

Difficulties of teaching the circulatory system in Life Sciences

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Abstract:

Teaching the concept of the circulatory system (CS) in college is facing many difficulties for both teachers and learners. We present in this paper a series of results which identify these difficulties. Misconceptions among learners as well as the lack of Information and Communication Technologies adoption by

teachers (ICT) are examples of such difficulties. Running experiments in the classroom is another issue faced by teachers. This work also suggests solutions for the identified problems.

Keywords:

Learning, Concept, Difficulties, Obstacles, Teachers, Learners, Experiments.

Abbreviations: LES: Life Earth and Sciences, CS: Circulatory System, ICT: Information and Communication Technologies

1. Introduction

Up until now, the problems associated with learning are rarely defined in terms of difficulties. Rather they are described in relation to the teacher and / or learner, as a lack of competence, or weaknesses related to previous teaching cycles. The difficulties encountered by either the teacher or the learner in a given course may rather be linked to the complexity of the concepts being taught and/or to the learning barriers. We should also mention the perceptions that teachers themselves accumulate through their academic studies (Teacher Epistemology). This difficulty is especially reported about junior teachers by Chevallard, 1985 [4]. In his research published in 1984, De Vecchi underlines the crucial importance of taking into account learners' representations [8]. Being himself a trainer, he exposed to teachers different aspects of

representations. The same author also published in 1989, a work on scientific education [9]. Tavernier and Lamarque published in 1992, a guide for teachers on teaching Biology and Geology at the elementary school [16]. Schneeberger raised in 1997 the issue of representations relating to the field of Life and Earth Science (LES) in teacher training [15]. According to the same author, the transition from a learner-centered pedagogy to a content-centered pedagogy is another obstacle faced by these junior teachers. These different observations lead directly to the central role that experimental science didactics play in learning [13]. Brousseau (1998) and Giordan (1999) have well detailed this point [3], [11]. These studies point in the same direction as those published in 1996 by Delacôte on the "Know how to learn"

[7]. References to knowledge were also presented in a document published on the didactics by Terrisse in 2000 [17]. Through all these studies, authors have reported that learners have difficulties in acquiring scientific knowledge. It is to note that the possession of a greater knowledge is not enough to transfer the conceptions to learners [10]. In this context, the identification and analysis of problems are an essential condition to overcome the difficulties related to learning and to ensure a certain quality of education. Consequently, the major difficulties have to be determined first, before developing any learning strategies. It should be noted that these barriers, called sometimes “Educational obstacles”, may be key steps to go through. This is the concept of “Objective-obstacle” introduced in 1996 by Martinand [12]. Furthermore, it is known that the epistemological obstacle is an expression of the philosopher Bachelard [2]. Several studies are published on the conceptions, the obstacles and the acquisition of knowledge in experimental sciences [1], [6], [11].

The aim of our study concerns the difficulties of teaching and learning the CS.

It should be noted that in Moroccan colleges, this concept is taught in the 3rd year, according to official instructions [18], [19], [20].

2. Materials and methods

To perform our work, we surveyed 100 3rd year college learners and 10 LES college teachers, in the region of Meknes. The teachers involved in this study have mostly 5 to 10 years of experience. Learners are 14-15 years old and no one of them is retaking the course. The classrooms, in these colleges, contained between 37 and 40 learners. Data collection was done through two questionnaires that were analyzed quantitatively and qualitatively.

- *Teacher Questionnaire:* Included open questions on the difficulties faced by teachers in teaching the CS and proposed solutions to facilitate it (Table 1).

Question 1	What are your difficulties in teaching the CS?
Question 2	What are your suggestions to overcome the difficulties in teaching the CS?
Question 3	What are your difficulties in running experiments related to CS?
Question 4	What is the interest of running experiments in learning the CS?

Table 1: Teacher Questionnaire

- *Learner Questionnaire:* Included open questions on the difficulties faced by learners in learning the CS and suggestions to overcome these obstacles (Table 2).

Question 1	What are your difficulties in learning the CS?
Question 2	What are your methods to overcome the difficulties in learning the CS?
Question 2	What are your proposals to facilitate learning the CS?

