ASE-13-0011
Research Report

Developing an audiovisual notebook as a self-learning tool in histology: Perceptions of teachers and students

Antonio Campos-Sánchez,[1,2] Juan-Antonio López-Núñez,[2] Giuseppe Scionti,[1] Ingrid Garzón,[1] Miguel González-Andrades,[1] Miguel Alaminos[1]*, Tomás Sola[2]

[1]Department of Histology, Medical School, University of Granada, Granada, Spain

[2]Department of Didactics and School Organization, University of Granada, Faculty of Education Sciences, Granada, Spain

Running title: Audiovisual notebook as a self-learning tool in histology

*Correspondence to: Prof. Miguel Alaminos, Department of Histology, Medical School, University of Granada, Avenida de Madrid 11, E-18071 Granada, Spain. E-mail: malaminos@ugr.es

Grant sponsor: Unidad de Innovación Docente, University of Granada; Grant number: UGR11-294 and UGR11-303

ABSTRACT

Videos can be used as didactic tools for self-learning under several circumstances, including those cases in which students are responsible for the development of this resource as an audiovisual notebook. We compared students' and teachers' perceptions regarding the main features that an audiovisual notebook should include. Four questionnaires with items about information, images, text and music, and filmmaking were used to investigate students' (n = 115) and teachers' perceptions (n = 28) regarding the development of a video focused on a histological technique. The results show that both students and teachers significantly prioritize informative components, images and filmmaking more than text and music. The scores were significantly higher for teachers than for students for all four components analyzed. The highest scores were given to items related to practical and medically-oriented elements, and the lowest values were given to theoretical and complementary elements. For most items there were no differences between genders. A strong positive correlation was found between the scores given to each item by teachers and students. These results show that both students' and teachers' perceptions tend to coincide for most items, and suggest that audiovisual notebooks developed by students would emphasize the same items as those perceived by teachers to be the most relevant. Further, these findings suggest that the use of video as an audiovisual learning notebook would not only preserve the curricular objectives but would also offer the advantages of self-learning processes.

Keywords: histology education, microscopic anatomy education, medical education, self-learning modules, students´perceptions, teachers´perceptions, audiovisual notebook, video modules, computer assisted learning.

INTRODUCTION

Video is a widely used medium in different levels of education, including medical education (Bacro et al., 2000; Woosley, 2006; Bacro et al., 2010). Although some reports demonstrated that the use of video may be very useful (DiLullo et al., 2006; Tavlasoglu et al., 2013), several researchers found that video may increase the satisfaction of the students but not their performance (Backstein et al., 2005; Saxena et al., 2008; Mahmud et al., 2011). In recent decades video has been used at different stages of training such as undergraduate and postgraduate education and residency programs, as well as in continuing medical education (Ramey, 1968; Barber, 1992; Backstein et al., 2005; McNulty et al., 2009). In addition, this medium has proved useful in a variety of clinical specialties and in preclinical training (Pereira et al., 2004; Hotokezaka et al., 2008; Senchina, 2011; Tolerton et al., 2012). Through the years, video has been associated with successive information and communication technologies, and more recently the Internet has been used as a medium of communication (Liaskos and Diomidus, 2002; Alikhan et al., 2010; Hanson et al., 2011).

Video has been used in some of the more novel teaching modalities such as problem-based learning (Chiu et al., 2006; Roy and McMahon, 2012) and as a tool for the evaluation and self-evaluation of desired outcomes and competencies (Baribeau et al., 2012; Hawkins et al., 2012). Its use in teaching is particularly related to the modality known as reception learning which involves the external participation of an instructor or professor who transmits to students a systematized set of information about the learning topic in question (O'Brien and Shapiro, 1977; Campos-Sanchez et al., 2012). In this context, videos could

be elaborated by teachers or professionals and shown to the students so that students could use these videos as learning documents (teaching videos) and revisualize them as many times as they wish. As didactic tools, videos can be used to present knowledge to the students so that they may understand and subsequently apply it (Metzner and Bittker, 1973; Pereira et al., 2004). Although the use of teaching videos could be useful, it cannot reproduce the traditional teaching method involving a live professor in the classroom in which interactive learning and dialog among students and instructor is possible.

Self-learning has acquired increasing importance in medical education (Spencer and Jordan, 1999), and the use of pre-recorded lectures or podcasts have become rampant in medical education (Alikhan et al., 2010; Perez-Bouza et al., 2011; Matava et al., 2013). Recently, video streaming, which uses the Internet to deliver curricular contents, has started to be incorporated into self-learning in a way that facilitates students' control over the way in which the content is delivered (Bridge et al., 2009). However, the use of videos elaborated by the students has been little used as a self-learning modality in medical education (Jensen et al., 2012).

