UNIVERSIDAD DE GRANADA
FACULTAD DE CIENCIAS DE LA EDUCACIÓN

MOTIVACIÓN Y AUTOAPRENDIZAJE EN LA ORGANIZACIÓN CURRICULAR Y LA DIDÁCTICA DE LA HISTOLOGÍA

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MOTIVACIÓN Y AUTOAPRENDIZAJE EN LA ORGANIZACIÓN CURRICULAR Y LA DIDÁCTICA DE LA HISTOLOGÍA

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I. INTRODUCCIÓN

INTRODUCCIÓN

1. LA HISTOLOGÍA Y SU DIDÁCTICA

La histología es un área del conocimiento del ámbito de la biología y las ciencias de la salud que tiene por objeto la investigación y el conocimiento de las estructuras microscópicas de los seres vivos incluido el ser humano. La histología constituye a este respecto un importante capítulo de los contenidos docentes de la enseñanza primaria, secundaria y universitaria especialmente en esta última en los *curricula* de biología y ciencias de la Salud.

Con el objeto de establecer la delimitación conceptual y metodológica de la histología y abordar con posterioridad su didáctica describiremos sucesivamente la evolución histórica de su concepto y los distintos factores y objetivos que configuran y conforman su futuro desarrollo para pasar a continuación a describir los contenidos básicos en los distintos niveles educativos y las modalidades y estrategias didácticas básicas que se utilizan para favorecer su aprendizaje.

1.1 Delimitación conceptual y metodológica de la Histología

La Histología surge como disciplina científica a principios del siglo XIX cuando se produce la síntesis entre dos conceptos básicos surgidos en dicho periodo: la Anatomía General de Bichat y la Teoría Celular de Schleiden y Schwann. Para el primero, y desde una perspectiva anatómica y sensorial (dureza, elasticidad, etc.), el organismo humano está constituido por veintiún tejidos o partes similares que, asociándose, constituyen los órganos. Para Schleiden y Schwann, y desde una perspectiva microscópica, los seres vivos están constituidos por células (unidades elementales básicas que configurarían la unidad estequiológica de los mismos).

La Histología, término que acuñó Mayer en 1819, es la ciencia que estudia los tejidos o partes similares del organismo que, a su vez, están integrados por unidades estequiológicas (células vivas). El concepto de Histología no surge de repente. Por el contrario, este término se viene gestando progresivamente desde el Renacimiento. En este sentido destaca el primitivo concepto de tejido intuido por Falopio al propugnar que las partes sólidas del organismo están constituidas por la asociación, en trama lineal, superficial o tridimensional, de las fibras elementales. Hasta el siglo XIX, se consideró que la fibra constituía la unidad estequiológica de los seres vivos (Laín Entralgo, 2001).

La aparición del microscopio hacia 1610, cuya primacía de invención se disputan italianos y holandeses, vino asimismo a cambiar la perspectiva del conocimiento biológico. En este sentido no parece exagerado afirmar que la historia de la ciencia puede dividirse en una era premicroscópica y otra microscópica. El progresivo conocimiento de las estructuras microscópicas llevadas a cabo por científicos como Hooke, Grew, Leeuwenhoek y Swammerdam, comenzó a cuestionar la fibra como unidad estequiológica e hizo posible, junto con las avanzadas metodologías y descripciones de principios del siglo XIX -Dutrochet, Brown, Muller, etc.- el nacimiento de la Teoría Celular (Laín Entralgo, 2001).