Table 2: Learner Questionnaire

3. Results

3.1 Teacher Questionnaire

3.1.1 Difficulties in teaching the CS

Phases	Difficulties encountered	Percentage of teachers
During preparation of the course	Integration of ICT	60%
	Preparation of the chapter material	40%
During the course	Time management	40%
	High number of learners	30%
	Learner misrepresentations	30%
During the evaluation	Incorrect understanding of the questions by learners	40%
	Difficulties in learner evaluations (e.g. because cheating)	40%
	Persistent learner misrepresentations	20%

Table 3: Difficulties in teaching the CS

- During the preparation: Integrating ICT and preparing the chapter material are the major problems. These responses were recorded respectively in 60% and 40% of surveyed teachers.

- During the course: The major problem is the high number of learners from 40% of the teachers in our study. Correcting misrepresentations that learners have and managing the time dedicated to this concept accounted for 30% each.

- During the evaluation: 40% of surveyed teachers have the problem of question misinterpretation by learners. Difficulties in learner evaluation, because of cheating, were reported by 40%. Persistent misrepresentations were also cited by 20% of surveyed teachers.

We collected afterwards teachers' suggestions to address the difficulties. Responses are reported below.

3.1.2 Teacher suggestions to overcome the difficulties in teaching the CS

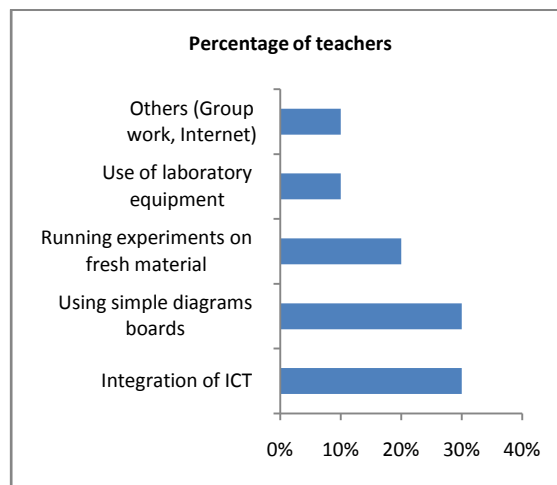


Figure 1. Teacher suggestions to overcome the difficulties in teaching the CS.

Figure 1 shows that teachers propose the integration of animated sequences (30%) and simple diagrams (30%) to make this course easier for learners. Only 20% suggest running experiments on fresh material. The difficulties encountered during experiments were the main cause of teachers' lack of motivation to run experiments. We detail this point below. In addition, a minority of our sample tend to use laboratory equipment (10%) or to work in groups (10%).

3.1.3 Teacher difficulties during running experiments related to the CS

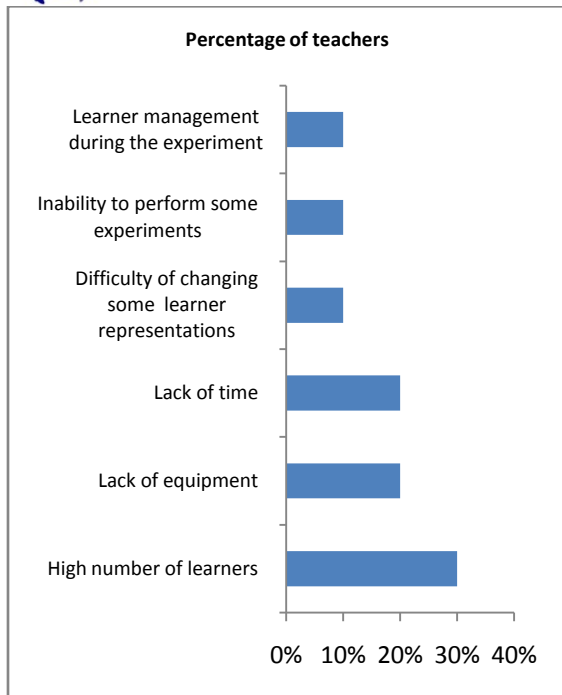


Figure2. Teacher difficulties during running experiments related to the CS.