As described in an earlier publication, self-learning is a constructivist learning process which favors students' active participation and encourages them to construct their own learning (Campos-Sanchez et al., 2012). According to Kaufman, constructivism is based on the idea that students construct their own knowledge on the basis of what they already know. This theory postulates that the learning process is active rather than passive, and students can make judgments and take decisions about when and how to modify their own knowledge (Kaufman, 2003; Hung et al., 2006). To use a video recording as a

learning object (Ruiz et al., 2006), i.e., as a didactic instrument for self-learning, this tool must be converted into an audiovisual notebook, i.e., a working tool that allows students to participate as active protagonists in the construction of their own learning (Drake et al., 2009). Such active involvement implies that students should participate in the construction and development of the videos they will subsequently use for their own education and training. If video is considered an audiovisual teaching tool from the tradition perspective of reception learning, it follows that from the perspective of self-learning, video can be considered an audiovisual learning resource requiring the personal effort and implication of the students that is comparable to the work that students usually do when they elaborate a notebook. Therefore, the term audiovisual notebook refers not only to the final document that is generated (the scientific video), but also to the learning activity that is involved in the process.

Progress in this area will require better knowledge about how students perceive the characteristics that video-based tools should have (in terms of, e.g., information, images, filmmaking, etc.) and comparisons with the perceptions of teachers – two key elements in the development and implementation of self-learning programs based on this medium. As is well known, students' perceptions are not only the foundation of the self-learning process but are also constructs that refer in particular to students' expectations regarding the tasks and skills that they should acquire (Schommer, 1990; Wolters, 2004; Mattern, 2005; Chan, 2011).

Medical histology is a basic discipline dealing with concepts regarding the structure of the human body. A proper histological knowledge is essential to understand how structural abnormalities may lead to disorders and disease

(Stevens and Lowe, 2005; Shaw and Friedman, 2012). The “Medical Histology” course is a core course in the basic medical degree program and includes two levels: general medical histology and microscopical anatomy of body organs. Each one is taught during 4 months in the context of the six years academic program in accordance with European Union regulations.

The present study was designed to record separately and then compare the perceptions of students and teachers regarding the most desirable characteristics of a teaching video for a specific pedagogical content knowledge (PCK) element within the area of anatomy and histology (Shulman, 1987; Magnusson et al., 1999). Although a previous study already evaluated the use of audio-tapes in self-instruction in histology (Clarke, 1975), the utilization of videos in self-learning has not been fully explored in this discipline. The PCK chosen as the subject of the present study was the silver impregnation histological technique, a procedure used to prepare nervous tissue for examination. Information about teachers’ and students’ perceptions regarding the best ways to develop this PCK in a video can help determine the usefulness and most effective role for this tool in self-learning processes, and more broadly, in medical education.

METHODS

Study Design

The participants in this study were students and teachers of medical anatomy and histology at the University of Granada, Spain. The student sample consisted of 115 first-year undergraduate medical students: 75 (65.2%) women and 40 (34.8%) men. Average age of the students was 18.5 years (range 18-

21). The teachers sample consisted of 28 professors and lecturers of medical anatomy and histology: 9 women (32.1%) and 19 men (67.9%). Average age of the teachers was 44.5 years (range 42-55). All teachers had a neuroanatomy background, including knowledge and experience in the use of the histological technique used in this study.

All participants agreed to participate in the study, which was approved by the Ethics and Research Committee of the Medical School of the University of Granada, Spain.

To evaluate students' and teachers' perceptions regarding the development of an audiovisual notebook focused on histological techniques that required the use of a light microscope, we used four specific questionnaires. The PCK to be taught was the Cajal histological technique, which consists of the staining and impregnation with silver nitrate of human central nervous system tissues in order to visualize nerve cells. One of the reasons why this method was selected is the fact that knowing the biochemical substrate and the procedure steps of at least three histological techniques (silver impregnation, haematoxylin-eosin and a histochemical staining method), is considered among the objectives of our histological course, and they are a requirement to pass the subject.

Each questionnaire focused on a different component or topic, i.e. information, images, text and music, and filmmaking, and contained a different number of items. The answers in all questionnaires were recorded on a five-point Likert-like scale from 1 to 5, on which students and teachers were asked to rate the importance of each item. The scores corresponded to the following levels of agreement: 1, Strongly disagree; 2, Disagree; 3, Neither agree nor disagree; 4, Agree; 5, Strongly agree.

In the first questionnaire (1, information), the students and teachers were asked to respond the question, “Would you agree to include the following specific information related to the technique in the audiovisual notebook?”. The specific items were 1.1, history of the technique; 1.2, biography of the person who first described the technique; 1.3, the chemical basis; 1.4, the steps of the procedure; 1.5, histological structures that can be visualized; 1.6, usefulness for the histological diagnosis; 1.7, available alternatives; 1.8, advantages; 1.9, disadvantages; 1.10, time needed to perform the technique; 1.11, type of microscope that provides the best images of the material prepared with the technique; and 1.12, characteristics of the dyes and chemicals that should be used.

In the second questionnaire (2, images), participants were asked to respond the question, “Would you agree to include the following images related to the technique in the audiovisual notebook?”. The specific items asked about the inclusion of images associated with: 2.1, the person who first described the technique; 2.2, the historical period when it was described; 2.3, the chemical structures and formulas; 2.4, the chemical mechanism of action; 2.5, the steps of the procedure; 2.6, the histological structures that can be visualized; 2.7, the type of microscope that provides the best images of the material prepared with the technique; 2.8, the artifacts that can occur; 2.9, schematic illustrations of the technique; 2.10, cartoon figures of the technique; and 2.11, the equipment used to perform the technique.

