. I like to do better than the other students…, Earning a good science grade is important.). Both career and grade motivations refer to the extrinsic–motivation component.

2. The Greek Case

In Greece there has been so far no systematic study which aims directly at measuring students' motivation to learn chemistry. A measurement of high school students' attitudes toward chemistry reveals a neutral attitude regarding the interest of the chemistry course and a negative attitude regarding the usefulness of the chemistry course to their future career. Only few students (about 4%) express the wish to study chemistry at University [13]. These neutral and negative attitudes indicate a low motivation to study and learn chemistry.

The work of several Greek researchers gives strong indication of different factors that seem to influence positively the motivation of students to learn chemistry. These factors can be categorized as follows: teaching approaches, educational tools, non-formal educational material and activities.

The factor "teaching approaches" refers to laboratory instruction, interdisciplinary teaching approaches and other approaches. In respect with laboratory instruction, a recent study by Kotsis [14] showed that it motivates primary school students to learn science. In addition, a study by Liapi and Tsaparlis [15] points to the significance of experimental work performed by the students themselves, in order to stimulate their interest toward chemistry and positively affect their attitudes. The same study also concludes that students show a strong preference for conducting experiments that have a direct connection with everyday life. A connection between the performance of laboratory tasks in a cooperative environment with positive attitudes and students' motivation has also been pointed out [16]. In respect with the interdisciplinary approach, an application of four modules from the European project PARSEL in a real upper secondary school classroom, showed the clear superiority of such a teaching approach in enhancing students' interest and performance relative to traditional instructional methods [17]. Other examples of interdisciplinary teaching approaches positively influencing students' attitudes and enhancing their motivation to learn chemistry and science in general have been reported by Baratsi-Barakou [18], Kafetzopoulos et al [19] and Seroglou [20]. These

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methodologies are based on problem-based learning [18], discovery [19] and science-society interrelation [20]. Finally, in relation with other teaching approaches, a study on the use of analogies in chemistry teaching [21] points to the attainment of a positive affective effect to most students.

The factor “educational tools” refers to information and communications technology (ICT) based applications. More specifically, the use of educational software related to chemistry teaching was shown to be connected with a rise in secondary school students’ motivation to study chemistry [22]. Different types of multimedia applications (such as interactive 3D animation) have been shown to stimulate student interest toward chemistry and render the teaching material more appealing [23].

The last factor indicative of influencing student motivation is “non-formal educational material and activities” and it refers to museum visits [24], science fairs [25] and press science [26]. Enhancement of student motivation toward science can be achieved only via careful design of the visit. The type of language employed in popularized science articles of the press seems to stimulate students' interest and motivate them towards further reading

The above presentation aimed at examining the work of Greek researchers in order to identify different factors that have been inferred to influence student motivation to learn chemistry. In addition to these factors, a recent case study analysis conducted in Greece [27], indicated that students’ low motivation to study chemistry could be related to the (presumed) difficulty of the chemistry course, the often demanding chemistry curriculum in combination with very little allocated teaching time, the use of unattractive teaching methods, and the few career opportunities. More in-depth research is required in order to directly measure the factors that influence student motivation to learn chemistry as well as their interactions.

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