NEW TEACHING ERA FOR HISTOLOGY: FROM GLASS SLIDES TO VIRTUAL MICROSCOPE AS AN ALTERNATIVE FOR SELF-DISCOVERY LEARNING

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Abstract

Medical histology is a basic science that deals with concepts and facts regarding the microscopic structure of the human body. Histology has traditionally been taught as a lecture and microscopy-based practical course using glass slides and microscopes and it is based on reception learning. However, a new era has been implemented using virtual microscope in order to improve the self-discovery learning process. Self-discovery learning is a constructive learning method that takes place without systematic external guidance and differs from tutorization and continuous instructions of reception learning method. The use of virtual microscope implies autonomous exploration of the histological images by simply dragging the mouse and changing the file of interest accompanied by the observation at different magnifications with a click. This method increases discussion and collaboration while increasing the speed and efficiency of learning without the need of light microscope. Virtual microscope encourages active learning environment and also places the students at the forefront of their own learning process being an useful tool for self- discovery learning.

The knowledge about the students' perceptions and their preferences is necessary for better design of self-discovery strategies in medical histology. In this study we have investigated male and female student´s preferences for optical (OM) and virtual microscope (VM) in a medical histology practical course. To achieve this, 90 first year medical students enrolled in medical histology course were evaluated. All students received 10 practical histology units (20 hours) where 5 (10 hours) units were taught using OM and 5 units (10 hours) with VM. Each student received both methods during the practical course. Each student completed a questionnaire after the whole practical units were performed in order to evaluate the student´s perceptions and preferences. The questionnaire consisted on four questions regarding OM and four questions related to VM the students have to answer to each question using a Likert scale from 1 to 5. Finally, a statistical test was use to analyze the results on the students perception´s and preferences for OM vs VM.

Our results showed that both, OM and VM are adequate for histology learning as revealed by the high scores obtained for both types of methods. OM and VM tools were easy to manage and facilite the localization of histological structures during the visualization for all the students. However, most of the students significantly prefer to use VM to study the histological components of human tissues. The gender analysis revealed differences being statistically significant for men vs women for VM. These results suggest that VM should be included as an important tool for teaching human histology due to promote the self-discovery learning by the students.

1 INTRODUCTION

Human histology has been considered as a basic medical science based in the study of structure, function and development of tissues. Their study is based on the observation under the microscopy of the structure of tissues, cells and organs [1]. An understanding of histology is vital to the comprehension of human biochemical and physiological processes, as well as in gaining insights into how structural abnormalities lead to disorders resulting in disease [2,3]. In this context, histology has traditionally been taught as a lecture-and microscope based course in which students must to develop skills in the identification of tissues, cells, and organs using light microscopy as an essential tool in the process of learning [4]. In this context, medical education research has been focused particularly during the past three decades, on basic research in medical expertise, problem-based learning, performance assessment, continuing education, and the assessment of practicing physicians [5]. All of this has lead into classical learning method called reception learning.

Reception learning (RL) is one of the main approaches that have been used to teach histology in medical and health science institutions [4]. This method is based on the participation of an instructor or professor, who communicates to students a systematized set of information about the topic being taught [6]. In RL processes, students receive concepts, terms, and knowledge about the histological features of the microscopic structures of the human body through lectures. This knowledge is presented to students for their understanding and subsequent application to curricular development [7].

Education research in basic medical sciences like anatomy, histology, and physiology has focused mainly on improved teaching methods [8-11], and it is only in recent years that student`s perceptions have become a focus of research as an important factor in learning and academic achievement [12,13]. Therefore, new approaches have been recently implemented and have been emphasized into the self-learning processes. Among these approaches that have been taken into account, the virtual histology is becoming increasingly important in medical schools around the world [3,14,15] not only because this method place students at the forefront of their own learning processes but also because it facilitates student understanding of the correlation between histology and clinical practice. These trends have resulted in the development of a new era for teaching histology [16]. However, thanks to globalization and the integration of information and communication technologies (ICT), virtual microscope (VM) is an innovative tool for use in the teachings of histology. Virtual microscopy allows scanning high-resolution digital images of microstructures from glass slides which can be viewed via digital screens processed by software [17,18]. The recent boom of virtual microscopy (VM) has identified numerous advantages of this microscope. Among these, users gain unlimited access to numerous histological preparations simultaneously and thus allowing access from any location point where the student is. These properties allow the student to have an innovative self-study alternative [19]. Moreover, VM technology aims for a decrease in maintenance costs of an optical microscopy (OM) laboratory [15] because it does not require individual microscopes or set of glass slides for each student. In this milieu, self-discovery learning (SDL) has begun to be a vital learning technique in the teaching of histology during practical sessions.