The third questionnaire (3, text and music) asked, “What kind of texts and music would you agree to use in the audiovisual notebook?”. The specific items were: 3.1, a text narrated by the technician who carries out the technique; 3.2, a text

narrated by a professional voice actor; 3.3, a text narrated by a student; 3.4, a written text shown on the screen; 3.5, a written text shown separately between images; 3.6, an environmental sound (working laboratory equipment); 3.7, classical music; 3.8, conventional nonclassical music; 3.9, background music heard throughout the notebook; 3.10, background music heard only between narrated texts.

The last questionnaire (4, filmmaking) asked, “What kind of shots would you agree to use for video production of the audiovisual notebook?”. The specific items asked about the use of: 4.1, long shots showing a general view of the laboratory; 4.2, medium shots showing a closer view of the technician and the technique; 4.3, close-up shots showing a more detailed view of the technique; 4.4, direct transition between shots; 4.5, dissolves (gradual overlapping from one image to another); 4.6, fade-outs or fade-ins (transitions to and from a blank image).

Statistical Analysis

Four variables were analyzed in this study: the role in the educational process (teacher or student), the gender (male or female), the specific item included in the questionnaire (39 items in total) and the topic or component evaluated in each questionnaire (information, images, text and music or filmmaking). Due to the non-parametric nature of each variable as determined by the Kolmogorov-Smirnov analysis, non-parametric tests were used for all statistical comparisons.

For each specific item included in each questionnaire, mean results and standard deviations were calculated for all participants, for students and

teachers separately and for each gender. Means and standard deviations were also globally calculated for each topic (global results) by determining the mean and standard deviation of the results obtained for all items included in each questionnaire (for instance, the 6 items included in questionnaire 4). Differences in perceptions between students and teachers and between genders were identified with the Mann-Whitney nonparametric statistical test run with SPSS 15.0 software. This statistical test was used to compare: 1) the results obtained for each specific item separately (for instance, male vs. female students for item 1.1); 2) the global results obtained for each topic (global comparisons) between teachers and students (for instance, “images” for teachers vs. students); 3) the global results obtained for each topic (global comparisons) as compared to a different topic (for instance, “information” vs. “images” for students). To identify overall differences among several topics, we used the Kruskal-Wallis test. To search for statistical correlations between the results for teachers and students, we used the Spearman rho correlation test. P values below 0.05 were considered statistically significant, and all tests were two-tailed.

RESULTS

In the first place, we analyzed the global results obtained for each questionnaire. When the four topics regarding teachers’ and students’ perceptions were compared with the Kruskal-Wallis test, we found that the overall scores for each topic differed significantly from one group to another ($p<0.0001$ for the global comparison of the 4 groups). Specifically, the third topic (text and music) differed significantly from the other three topics (information, images and filmmaking, $p=0.0001$ for all three global comparisons

with the Mann-Whitney test). No significant differences were found for the one-to-one global comparisons between these topics (1 vs. 2, 1 vs. 4 and 2 vs. 4 global groups) ($p>0.05$) (Figure 1). As shown in Table 1, there were significant differences between teachers and students in each topic in the global analysis (information, images, text and music, and filmmaking, $p<0.05$ with the Mann-Whitney test). Interestingly, teachers' scores were higher than students' scores in all topics in the global analysis (global values obtained for each topic). The scores given by both the teachers and the students to the topics information, images and filmmaking were significantly higher than text and music ($p<0.05$). The mean global values for each topic are represented in Figure 1.

In the second place, each specific item was analyzed separately (Table 1). For the first topic (information), the scores were significantly higher for teachers than for students on all items ($p<0.03$) except for item 1.4 (the steps of the procedure), which was scored significantly higher by students ($p=0.044$). For the second topic (images), the scores were significantly higher for teachers than for students on all items ($p<0.02$) except for 2.10 (cartoon figures of the technique), which did not differ significantly ($p>0.05$). In the third topic (text and music), only items 3.1 (a text narrated by the technician who carries out the technique), 3.5 (a written text shown separately between images) and 3.10 (background music heard only between narrated texts) differed significantly between teachers and students, and in these cases the scores for teachers were higher than for students ($p<0.03$). The rest of the items did not differ significantly ($p>0.05$). Finally, the results for the fourth topic (filmmaking) showed that teachers scored items 4.2 (medium shots showing a closer view of the technician and the technique) and 4.3 (close-up shots showing a more

detailed view of the technique) significantly more highly than students ($p<0.02$). No significant differences were found for the rest of items ($p>0.05$). The results are summarized in Table 1.