El desarrollo de la Histología y Embriología en la segunda mitad del siglo XIX y primer tercio del XX resultó espectacular (López Piñero, 2000). A ello contribuyó en gran medida el pensamiento positivista dominante en la época, así como las innovaciones tanto en el microscopio como en las técnicas histológicas de tinción. Entre estas últimas destacan las hematoxilinas de Bohner, las anilinas de Ehrlich, el bicromato argéntico de Golgi, el nitrato de plata de Ramón y Cajal y los métodos de Río Hortega. Todos estos avances contribuyeron muy significativamente a la descripción sistemática de los distintos tejidos y órganos. Por ejemplo, Henle y Kolliker llevaron a cabo descripciones pormenorizadas de los tejidos epiteliales, Ranvier y Virchow de los tejidos conjuntivos y sus variedades, mientras que Bowman, Hensen y Krause contribuyeron al conocimiento microscópico y estructural del tejido muscular. La sangre fue objeto de investigación de Welcker, Ehrlich, Hayeum y Bizzozero. En el tejido nervioso destaca la obra de Ramón y Cajal y de la Escuela Española de Histología con Pio Río Hortega, Jorge Tello y Fernando de Castro, que realizaron aportaciones absolutamente decisivas en este campo tales como el establecimiento de la teoría de la neurona y la descripción morfoestructural e histogenética de la glía. La célula, componente básico de los tejidos, va a ser también en todo este periodo objeto básico de profunda investigación. En este sentido, Altmann y Benda describen los condriocontes, Hertwig y Garnier, el ergatoplasma, Golgi el aparato reticular interno y Van Beneden, Schneider, Strassburger, Flemming, Farner y Moore el centrosoma y los fenómenos de mitosis y meiosis.

Uno de los hechos más singulares de todo el periodo cronológico que comentamos lo constituye, sin embargo, la aportación de Rudolph Virchow y su idea de que la célula constituye el asiento básico de todo proceso patológico. En este sentido, este científico afirma que "*toda enfermedad se basa en la alteración de un conjunto grande o pequeño de unidades celulares del organismo viviente. Toda alteración patológica, toda acción terapéutica no adquiere su último significado hasta que es posible encontrar el grupo determinado de elementos celulares que han sido afectados y determinar el tipo de alteración que los elementos individuales de dicho grupo sufren. La tan buscada esencia de la enfermedad es la célula alterada*". Este pensamiento constituye el eje esencial sobre el que, desde entonces, se han sustentado las distintas disciplinas relacionadas con las Ciencias de la Salud (Laín Entralgo, 2001).

En el segundo tercio del siglo XX, el desarrollo de la Histología se ha visto condicionado, al igual que la etapa anterior, por los avances instrumentales y metodológicos. En efecto, el desarrollo de la física de entreguerras hizo posible, entre otros, el desarrollo del microscopio electrónico de transmisión, el microscopio electrónico de barrido y el microscopio de contraste de fases. En nuestros días, se han desarrollado diversos sistemas microanalíticos susceptibles de asociarse a los distintos sistemas microscópicos. La metodología utilizada para la preparación de muestras biológicas, incluyendo el cultivo de tejidos, técnicas autorradiográficas, técnicas inmunológicas, centrifugación diferencial, etc., han hecho posible, asimismo, obtener una información microscópica de carácter esencialmente dinámica que se relaciona con las diferentes actividades funcionales de las células y los tejidos. En este contexto, citólogos e histólogos como Palade, Porter, De Duve, Sjostrand y De Robertis, Lajtha, Potten, Leblond, al asociar básicamente la ultraestructura y la citoquímica desde diversos métodos, han dado origen no sólo a una auténtica Biología Celular y tisular, sino también a una explicación histofuncional e histodinámica de los propios tejidos (Campos, 1985).

Como resultado de este proceso, la histología, considerada tradicionalmente una ciencia descriptiva, emerge como una disciplina científica bien delimitada (De Juan Herrero, 1999; Campos, 2004a) a cuyo conocimiento se accede a través de los distintos métodos amplificantes. La histología en este sentido debe ocuparse por tanto del conocimiento de los niveles de organización celular y tisular, que se intercalan entre el nivel Bioquímico (el nivel atómico-molecular) y el nivel anatómico (el nivel morfológico-macroscópico) (Campos, 2004b). Para alcanzar dicho conocimiento la Histología posee una metodología propia (instrumentos amplificantes), unas técnicas específicas (las técnicas histológicas, histoquímicas o de cultivos celulares y tisulares) y un objetivo básico común: la sistematización estructural cambiante de las células y los tejidos en las distintas actividades biológicas vinculadas a ellos y en los distintos periodos cronológicos de la vida. Los métodos propios de la histología se muestran de manera esquemática en la Figura 1.