Self-discovery learning can be defined as a constructivist learning process that takes place without systematic external guidance. In histology, one constructivist SDL approach consists of microscopic observation-based instruction, which favors students ‘active participation and encourages them to construct their own learning [19-21]. In both approaches, complementary learning strategies, (CLS) are needed, and the use of books, atlases, the internet, audiovisual media, and tutorials (among other resources) is frequently required after both learning activities.

In this study we have evaluated the student´s perceptions and preferences for practical learning methods based on light microscope and virtual microscope in order to determine the most accurate tool for practical histology teaching.

2 METHODOLOGY

In this work, a total of 90 first-year medical students from the Faculty of Medicine of the University of Granada, Spain were selected during the 2011-2012 academic year. All students were enrolled in the subject “Histology of the human stem cells and body tissues”, which consists of 10 practical groups of students. The practical sessions were divided in 10 practical histology units with a duration of 2 hours. Five units (10 hours) were taught using OM, and 5 units (10 hours) were taught with VM. All the students received both, OM and VM histology learning methods during the practical sessions.

The evaluation of the student’s perceptions and preferences regarding OM and VM was performed by using a questionnaire that was filled out by the students on a voluntary and anonymous basis. The questionnaire contained several questions regarding the usefulness of each method (OM and VM), as determined by the following questions included in the survey: (1) The method is able to facilitate the study of the muscle tissue, (2) The method is able to facilitate the localization of the structures, (3) The method is easy to use and manage, (4) The method is able to motivate the students. Each one of these questions were rated by the students using a Likert scale ranging from 1 to 5: 1=complete disagreement; 2=disagreement; 3=neither disagreement nor agreement: 4=agreement and 5=complete agreement (Table 1). This questionnaire was used both at the beginning and at the end of the academic year.

At the very beginning of the evaluation, the students were asked to give information about their gender. Finally the data generated from the questionnaires were analyzed using t-test for gender study and Mann-Whitney non-parametrical test for all comparisons using SPSS 20.0 software.

After your practical sessions in histology. please answer to the following questions related to the use of optical microscope (OM) and virtual microscope (VM) during the practical sessions:

1-The method is able to facilitate the study of the muscle tissue:

OM 1 2 3 4 5
□ □ □ □ □

VM
1 2 3 4 5
□ □ □ □ □

2-The method is able to facilitate the localization of the structures:

OM 1 2 3 4 5
□ □ □ □ □

VM
1 2 3 4 5
□ □ □ □ □

3-The method is easy to use and manage:

OM 1 2 3 4 5
□ □ □ □ □

VM
1 2 3 4 5
□ □ □ □ □

4-The method is able to motivate the students:

OM 1 2 3 4 5
□ □ □ □ □

VM
1 2 3 4 5
□ □ □ □ □

Table 1. Evaluation questionnaire that was used at the beginning of the academic year (evaluation test) and at the end of the year.

3 RESULTS

Our results demonstrate that the highest values generally corresponded to VM (virtual microscope). For VM, average values were 4.60 ± 0.62 for question 1 (The method is able to facilitate the study of the muscle tissue); 4.54 ± 0.67 for question 2 (The method is able to facilitate the localization of the structures); 4.46 ± 0.84 for the third question (The method is easy to use and manage); and 4.27 ± 0.84 for the last question (The method is able to motivate the students). For OM, average values were 3.98 ± 0.94; 4.05 ± 0.90; 4.08 ± 1.07; and 4.32 ± 0.94 for questions 1, 2, 3 and 4, respectively. Specifically, the answers given to questions 1, 2 and 3 were significantly higher for VM than for OM (p=0.0000, 0.0002 and 0.0176 for the comparison of VM vs OM for questions 1, 2 and 3, respectively), although no differences were found for the fourth question (p>0.05) (Figure 1 Table 2).