Figure 2 shows that the high number of learners, the lack of equipment and time, the difficulty of changing certain learners' representations, and the classroom management are the teacher difficulties during experiments.

However, all teachers under our research have confirmed the interest of running experiments in the classroom. We focused in the following, on the scientific contribution of experiments.

3.1.4 Interest of running experiments in learning the CS

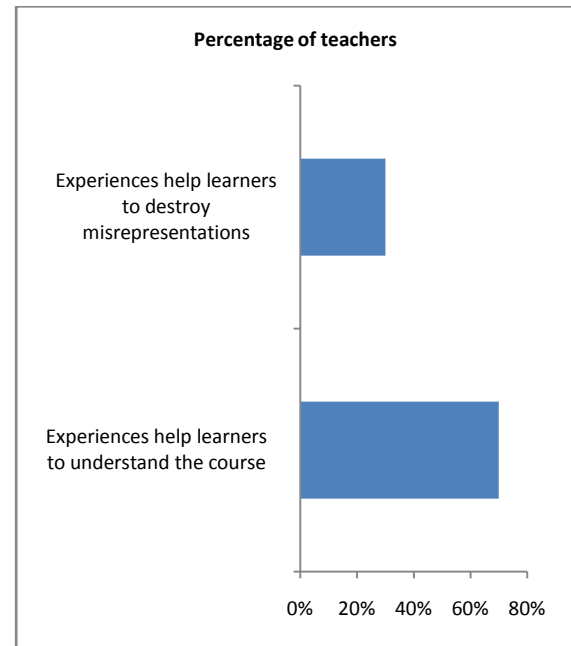


Figure 3. Interest of running experiments in learning the CS.

The results obtained showed that performing experiments in class plays an important role in learning the CS as well as getting rid of false representations that learners already have (Figure 3).

3.2 Learner Questionnaire

3.2.1 Difficulties in learning the CS

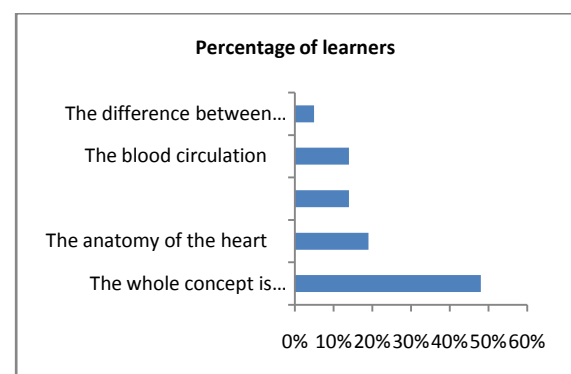


Figure 4. Difficulties in learning the CS.

The collected results showed that 19% of surveyed learners did not come to understand the heart anatomy. The mechanism of blood flow and transport of respiratory gases through blood were also problematic. The difference between arteries and veins was also one of the

difficulties faced by learners but with a very small percentage (5%). It is important to note that a fairly high percentage (48%) had reported that they didn't understand the concept at all (Figure 4).

3.2.2 Learner methods to overcome the difficulties of learning the CS

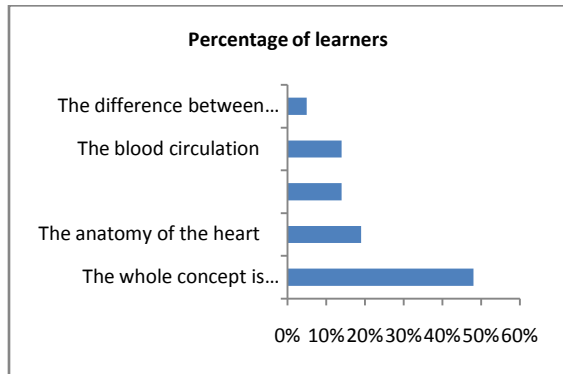


Figure 5. Learner methods to overcome the difficulties of learning the CS.

Figure 5 shows that 31% of learners involved in our study use the Internet to overcome the difficulties encountered in the course of CS versus 26% who use the textbooks. The help of some people, the use of documents outside the program and the tutoring were cited respectively by 22%, 12% and 9% of learners.