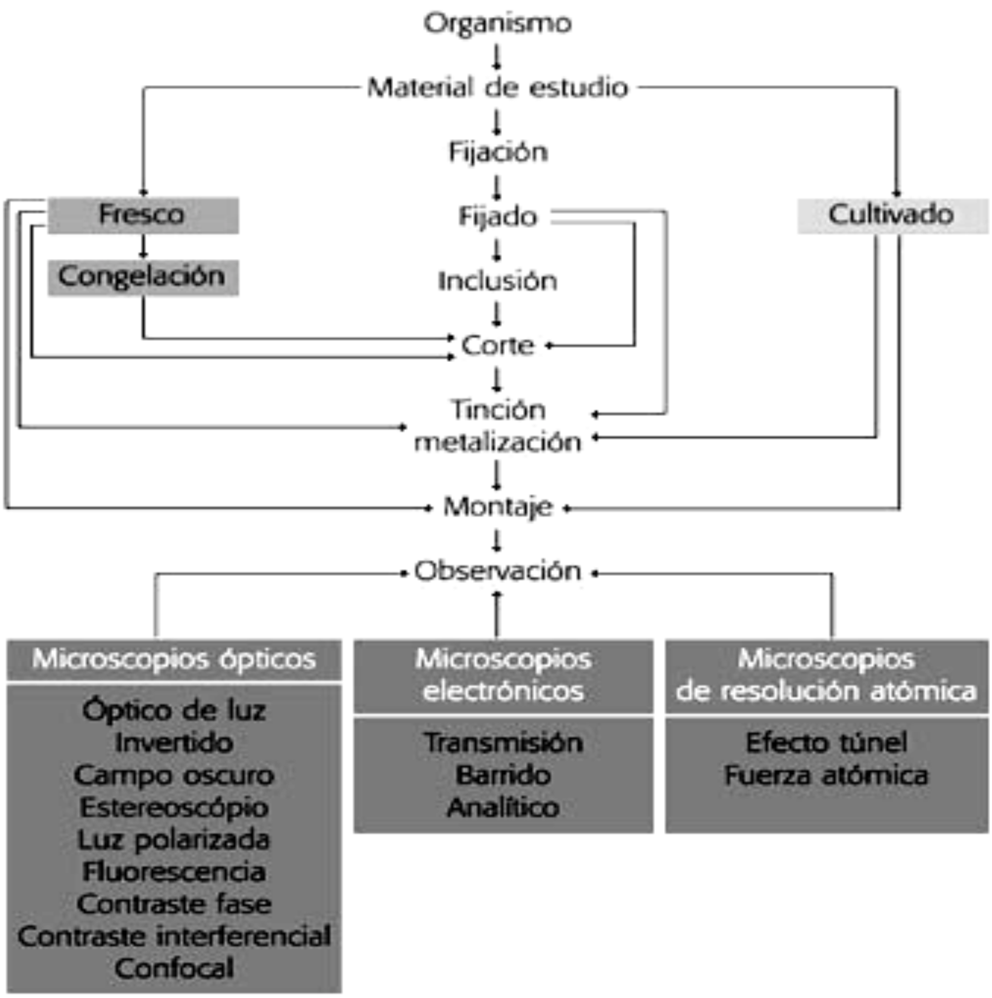

Figura 1. Esquema general de la técnica histológica y de los instrumentos de observación (de Gómez de Ferraris y Campos, 2009).

1.2 Contenidos y objetivos de la histología en los distintos niveles educativos

Para la docencia de la histología en los distintos niveles educativos los contenidos de la disciplina deben adecuarse a los objetivos generales y específicos de los distintos *curricula* y a las competencias que deben alcanzarse en relación con los mismos.

1.2.1 Contenidos y objetivos en la enseñanza no universitaria

Los contenidos relacionados con la histología en educación primaria, se recogen dentro del área del conocimiento del medio; en educación secundaria en las Ciencias de la naturaleza y en bachiller, en biología y geología. La Histología propiamente dicha se empieza a enseñar en el primer curso de la educación secundaria, donde los alumnos estudian los conceptos básicos de la célula y algunos de los tipos de célula existentes.