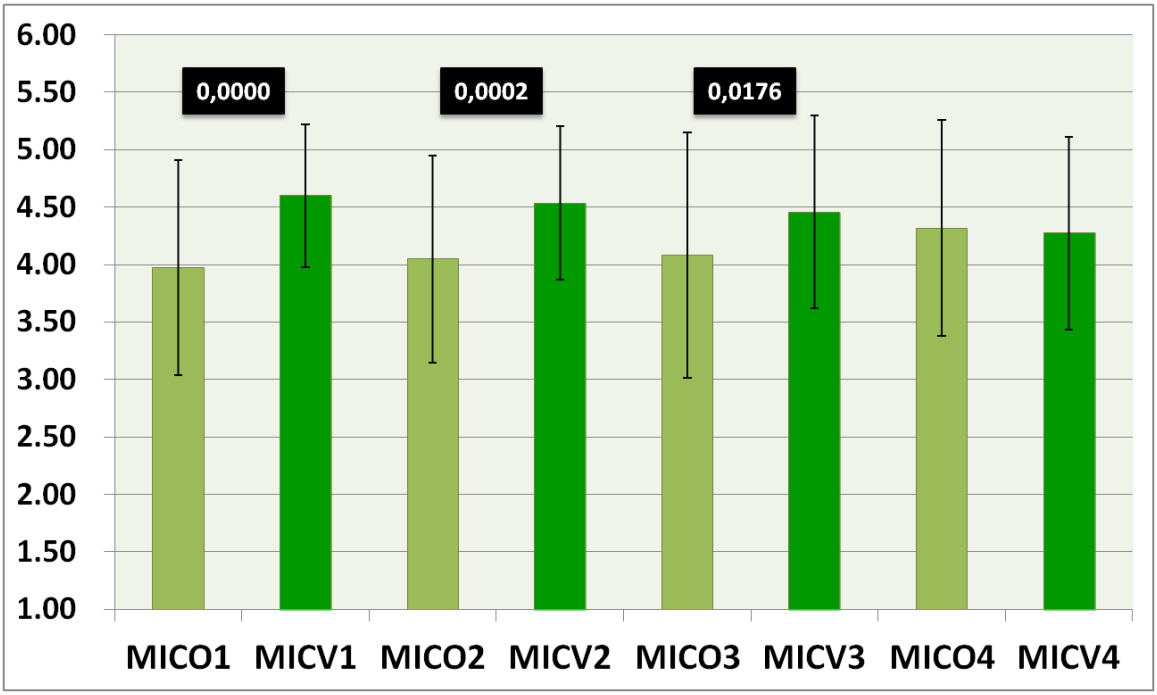

Figure 1. Average scores obtained in the evaluation test for each item for the method based on the use of optical microscope (OM) and virtual microscope (VM) for all students. P values correspond to the statistical comparison of the results obtained for each method.

		OM1	VM1	OM2	VM2	OM3	VM3	OM4	VM4
ALL	MEAN	3.98	4.60	4.05	4.54	4.08	4.46	4.32	4.27
	SD	0.94	0.62	0.90	0.67	1.07	0.84	0.94	0.84
MALE	MEAN	4.14	4.76	4.05	4.75	4.19	4.65	4.38	4.35
	SD	0.93	0.49	0.94	0.50	1.02	0.72	0.72	0.82
FEMALE	MEAN	3.85	4.48	4.04	4.38	4.00	4.31	4.27	4.21
	SD	0.93	0.68	0.88	0.73	1.10	0.90	1.09	0.86

Table 2. Average scores and standard deviations obtained in the evaluation test for each item for the method based on the use of optical microscope (OM) and virtual microscope (VM) for all students. For each question and each method, global values are shown along with means and SD for each gender.

When the results were analyzed by gender, the values were very similar to those obtained for all students (male and female). For male students, we found that the higher scores corresponded to VM for the first three items of the questionnaire (4.76 ± 0.49; 4.75 ± 0.50 and 4.65 ± 0.72 for questions 1, 2 and 3, respectively). For OM, average values were 4.14 ± 0.93; 4.05 ± 0.94 and 4.19 ± 1.02 for questions 1, 2 and 3, respectively, with statistically significant differences as compared to VM (p=0.0018, 0.0004 and 0.0333, respectively). No differences were found for question 4 (Figure 2 and Table 2). For female students, differences were statistically significant only for the first question of the questionnaire (p=0.0002), which showed higher results for VM than for OM (3.85 ± 0.93 for OM and 4.48 ± 0.68 for VM). In contrast, no statistical differences were found for questions 2, 3 and 4 (Figure 3 Table 2).