3.2.3 Learner proposals to facilitate the learning of the CS

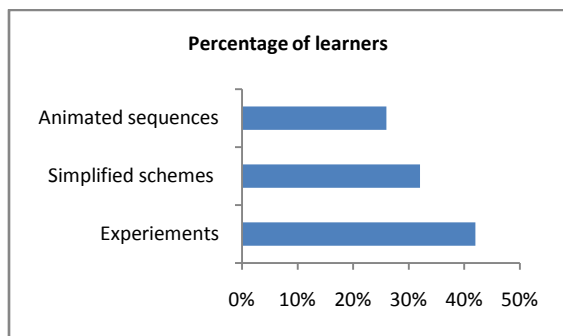


Figure 6. Learner proposals to facilitate the learning of the CS.

The suggestions of learners to facilitate the concept of the CS were divided between running experiments in the classroom and the use of schemes or animated sequences,

42%, 32% and 26%, respectively (Figure 6).

4. Discussion

This study allowed us to review the various difficulties encountered in college, by both the teacher and the learner, regarding the CS.

Results analysis showed that the major difficulty for teachers reside in the misrepresentations among learners. This has been reported on several occasions. This limiting factor was also observed when performing experiments in class. It is interesting to note that 52% of learners have difficulties in understanding the anatomy of the heart, the transport of respiratory gases, the blood circulation and the difference between arteries and veins (Figure 4). A large percentage reported that the entire concept is difficult. Misconceptions may be causing these results. It is interesting to note that these results indicate the epistemological barriers [1], [2], [6], [11]. In this context, experts always recommend to start with the identification of the weakness, its eradication and incorporation of new knowledge [1], [6], [11]. It is also established that knowledge transfer may still need to take into account the misconceptions [5], [14]. It is important to note that 30% of surveyed teachers suffered from managing the time dedicated to the concept of CS (Table 3). This result should lead to reconsider the number of hours reserved for the CS and the methodology. The determination of learner misrepresentations certainly requires a longer time and thus an increase of hours dedicated to this concept.

ICT integration is another keyword that was continually mentioned as part of the difficulties of CS teaching and learning. However, despite ICT importance in the illustration of complex phenomena, 40% of the teachers find difficulty in their use (Table 3). This would certainly be due to a

lack of training. In this context, considerable efforts are being made by the Moroccan Ministry of Education to spread and generalize these new technologies in the educational system. The 2009-2012 emergency plan launched by the Moroccan government to give a boost to education and training in Morocco, has devoted an entire project to integrate ICT (Area 1, Project 10) including ICT training.

To overcome the difficulties cited, teachers in our research highlighted the importance of integrating animated sequences and diagrams as well as performing experiments in class (Figure 1). The latter approach has an important role in learning the CS as well as fixing false representations (Figure 3). However, although 70% of teachers had confirmed the scientific value of the classroom experiments, their implementation was reported only by 20% of surveyed teachers (Figure 1). This is certainly due to the high number of learners as well as the lack of equipment and time (Figure 2).

Running experiments in the classroom, the use of patterns and the presentation of animated sequences certainly help learners to assimilate the course (Figure 6). Among the alternatives adopted by learners to understand certain conceptions of the CS, Internet resources, the use of textbooks as well as documents outside the program, the help of some people, and the tutoring were reported (Figure 5).

It is clear from these results that the combination of many methods as running experiments, integration ICT, using schemes and animated sequences would circumvent the difficulties related to the concept of CS.

Many answers were made to our questions about learning the CS but it was difficult to compare our results closely with those published. It should be noted that the references reported throughout this

document affect our subject in its general framework.

5. Conclusion

Our study showed that the major obstacle to overcome, in teaching the CS, is some misconceptions among learners. The results presented in this paper underline the requirement of teachers to deploy more efforts such as running experiments, using simplified schemes and animated sequences. We have also identified the barriers encountered by teachers during running experiments in class such as the high number of learners, the lack of equipment and time, the difficulty of changing certain learners' representations and classroom management.

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