Desde el primer curso de educación primaria el alumno va incorporando conocimientos relacionados con la estructura de su cuerpo, aparatos y órganos que lo forman. Los animales y plantas, como seres vivos, abarcan también gran parte de los contenidos en este primer ciclo. Y es en el quinto curso de educación primaria cuando se empieza a desarrollar con más profundidad la enseñanza de los órganos relacionados con la respiración, la circulación y la excreción. El último año de educación primaria se incorpora al curriculum la enseñanza de los aparatos reproductores masculinos y femeninos así como el proceso de la fecundación humana.

En la educación secundaria además de estudiar las células, se introduce el término de "tejido" haciéndose una breve descripción de los cuatro tipos de tejidos que configuran el organismo humano. Al igual que en la educación primaria, el alumno profundiza en el conocimiento de los distintos órganos, aparatos y sistemas y en la embriología del ser humano. La histología, como materia, se desarrolla en profundidad en el bachillerato, en el que se estudia la estructura celular incluyendo las organelas intracelulares, así como las distintas características de los diferentes tejidos que componen los órganos del cuerpo humano.

1.2.2 Contenidos y objetivos en la enseñanza universitaria

La histología se incorpora en España de modo obligatorio a los estudios de medicina en lo que al doctorado se refiere por RD de 2 de Julio de 1875 y en lo que respecta a la Licenciatura a través del RD de 16 de Septiembre de 1886. A partir de ese momento la Histología ha formado parte de los distintos planes de estudio de las facultades de Medicina y con posterioridad de otras facultades vinculadas a las ciencias de la salud. En la actualidad los estudios de medicina, odontología y farmacia, entre otros, incorporan la histología como materia troncal del periodo preclínico de sus respectivos currícula tanto en universidades españolas como extranjeras (Humphrey et al., 2002; Figg y Cox, 2003; Witt-Enderby y McFalls-Stringert, 2004). La histología por otra parte además de en las facultades vinculadas a las ciencias de la salud forma parte del curriculum de las facultades de ciencias biológicas y de los nuevos estudios biotecnológicos recientemente incorporados a las universidades

El imparable avance científico, así como las importantes transformaciones sociales de los últimos años y las sucesivas y crecientes demandas ciudadanas, han obligado a replantear y revisar diferentes ámbitos del conocimiento científico especialmente en lo que a las ciencias de la salud se refiere (Campos, 2001). Dichos cambios exigen, en relación con la formación pregraduada y posgraduada de los futuros profesionales, una profunda revisión de los objetivos utilizados hasta el presente, así como una definición más clara y pertinente de los mismos en relación con las nuevas orientaciones curriculares y con las demandas profesionales y sociales. La histología no está exenta en modo alguno de estas transformaciones y de estos replanteamientos curriculares.

La Histología del siglo XXI que se imparte en las facultades vinculadas con las ciencias de la salud además de constituir una disciplina básica para el conocimiento científico del cuerpo humano se ha erigido también en una disciplina con un importante significado medico-sanitario. En este sentido los objetivos de la histología se han redefinido en tiempos recientes en relación con los distintos estados euplásicos, proplásicos y retroplásicos descritos en el contexto estructural y funcional de la biología humana. Dichos estados no lesionales, existentes a nivel molecular, de orgánulos, células, tejidos y órganos, permiten comprender el sustrato morfoestructural en el que asientan las lesiones, los mecanismos que conducen tanto a la formación como a la defensa y reparación de las mismas y las posibilidades terapéuticas y efectos microscópicos de determinadas técnicas farmacológicas, físicas y quirúrgicas. Frente a estos estados no lesionales, objeto de la Histología, la histopatología tiene por objeto específico la investigación del estado lesional o, lo que es lo mismo, de las alteraciones morfoestructurales que se imprimen en los distintos niveles de organización del organismo humano (Campos, 1985). Aunque ambas disciplinas compartan como objetivo básico común la investigación microscópica humana, sus respectivos ámbitos de conocimiento son claramente diferenciables.

El estado euplásico es el estado ortotípico o estado de salud. La Histología tendrá, por tanto, como objetivo específico la sistematización microscópica en dicho estado del organismo humano y deberá hacerlo en los niveles de organización que le corresponden atendiendo además a cuantas variaciones temporales u homeostáticas puedan existir en dicho estado de salud.