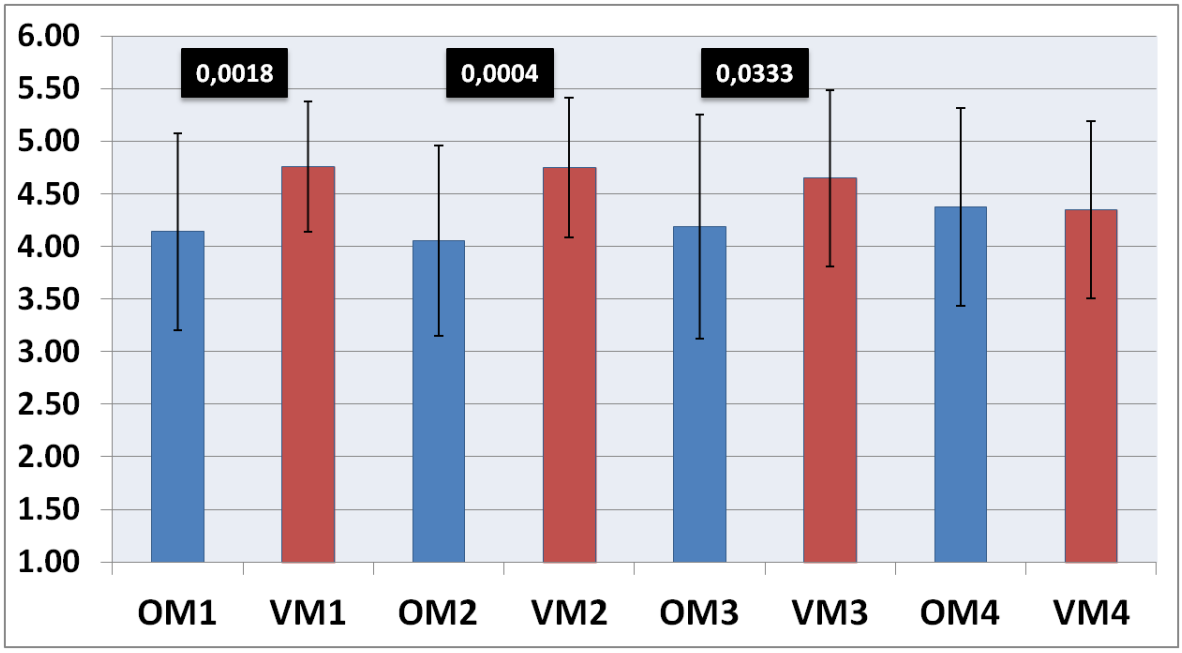

Figure 2. Average scores obtained in the evaluation test for each item for the method based on the use of optical microscope (OM) and virtual microscope (VM) only for male students. P values correspond to the statistical comparison of the results obtained for each method.