Both teachers and students gave the highest mean scores (>4) to seven items belonging to topics 1, 2 and 4 (information, images and filmmaking): 1.4 (the steps of the procedure), 1.5 (histological structures that can be visualized), 1.6 (usefulness for the histological diagnosis), 2.5 (the steps of the procedure), 2.6 (the histological structures that can be visualized), 2.7 (the type of microscope that provides the best images of the material prepared with the technique) and 4.3 (close-up shots showing a more detailed view of the technique). The items that teachers and students both scored lowest (<2) belonged to topics 2 (images, item 2.3 -the chemical structures and formulas-) and 3 (text and music, item 3.9 -background music heard throughout the notebook-) (Table 1).

Comparison of the seven highest scores versus the two lowest scores showed that the two groups of scores differed significantly ($p=0.0001$ with the Mann-Whitney test).

No significant differences were observed between men and women in the teacher or student samples, except for items 1.3 (the chemical basis) and 3.4 (a written text shown on the screen) for teachers and item 4.6 (fade-outs or fade-ins, i.e. transitions to and from a blank image) for students; in all three cases men gave these items higher scores than women.

Strikingly, a strong positive correlation was found between the scores on each item as perceived by both teachers and students ($p=0.0002$ and $r=0.8134$). This correlation was also significant when the scores for each topic were compared separately, suggesting that a similar profile may exist between teachers and

students (Figure 2) ($p=0.0001$ and $r=0.9314$ for topic 1; $p=0.004$ and $r=0.7836$ for topic 2; $p=0.004$ and $r=0.8109$ for topic 3; and $p=0.005$ and $r=0.9428$ for topic 4).

DISCUSSION

To evaluate students' and teachers' perceptions regarding the characteristics of a video to be prepared independently by each group on a specific PCK, we chose the identification of nerve tissue with the Cajal silver nitrate histological staining technique as a model, since it consists of a very systematized array of processes and sequential steps used to process nervous tissue for microscopic examination (Garcia-Marin et al., 2009). This technique requires a set of specific knowledge and operating skills that can and should be reflected in an audiovisual medium (video) in a way that makes them understandable to others from the traditional teachers' perspective of reception learning (Shulman, 1987; Magnusson et al., 1999). The novel approach the present study is based upon is to view the video tool from a self-learning perspective in which students are involved in the development of a video that will be used in their own educational process. Furthermore, elaboration of a video on a very specific technique such as silver impregnation allows the student to assembly pieces of information and then, to present them concisely. According to Black and Smith (2004), this is an essential skill required for students and physicians. In addition, this would facilitate the acquisition of proficiency in histological discipline language to tackle preclinical work as pointed out by Sinclair (1997).

Three main criteria – content, quality and clarity – have been used to evaluate videos for training and learning (Brown, 1985; Gul et al., 1999; Roshier et al.,

2011). Content refers to the message the video conveys; quality, to its technical aspects (sounds, use of camera angles, etc.), and clarity refers to how well the message of the video is conveyed. To evaluate students' and teachers' perceptions regarding the development of the video, we used four questionnaires with items that focused on the main components (topics) in an audiovisual product: information, images, text and music, and filmmaking (Chion, 1994; Cohen, 2001; Kojima and Tamura 2002; Jung et al., 2004; Bovik, 2010). These four components were analyzed separately in order to define different levels of perception comprising the information that the video should provide, the images used to illustrate the process to be taught, and the text and music that accompanies the information and images. These components were studied separately from the filmmaking processes used to produce the video, in order to avoid subjectivity in the use of common terms (content, quality and clarity), which both teachers and students can find difficult to define, categorize and record with precision.

The results show that the scores teachers and students gave to the information, images and filmmaking topics were significantly higher than the text and music component. This finding suggests that both teachers and students felt that the information, image and filmmaking topics were more relevant to the development of the video than the accompanying content provided as text and music, which received scores reflecting lower priority. Contributing factors to these perceptions may have been the difficulty in reading texts that appear during a video (Kruk and Mutter, 1984) and the belief that the emotional component provided by music is not essential to the teaching or self-learning

process sought by the teachers and students who develop the audiovisual tool (Chion, 1994; Cohen, 2001).

Another finding of note is the significant difference between teachers and students in global scores for each of the four topics and in specific scores for many items: the scores given by the teachers were, in general, higher than those given by students. This finding was especially notable for the information and image components.

For the information component, students scored only one of the 12 items significantly more highly than teachers: informing about the steps in the technical procedure. This result suggests that students preferred to see how the technique was performed in greater detail than teachers wished to show them. In other words, teachers sought to train conceptual competencies, i.e. knowledge, whereas students preferred to learn procedural competencies, i.e., how to do something – a different learning objective (Newble and Entwistle, 1986; Leung, 2002; Harris et al., 2010; Roshier et al., 2011).

The scores for different types of images to be used in the video were significantly higher in the teacher sample for all except one item (the use of cartoon figures to illustrate the technique), which was given a similar score by both teachers and students. A possible explanation for this result is that although the cartoon figure culture is more strongly embedded in the students' cultural context (Trier, 2006), teachers nonetheless do not rule out the use of cartoon figures as one of the multimedia resources currently available in the field of education (Keogh and Naylor, 1999; Perez-Bouza et al., 2011). Future studies should clarify if differences exist regarding the use of cartoon figures between teachers with long experience and a long academic career and novel

young teachers who are likely more close to the cultural environment of the students. The highest scores found in the group of teachers for most items corresponding to the topic “images” could imply a higher interest of teachers to clearly present the information about the concepts using a visual display. According to the results of the present study, teachers believe that images representing key concepts -basis of the technique, chemical structures, etc.- could facilitate the learning process. Although the results were high for both the teachers and students, the highest scores found in the group of teachers suggest that students do not feel that the correlation between concepts and images is strictly necessary.