El estado proplásico es un estado de actividad general incrementada. Está constituido por los fenómenos de renovación, regeneración y reparación tendentes a la recuperación del estado de salud. Por otro lado, el estado retroplásico es un estado de actividad general disminuida. Está constituido por los fenómenos de degeneración y envejecimiento tendentes a la pérdida del estado ortotípico de salud. Como consecuencia de este enfoque multidimensional, la histología humana tendrá asimismo como objetivo específico la sistematización microscópica del organismo humano en los estados proplásicos y retroplásicos. De este modo, se podrán esclarecer los mecanismos que explican ciertas modificaciones microscópicas existentes en las células y en los tejidos humanos y que, con frecuencia, son indebidamente catalogadas como lesiones en el curso de la práctica diaria o en la interpretación que de dichas modificaciones microscópicas hacen algunos histopatólogos (Campos, 2004b).

Desde un punto de vista docente, y manteniendo la perspectiva arriba esbozada, la histología que se ha enseñado, en las facultades de medicina, odontología o de otras ramas de las ciencias de la salud, ha adolecido, con frecuencia, de contenido médico y sanitario. La mayoría de los textos utilizados como base para la formación de los distintos profesionales sanitarios son textos, en general, comunes con los estudios de ciencias biológicas, en las que los objetivos indicados previamente apenas son esbozados. Resulta evidente que los objetivos docentes de la histología en el ámbito universitario y en los *curricula* vinculados a las ciencias de la salud han de incardinarse en el marco conceptual que acabamos de exponer.

En lo que respecta a los contenidos y objetivos de la histología que se imparte en las facultades vinculadas a las ciencias de la salud hay que señalar que en los últimos años ha surgido un nuevo y revolucionario impulso, tanto conceptual como metodológico, que va a condicionar, sin duda alguna, la docencia, la investigación y la aplicación sanitaria de la misma en el curso de las próximas décadas. Se trata de lo que ha venido denominándose en los últimos tiempos Ingeniería Tisular. La Ingeniería Tisular es, en este sentido, un área en expansión que, asentada en los conocimientos básicos de la histología, tiene por objetivo construir tejidos nuevos -tejidos artificiales-, funcionalmente activos, a partir de células procedentes de cultivos desarrollados previamente y de biomateriales de distinta naturaleza que sirven como soporte o andamiaje para las células cultivadas (Langer y Vacanti, 1993, 1995; Nerem y Sambanis, 1995). El histólogo del futuro tendrá que conocer la estructura de los tejidos corporales no sólo para alcanzar los objetivos de la Histología arriba indicados, sino también porque dicho conocimiento será necesario para la construcción de los tejidos artificiales que habrán de sustituir terapéuticamente a los primeros, alterados por algún tipo de patología (Campos, 2004a). Los nuevos tejidos fabricados resultarán de la asociación de células vivas y de una matriz o andamiaje natural, artificial o mixto (Lanza et al., 1997). La ingeniería tisular se nutre y se asienta en los conocimientos histológicos tradicionales, recibiendo asimismo aportaciones de otras disciplinas fundamentales que ayudan al logro final del objetivo propuesto: la construcción de un nuevo tejido vivo y funcional capaz de sustituir con eficacia terapéutica al tejido original dañado. Resulta evidente que esta novedosa concepción de la histología debe estar presente en los contenidos y los objetivos docentes de la enseñanza universitaria de la misma.

El reto de la Histología del siglo XXI, por tanto, en su investigación y su docencia, lo encontramos en el tránsito de un conocimiento descriptivo y funcional de los tejidos útil para explicar y diagnosticar la enfermedad, a un conocimiento constructivo de nuevos tejidos artificiales al servicio de su aplicación terapéutica.

1.3 El proceso enseñanza-aprendizaje en histología. Modalidades y estrategias didácticas

El aprendizaje receptivo y el autoaprendizaje por descubrimiento constituyen las dos modalidades básicas que se utilizan en las instituciones médicas y de las ciencias de la salud para acceder al conocimiento de la histología (Hightower et al., 1999).