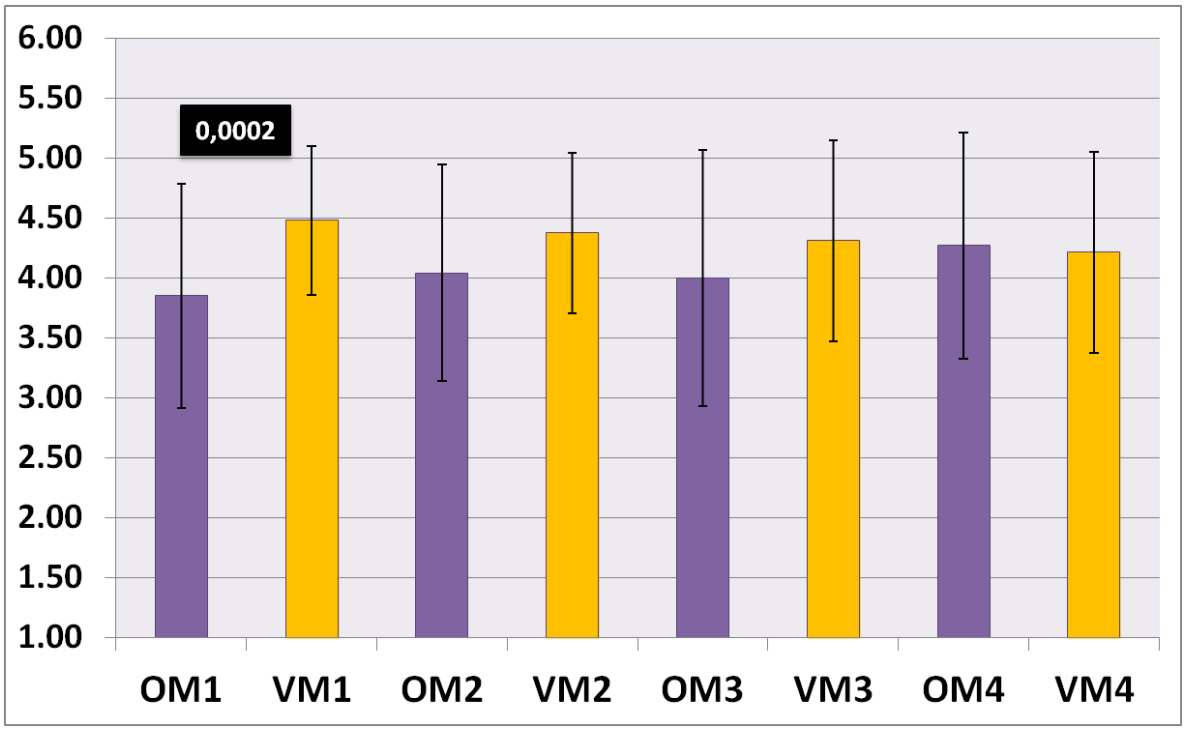

Figure 3. Average scores obtained in the evaluation test for each item for the method based on the use of optical microscope (OM) and virtual microscope (VM) only for female students. P values correspond to the statistical comparison of the results obtained for each method.

4 DISCUSSION AND CONCLUSIONS

The society is increasingly entering a technological age in which the use of electronic devices not only surrounds but governs the life of most individuals in personal, social and academic levels. The latter is of great importance because technology has significantly contributed to the production of large-scale knowledge and research advancement. Technology has not only allowed transition from OM to VM as a tool for practical development of histology, but has brought a histology teaching based on learning style called self-discovery unlike the one that has been traditionally used was called reception learning.

The new era of teaching that breaks traditional schemes, reconsiders and offers an alternative through which transmitting knowledge also consolidates learning, and emerges as a more flexible and self-discovery method. Now, each of the individuals do not learn in the same way and the techniques used to process the information and the time it takes to assimilate such content, are highly dependent on biological, psychological and social parameters. In this work, our results demonstrated that both types of learning (OM and VM) were adequate for teaching and learning. According to the student's perceptions, the learning process could be facilitated by the use of both types of microscopes as revealed by the high scores shown for both learning methods. Therefore, we can assume that both learning methods were highly efficient to facilitate the study to the students, to allow them to identify histological structures, and both were easy to use and motivating.

However, several items showed significantly higher results in the VM group as compared to the OM group, including the capability of the system to facilitate the study and localization of structures and it was easier to use and manage. In contrast, the motivation was no improved by the use of VM. This could be explained by the cognitive psychology that studies the effects on learning produced by the VM where it is necessary to create a mindset from multiple visuals for the construction of

knowledge, as the "visual learning" process allows differentiation and interpretation of images. It is the visual learning that promotes the decoding processes in working memory to identify and recognize visual information relevant and thus classify it [22]. It is pertinent to refer to the learning styles derived notion of psychology more specifically from the cognitive perspective that had its beginnings in the 50s, with the revolution in the field of computing and communications. One of the pioneers was Herman Witkin [23] who was interested in cognitive styles as one of the forms of expression of individuals to receive and process the information that comes from outside. Therefore, according with the learning styles [22], self-discovery learning may be improved by using virtual tools such as VM, so that the student-teacher interaction and communication can be preserved inside and outside the classroom thanks to various forums, chat rooms or social networking that internet provides effectively [24].

Apart from this, the gender analysis demonstrated that both, male and female students had preference for VM, being more significant for males than for females. In this regard, gender differences with respect to learning styles have also been described by Ford and Chen [25]. These studies showed that in unmatched learning situations, there was no difference in the learning outcome, but in matched conditions, the male learners performed significantly better than the female learners. This supports our suggestion that the virtual learning tools fit the needs of a certain cognitive style and, in our study, proved better suited to the male students. This could be probably associated to the higher affinity of the male gender to computers, and multimedia tools with more detailed data.

In this new era that demands the educational teaching to acquire a different way in which knowledge can be transmitted not only as it was done in the reception learning, but also constructed as self-discovery. Students are the main protagonist who should discover everything on their own, with autonomy, discipline and skills, but under the supervision of the mentor and tutor teacher. Students should take responsibility for their own learning process, and they should be able to regulate themselves and to establish work schedules. Currently, medical sciences, and more specifically histology, induce a significant way of teaching by generating spaces in which the teacher creates forms with a possible way for clarification, reflection, critique and debate. The knowledge acquired by the students should benefit themself with teachers playing a role not only as instructors but also as counselors. Thus, a new stage in which the teacher is responsible for empowering students and let their learning process on their hands is emerging. Traditional education that consistently imposed and required students the same results with differences undoubtedly physiological, cognitive, emotional and social should be complemented with novel self-learning based methods such as VM.

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