In the topic text and music used to accompany the information and images in the video, teachers gave higher scores on three items: narration by the technician performing the technique, the appearance of text separately between the images, and the use of music only between narrated text scenes. These items show that teachers are concerned with separating the different elements (text and music) that accompany the images from the information per se, and with using the voice of the technician who performs the histological technique to describe the steps in the procedure. These options are intended by teachers to favor clarity and credibility – factors that have a specific effect on students’ motivation state, affective learning and cognitive learning (Teven and McCroskey, 1997; Frymier and Houser, 2000; Chesebro and McCroskey, 2001; Brann et al., 2005). By using empathy, both types of learning would favor significant learning and the acquisition of structured information by the students Schaber et al., 2010). For example, an explanation of a technique by a

technician is perceived by teachers as clearer and more believable than if it is narrated by a professional voice actor or by a student.

For the items related to filmmaking, the significantly higher scores given by teachers reflect this group's preference for the use of medium shots to show the technician while he or she performs the technique, and for close-up shots to show a more detailed view of the technique. Once again, the teachers in the study appeared to seek an affective approach to the students to impart credibility and clarity to the audiovisual product they aimed to develop. The scores students gave to the components for text and music and for filmmaking confirmed earlier observations that students value clarity and do not consider the quality of the music or filmmaking a high priority in an educational video (Gul et al., 1999; Roshier et al., 2011).

As a consequence of this, we hypothesize that, although both groups share similar profiles in most topics and items related to the elaboration of a video, results show that teachers more profoundly emphasize conceptual competencies, seek a correlation between these competences and the images shown in the video, tend to clearly show key information and images free from accessory text and music and use medium shots and close-up shots to focus on the pedagogical objective displayed in the video. According to the students' preferences revealed in the present study, a video elaborated by students would not emphasize those aspects as clearly as teachers would do.

Moreover, the items related to the use of information and images to illustrate the steps in a procedure, the histological structures that can be visualized, usefulness for histological diagnosis, the type of microscope that provides the best images of the slides, and the use of close-up shots to show a more

detailed view of the technique were scored most highly by both teachers and students. The lowest scores for both teachers and students differed significantly from the highest scores, and were given to items related to the teaching and learning of theoretical components (chemical structures and formulas) and the excessive use of complementary elements such as background music throughout the duration of the video. These low scores contrasted with the much higher scores both groups of participants gave to core elements such as the information and images to be used in the audiovisual product. The main motivating factor in educational videos, according to another recent study, was clarity in relation with their learning goals for specific tasks and in the visualization of specific techniques (Roshier et al., 2011). Complementary data, i.e. information that can be considered as accessory but not directly applicable in the medical context, seem to be less relevant not only for students, but also for teachers who participated in this study.

Although significant differences were recently reported between male and female medical students in their use of video games (Kron et al., 2010), the study found no significant differences between male and female students or teachers in the scores for different items related to the development of educational videos. The only significant differences were the higher scores given by male teachers and students to the items for how to show text and for the use of fade-outs or fade-ins in the filmmaking process. These items cannot be considered a crucial part of the educational content of the video. The results for the information component, however, showed that male teachers scored the need to include information about the chemical basis of the histological technique more highly than female teachers.

Finally, the results of this study show a strong positive statistical correlation between scores assigned in each item by teachers and students, even in comparisons for each topic separately, although this correlation was stronger for information and images than for text and music and filmmaking. Strikingly, the correlation was more significant for those areas where a teaching video is most likely to influence the quality of learning. This correlation shows that teachers and students tend to agree on the relative importance of each item in each of the four topic groups -information, images, text and music, and filmmaking-, although teachers tend to show higher scores for many of the items. Thus, there appears to be consensus and compatibility between the beliefs and conceptions of teachers who wish to develop the video medium as an audiovisual teaching tool (teaching video) and students who wish to develop the medium as an audiovisual learning tool (audiovisual notebook).

Furthermore, the close correlation between teachers and students supports the idea that audiovisual notebooks developed for a specific PCK by students would not alter the curricular objectives of the PCK of interest (a histological technique, in the present study). The fact that teachers and students tend to agree on the importance of each item of a teaching video does not necessarily imply that design and elaboration of a video should be restricted to teachers, since the active implication of students would favor self-learning and incorporate the added advantages of the types of skills acquired through this learning process (Campos-Sánchez et al., 2012).