El aprendizaje receptivo se lleva a cabo a través de un profesor o instructor, el cual transmite a los estudiantes un conjunto sistematizado de información sobre el tema objeto de enseñanza (O'Brien y Shapiro, 1977). A través de dicho aprendizaje los alumnos reciben conceptos, términos y conocimiento sobre las características histológicas de la estructura microscópica del cuerpo humano. El conocimiento, que se presenta a los alumnos para su compresión y subsiguiente aplicación en el curso del desarrollo curricular, exige también la participación del estudiante al tener este que activar su sistema sensorial y neuroeducativo si bien dicha participación es mas reactiva que proactiva. El instrumento o recurso más utilizado en este proceso de aprendizaje receptivo es la clase o lección magistral, la cual se realiza de forma oral por parte del profesor sin que se excluya por parte de este el recurso a esquemas y dibujos sencillos en la pizarra y/o diapositivas o imágenes digitalizadas para facilitar el esclarecimiento de los conceptos, su concatenación y en algunos casos el control del tiempo de exposición (Guilbert, 1994).

Para Laín (1979) una clase o lección magistral es real y verdaderamente útil cuando ayuda al alumno a saber entender (presentación de lo que ya se conoce), a saber dudar (sacar a la luz los problemas y las ignorancias) y a saber buscar (invitación a conquistar lo que podría saberse pero aún no se sabe).

La transmisión de conocimientos basada en las clases teóricas ha de tener en cuenta en relación con el aprendizaje a la denominada estrategia de repetición, de acuerdo con lo postulado por Weinstein (1988), así como a las estrategias de apoyo, procesamiento, personalización y metacognitivas de la clasificación de Beltrán (2003). De este modo, se favorecerá la adquisición de un aprendizaje significativo por parte de los alumnos, y no una mera recepción pasiva de conocimientos.

La estrategia de repetición es un tipo de estrategia que tiene por objeto mantener la información de manera activa en la memoria a corto plazo, recitándola o nombrándola de manera repetida, para poder ser transferida a la memoria a largo plazo. Las estrategias de repetición son unas estrategias muy antiguas y muy frecuentemente utilizadas por los estudiantes con el propósito principal de facilitar la retención de la nueva información. La repetición no sólo tiene efectos cuantitativos (recordar más información), sino que también puede ayudar al estudiante a descubrir la estructura del contenido y a utilizar esa estructura como andamiaje para seleccionar y recordar la información del texto. Según Beltrán (2003), existen dos formas fundamentales de repetición: la repetición de mantenimiento y la repetición elaborativa, ambas muy utilizadas en el ámbito universitario. La primera -la repetición de mantenimiento- es la más elemental y no tiene más objeto que el mantenimiento de unos datos desconectados en la memoria a corto plazo. La segunda -la repetición elaborativa- es una forma superior de repetición, en la que ya existe el propósito de retener la información, por lo que se intenta relacionar los datos con otros conocimientos almacenados en la memoria.

Según señala Ausubel (1968), la repetición favorece el aprendizaje mediante dos mecanismos. En primer lugar, la repetición permite consolidar el material aprendido, poco después del aprendizaje inicial y antes de que se presente el olvido. En segundo lugar, una vez que la información ha sido olvidada por el alumno, la repetición proporciona al mismo la oportunidad de evitar la ambigüedad o la confusión entre ideas similares. Junto a ello, permite también concentrar la atención y el esfuerzo del estudiante en aquellas partes de la tarea que, por su naturaleza, sean más difíciles de retener.

Por otro lado, una de las condiciones que determina la eficacia de la repetición es la frecuencia de su práctica, tanto con el material sin sentido como con el material significativo y su distribución, siendo de mayor eficacia la práctica distribuida que la práctica concentrada, pues es más eficaz aprender unos contenidos en varios días diferentes que insistir una y otra vez en un solo día. Sin embargo, hay tareas que exigen periodos prolongados y considerables esfuerzos concentrados, en cuyo caso la práctica distribuida es menos eficaz que la masiva.

Por lo que respecta al autoaprendizaje por descubrimiento este puede definirse como un proceso de aprendizaje constructivista que se lleva a cabo sin guía externa sistemática por parte del profesor o instructor de la materia. En histología el sistema básico de autoaprendizaje constructivista es el que se genera a través de la estrategia didáctica que supone situar al alumno frente al microscopio para que a través de la observación de preparaciones histológicas seleccionadas, participe activamente en la construcción de su propio aprendizaje (Sudzina, 1997; Harris et al., 2001; Drake et al., 2009).

Las clases prácticas de observación microscópica constituyen un tipo de enseñanza fundamental e insustituible. Gracias a la enseñanza práctica, los alumnos pueden adquirir aptitudes y habilidades psicomotoras relacionadas con la Histología, además de contribuir notablemente a la fijación de los conocimientos teóricos adquiridos mediante la lección magistral. En este sentido, se ha demostrado que la enseñanza práctica es capaz de generar conocimientos significativos en los alumnos que, según la teoría de Ausubel, podrán relacionar los conocimientos teóricos previamente almacenados en sus estructuras cognitivas con los nuevos saberes y habilidades adquiridos mediante la enseñanza de carácter práctico. En esta relación hemos de enmarcar el conocimiento significativo que adquirirá el alumno y que le será muy útil a la hora de poner en práctica las habilidades adquiridas. Para ello, la utilización de la enseñanza práctica debería asociarse a las estrategias metacognitivas, considerada por Beltran (2003) como una de las estrategias generales de aprendizaje. Se trata de procedimientos que desarrollamos sistemática y conscientemente para influir en las actividades de procesamiento de información tales como buscar y evaluar la información, almacenarla en nuestra memoria y recuperarla para resolver problemas y auto-regular nuestro aprendizaje.

Aunque la histología se ha enseñado y aprendido utilizando básicamente las dos modalidades arriba indicadas en ambas modalidades existen numerosas variantes. Así por ejemplo en lo que se refiere al aprendizaje receptivo se ha utilizado lo que se conoce como las microlecciones que consisten en clases cortas en la que se aportan conceptos básicos (Gelula y Yudkowsky, 2002; Kamboj et al., 2010) y en lo que respecta al autoaprendizaje se han incorporado en los últimos tiempos, el denominado aprendizaje autoguiado de preparaciones en microscopio, el autoaprendizaje con imágenes proyectadas, el autoaprendizaje con imágenes digitalizadas o el autoaprendizaje con microscopia virtual, método que se ha extendido en numerosas facultades vinculadas a las ciencias de la salud, con especial incidencia en las de nueva creación (Hulsmann et al., 2009; Paulsen et al., 2010; Shaw y Friedman, 2012).

Junto a estas dos modalidades básicas de aprendizaje de la histología el desarrollo de nuevas estrategias didácticas curriculares en el ámbito de la medicina y la salud, como la que desde hace años impulsa el modelo SPICES (Harden et al., 1984; Palés, 2006) (Cuadro 1) ha creado mecanismos de aprendizaje mixto que, como por ejemplo la enseñanza basada en problemas o la enseñanza integrada, han sido hasta el presente escasamente investigados desde una perspectiva didáctica (Blumberg y Michael, 1992; Walker y Lofton, 2003; Murad y Varkey, 2008).

Estrategias Didácticas según Modelo Spices. Harden 1984

1. Centrada en el estudiante	1. Centrada en el profesor
2. Basada en problemas	2. Basada en trasmisión de información
3. Integrada	3. Basada en disciplinas
4. Orientada a la Comunidad	4. Orientada a los Hospitales
5. Basada en cursos optativos	5. Basada en Programas establecidos
6. Enseñanza Sistemática	6. Enseñanza Coyuntural
Nuevas estrategias	Estrategias clásicas

En cualquier caso y con independencia del modelo de aprendizaje de la histología previamente señalado ambos enfoques requieren un modelo de formación complementaria en el que los medios y recursos didácticos juegan un papel fundamental (Hightower et al., 1999). En este sentido la utilización de distintos medios tales como libros, atlas, audiovisuales, internet, etc. se hace imprescindible. Es importante resaltar que dichos medios didácticos tienen como finalidad fundamental facilitar y dirigir como señala De Juan (1996) el encuentro entre el alumno y los contenidos objeto del aprendizaje.