The strength of this study is the comprehensive evaluation of most elements that form part of a teaching video, including information, images and complementary features such as filmmaking, text and music. In addition, the

perspective of teachers and students is evaluated and compared to shed light on what are the preferences of both groups. A possible limitation of the study is the lack of results regarding the final performance of the students involved in the elaboration of the audiovisual notebook. Another possible limitation is the selection of the Cajal silver staining technique as PCK. Future studies should aim to clarify whether PCKs other than the one used in the present study also behave according to convergent models of teachers' and students' perception regarding the development of a successful video tool in terms of information, images, text and music and filmmaking. Because students' beliefs and conceptions are related to their learning strategies and achievements (Chan, 2011), studies of audiovisual notebooks in other areas of knowledge are advisable before this instrument can be used more generally as an appropriate self-learning tool. On the other hand, it will be of interest to find out if dividing the data for teachers by years of teaching experience and by gender, could influence the results, since it has been previously demonstrated that teacher's pedagogical background can influence teaching and probably perception (Kjellgren et al., 2008). To further inquire if the gender of the person who narrates the text may influence the results, future studies should be carried out with narrators of different genders. Furthermore, upcoming research could evaluate the didactic usefulness of different versions of the video elaborated according to the preferences of the teachers or of the students.

CONCLUSIONS

In conclusion, with the novel approach that we developed in this study, we contributed to a better knowledge of the students' perceptions about how to

elaborate a teaching video in comparison with the perspective of the teachers. Evaluation of the four main components of a video - information, images, text and music, and filmmaking - revealed that both teachers and students consider that information, images and filmmaking are significantly more relevant than text and music, which is felt as having and accessory role, with very few gender differences. Interestingly, the scores were constantly higher for teachers than for students for most items and for all components, although the same profile was found for both teachers and students. In general, we can conclude that teachers more profoundly emphasize conceptual competencies and tend to correlate these competences with the images, to clearly show key information and images and use medium and close-up shots to focus on the pedagogical objective displayed in the video. On the other hand, students preferred to see how the technique was performed in greater detail than teachers. As a consequence of this, we can postulate that teaching videos elaborated by teachers would preferentially be oriented towards more didactic contents and displays as compared to videos elaborated by students, which would be more focused on the acquisition of procedural competences. Care should be taken when designing a teaching video so that both the conceptual and the procedural competences can be considered in the video. In spite of these differences, the close correlation found between the profiles of teachers and students for the four components allow us to hypothesize that students could confidently participate in the elaboration of the videos as self-learning tools in histology.

ACKNOWLEDGMENTS

This work was supported by Unidad de Innovación Docente, University of Granada, Spain through grants UGR11-294 and UGR11-303. We thank K. Shashok for translating parts of the manuscript into English.

NOTES ON CONTRIBUTORS

ANTONIO CAMPOS-SÁNCHEZ, M.Sc., is a Master Degree and Ph.D. student at the University of Granada, Granada, Spain. He is involved in education research with a focus on self-learning methodologies.

JUAN ANTONIO LÓPEZ NÚÑEZ, Ed.D., is a professor in the Department of Didactics and School Organization at the Faculty of Education, University of Granada. He is involved in education research at the university level.

GUISEPPE SCIONTI, M.Sc., is a research fellow in the Department of Histology at the University of Granada, Granada, Spain. He is a member of the Tissue Engineering Group and interested in university education.

INGRID GARZÓN, D.D.Sc., Ph.D., is an associate professor in the Department of Histology at the University of Granada, Granada, Spain and a member of the Tissue Engineering Group.

MIGUEL GONZÁLEZ-ANDRADES, M.D., Ph.D., is an ophthalmologist in the Division of Ophthalmology, University Hospital San Cecilio, Granada, Spain, and associate instructor at the University of Granada. He is involved in medical education research.

MIGUEL ALAMINOS, M.D., Ph.D., B.Sc., Ph.D., is a professor in the Department of Histology, University of Granada, Granada, Spain. He is a

member of the Tissue Engineering Group and is responsible for higher education research projects.

TOMÁS SOLA, Ed. D., is a professor in the Department of Didactics and School Organization at the Faculty of Education, University of Granada. He is involved in research related to educational technologies and organization.

LITERATURE CITED

Alikhan A, Kaur RR, Feldman SR. 2010. Podcasting in dermatology education. J Dermatol Treat 21:73–79.

Backstein D, Agnidis Z, Sadhu R, MacRae H. 2005. Effectiveness of repeated video feedback in the acquisition of a surgical technical skill. Can J Surg 48:195–200.

Bacro T, Gilbertson B, Coultas J. 2000. Web-delivery of anatomy video clips using a CD-ROM. Anat Rec 261:78–82.

Bacro TR, Gebregziabher M, Fitzharris TP. 2010. Evaluation of a lecture recording system in a medical curriculum. Anat Sci Educ 3:300–308.

Barber SG. 1992. Postgraduate teaching audit by peer review of videotape recordings. Med Teach 14:149–157.

Baribeau DA, Mukovozov J, Sabljic T, Eva KW, Delottinville CB. 2012. Using an objective structured video exam to identify differential understanding of aspects of communication skills. Med Teach 34:242–250.

Black VH, Smith PR. 2004. Increasing active student participation in histology. Anat Rec B New Anat 278:14-17.

Bovik AC. 2010. Handbook of Image and Video Processing. 2nd Edition. London, UK: Elsevier Academic Press. 1384 p.

Brann M, Edwards C, Myers SA. 2005. Perceived instructor credibility and teaching philosophy. Commun Res Rep 22:217–226.

Bridge PD, Jackson M, Robinson L. 2009. The effectiveness of streaming video on medical student learning: A case study. Med Educ Online 14:11–15.

Brown GA. 1985. How to make and use videos in teaching. Med Teach 7:139–149.

Campos-Sánchez A, Martín-Piedra MA, Carriel V, González-Andrades M, Garzón I, Sánchez-Quevedo MC, Alaminos M. 2012. Reception learning and self-discovery learning in histology: Students' perceptions and their implications for assessing the effectiveness of different learning modalities. Anat Sci Educ 5:273–280.

Chan KW. 2011. Preservice teacher education, students' epistemological beliefs and conceptions about learning. Instr Sci 39:87–108.

Chesebro JL, McCroskey JC. 2001. The relationship of teacher clarity and immediacy with student state receiver apprehension, affect, and cognitive learning. Commun Educ 50:59–68.

Chion M. 1994. Audio-Vision. Sound on Screen. 1st Edition. New York, NY: Columbia University Press. 139 p.

Chiu C, Lee GC, Yang J. 2006. A comparative study on post-class lecture video viewing. Adv Tech Learn 3:195–203.

Clarke RM. 1975. Replacement of class instruction in histology by audio-tape and booklet self-instruction sessions. Br J Med Educ 9:36–37.

Cohen AJ. 2001. Music as a source of emotion in film. In: Juslin PN, Sloboda JA, (Editors). Music and Emotion: Theory and Research. 1st Edition. Oxford, UK: Oxford University Press, p 249–279.

DiLullo C, Coughlin P, D'Angelo M, McGuinness M, Bandle J, Slotkin EM, Shainker SA, Wenger C, Berray SJ. 2006. Anatomy in a new curriculum: Facilitating the learning of gross anatomy using web access streaming dissection videos. J Vis Commun Med 29:99-108.

Drake RL, McBride JM, Lachman N, Pawlina W. 2009. Medical education in the anatomical sciences: The winds of change continue to blow. Anat Sci Educ 2:253–259.

Frymier AB, Houser ML. 2000. The teacher/student relationship as an interpersonal relationship. Commun Educ 49:207–219.

Garcia-Marin V, Garcia-Lopez P, Freire M. 2009. The growth cone as seen through Cajal's original histological preparations and publications. J Hist Neurosci 18:197–210.

Gul YA, Wan AC, Darzi A. 1999. Undergraduate surgical teaching utilizing telemedicine. Med Educ 33:596–599.

Hanson AH, Krause LK, Simmons RN, Ellis JI, Gamble RG, Jensen JD, Noble MN, Orser ML, Suarez AL, Dellavalle RP. 2011. Dermatology education and the Internet: Traditional and cutting-edge resources. J Am Acad Dermatol 65:836-842.

Harris P, Snell L, Talbot M, Harden RM. 2010. Competency-based medical education: Implications for undergraduate programs Med Teach 32:646–650.

Hawkins SC, Osborne A, Schofield SJ, Pournaras DJ, Chester JF. 2012. Improving the accuracy of self-assessment of practical clinical skills using video feedback – The importance of including benchmarks. Med Teach 34:279–284.

Hotokezaka M, Chijiiwa K, Kondo K, Kai M, Eto TA, Hidaka H, Jimi S, Maehara N, Ohuchida J, Matsumoto K, Nakao H. 2008. Video monitoring and slide and video presentations as tools for surgical education. Hepatogastroenterology 55:1519–1522.

Hung D, Tan SC, Koh TS. 2006. From traditional to constructivist epistemologies: A proposed theoretical framework based on activity theory for learning communities. J Interact Learn Res 17:37–55.

Jensen M, Mattheis A, Johnson B. 2012. Using student learning and development outcomes to evaluate a first-year undergraduate group video project. CBE Life Sci Educ 1:68–80.

Jung K, Kim KI, Jain AK. 2004. Text information extraction in images and video: a survey. Pattern Recognit 37:977–997.

Kaufman DM. 2003. Applying educational theory in practice. Br Med J 326:213–216.

Keogh B, Naylor S. 1999. Concept cartoons, teaching and learning in science: an evaluation. Int J Sci Educ 21:431–446.

Kjellgren KI, Hendry G, Hultberg J, Plos K, Rydmark M, Tobin G, Saljo R. 2008. Learning to learn and learning to teach - introduction to studies in higher education. Med Teach 30:e239–e245.

Kojima A, Tamura T. 2002. Natural language description of human activities from video images based on concept hierarchy of actions. Int J Comput Vis 50:171–184.

Kron FW, Gjerde CL, Sen A, Fetters MD. 2010. Medical student attitudes toward video games and related new media technologies in medical education. BMC Med Educ 10:50.

Kruk RS, Mutter P. 1984. Reading of continuous text on video screens human factors. Hum Factors 26:339–345.

Leung WC. 2002. Competency based medical training: Review. Br Med J 325:693–696.

Liaskos J, Diomidus M. 2002. Multimedia technologies in education. Stud Health Technol Inform 65:359–372.

Magnusson S, Krajcik J, Borko H. 1999. Nature, sources, and development of pedagogical content knowledge for science teaching. In: Gess-Newsome J, Lederman NG, (Editors). Examining Pedagogical Content Knowledge: The Construct And its Implications for Science Education. 1st Edition. Dordrecht, The Netherlands: Kluwer Academic Publishers, p 95–132.

Mahmud W, Hyder O, Butt J, Aftab A. 2011. Dissection videos do not improve anatomy examination scores. Anat Sci Educ 4:16–21.

Matava CT, Rosen D, Siu E, Bould DM. 2013. eLearning among Canadian anesthesia residents: a survey of podcast use and content needs. BMC Med Educ 13:59.

Mattern RA. 2005. College students' goal orientations and achievement. Teach Learn High Educ 17:27–32.

McNulty JA, Hoyt A, Gruener G, Chandrasekhar A, Espiritu B, Price RJr, Naheedy R. 2009. An analysis of lecture video utilization in undergraduate medical education: Associations with performance in the courses. BMC Med Educ 9:6.

Metzner RJ, Bittker TE. 1973. Videotape production by medical educators: Some practical considerations. J Med Educ 48:743–745.

Newble DJ, Entwistle NJ. 1986. Learning styles and approaches: Implications for medical education. Med Educ 20:162–175.

O'Brien TC, Shapiro BJ. 1977. Number patterns: Discovery versus reception learning. J Res Math Educ 8:83–87.

Pereira JA, Merí A, Masdeu C, Molina-Tomás MC, Martínez-Carrió A. 2004. Using video clips to improve theoretical anatomy teaching. Eur J Anat 8:143–146.

Perez-Bouza A, Merk M, Rieck I, Knuechel R. 2011. Video-based teaching in pathology. Experience gained in the last 3 years at the RWTH Aachen University. Pathologe 32:244–249.

Ramey JW. 1968. Teaching medical students by videotape simulation. J Med Educ 43:55–59.

Roshier AL, Foster N, Jones MA. 2011. Veterinary students' usage and perception of video teaching resources. BMC Med Educ 11:1.

Roy RB, McMahon GT. 2012. Video-based cases disrupt deep critical thinking in problem-based learning. Med Educ 46:426–435.

Ruiz JG, Mintzer MJ, Issenberg SB. 2006. Learning objects in medical education. Med Teach 28:599–605.

Saxena V, Natarajan P, O'Sullivan PS, Jain S. 2008. Effect of the use of instructional anatomy videos on student performance. Anat Sci Educ 1:159–165.

Schaber P, Wilcox KJ, Whiteside A, Marsh L, Brooks DC. 2010. Designing Learning Environments to Foster Affective Learning: Comparison of Classroom to Blended Learning. Int J Scholarship Teach Learn; 4(2).

Schommer M. 1990. Effects of beliefs about the nature of knowledge on comprehension. J Educ Psychol 82:498–504.

Senchina DS. 2011. Video laboratories for the teaching and learning of professional ethics in exercise physiology curricula. Adv Physiol Educ 35:264–269.

Shaw PA, Friedman ES. 2012. Clinico-Histologic Conferences: Histology and disease. Anat Sci Educ 5: 55–61.

Shulman LS. 1987. Knowledge and teaching: Foundations of the new reform. Harv Educ Rev 57:1–22.

Sinclair S. 1997. Making doctors. An institutional apprenticeship. 1st Edition. Oxford, UK: Berg Publishers. 320 p.

Spencer JA, Jordan RK. 1999. Learner centred approaches in medical education. Br Med J 318:1280–1283.

Stevens A, Lowe JS. 2005. Human histology. 3rd Edition. London, United Kingdom: Mosby. 428 p.

Tavlasoglu M, Durukan AB, Arslan Z, Kurkluoglu M, Amrahov A, Jahollari A. 2013. Evaluation of skill-acquisition process in mitral valve repair techniques: a simulation-based study. J Surg Educ 70:318–25.

Teven JJ, McCroskey JC. 1997. The relationship of perceived teacher caring with student learning and teacher evaluation. Commun Educ 46:1–9.

Tolerton SK, Hugh TJ, Cosman PH. 2012. The production of audiovisual teaching tools in minimally invasive surgery. J Surg Educ 69:404–406.

Trier J. 2006. Teaching with media and popular culture. J Adolesc Adult Lit 49:434–438.

Wolters CA. 2004. Advancing achievement goals theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. J Educ Psychol 96:236–250.

Woosley J. 2006. Creating interactive pathology tutorials in QuickTime and Flash. Hum Pathol 37:974–977.

FIGURE LEGENDS

Figure 1. Mean scores assigned by teachers and students to each topic or component (information, images, text and music, filmmaking). Black vertical lines represent standard deviations for each topic.

Figure 2. Average scores assigned by teachers and students to each specific item corresponding to topic groups 1 (information), 2 (images), 3 (text and music) and 4 (filmmaking) showing the correlation between teachers and students.