2. MOTIVACIÓN Y AUTOAPRENDIZAJE EN LA DIDÁCTICA DE LAS CIENCIAS EXPERIMENTALES Y DE LA SALUD. LA HISTOLOGÍA COMO MODELO

2.1 La motivación y sus componentes en la didáctica de las ciencias experimentales y de la salud

La motivación es un componente fundamental del proceso educativo y ha sido objeto de una intensa investigación en los distintos niveles de enseñanza (Weiner, 1990; Wigfield y Cambria, 2010). La dimensión motivacional en dicho proceso es especialmente importante por la gran influencia que ejerce en el desarrollo de los comportamientos de aprendizaje de los alumnos y en el modo en el que estos eligen un comportamiento determinado (Pertri, 1996). La motivación constituye por ello un elemento clave en la investigación educativa y en este sentido se han postulado numerosas teorías para explicar su naturaleza e incidencia en el proceso de aprendizaje (Eccles y Wigfield, 2002; Pintrich, 2003; Blumenfeld et al., 2006).

Entre las teorías sobre la motivación que han tenido una mayor influencia destacan la teoría de la jerarquización de necesidades (Maslow, 1970), la teoría del valor-expectativa (Atkinson, 1966), la teoría atribucional de la Motivación (Weiner, 1974), la teoría de la autodetermianación (Deci y Ryan 1985) y la teoría cognitiva social de Bandura (Bandura, 1986).

De acuerdo con esta última teoría (Bandura 1986, 2001, 2006), que es la que con más frecuencia se ha utilizado para explicar la participación del factor/componente motivacional en el aprendizaje de la ciencia (Sanfeliz y Stalzer, 2003; Bryan et al., 2011), la motivación debe entenderse como una serie de interacciones recíprocas entre los contextos ambientales y las características y los comportamientos personales (Bryan et al., 2011). El aprendizaje de los estudiantes es más eficaz, de acuerdo con esta teoría, cuando, como señala Glynn et al., (2011) es mas autoregulado, esto es cuando los estudiantes comprenden, monitorizan y controlan su motivación y su comportamiento hacia los fines educativos propuestos. La autorregulación del aprendizaje parece haberse convertido en un proceso clave al suponer un avance en la autodirección personal que permite a los estudiantes transformar sus actitudes mentales en competencias académicas (McCombs, 2001; Zimmerman, 2001; Salmerón Pérez y Gutiérrez Braojos, 2012).

La motivación para aprender ciencia, y en concreto las ciencias de la salud, se define en el marco de la teoría cognitiva social de Bandura como un estado interno que impulsa, dirige y sostiene el comportamiento necesario para aprender dicha ciencia y lo hace como un constructo integrado por varios componentes. Los componentes cuyas características han sido recientemente investigadas por distintos autores (Glynn y Koballa, 2006; Koballa y Glynn, 2007; Eccles y Wigfield, 2002; Pintrich, 2003), se consideran tipos y atributos de la motivación.

Entre dichos componentes destacan la motivación intrínseca que implica la satisfacción del aprender ciencia por la ciencia misma (Eccles et al., 2006); la autoeficacia que está relacionada con la creencia que tienen los estudiantes sobre su capacidad de alcanzar un buen conocimiento científico (Lawson et al., 2007); la autodeterminación que hace referencia al control que los estudiantes creen tener sobre su aprendizaje de la ciencia L (Black y Deci, 2000) y la motivación extrínseca que implica aprender la ciencia como un medio para un fin tangible como puede ser por ejemplo el desarrollo de una carrera o la obtención de un grado (Mazlo et al., 2002). Esta distinción entre grado y carrera en lo que a motivación extrínseca se refiere es importante en la educación en ciencias de la salud al estar relacionada con la obtención de metas a corto plazo, como ocurre en el desarrollo del grado, o con la obtención de metas a largo plazo que en las profesiones sanitarias están reguladas por organismos profesionales y gubernamentales (Glynn et al., 2011).

2.2 El autoaprendizaje y sus componentes en la didáctica de las ciencias experimentales y de la salud

En la actualidad el sistema educativo español en el ámbito universitario se encuentra inmerso en el proceso de construcción del Espacio Europeo de Educación Superior (EEES), lo que supone tanto una nueva configuración de la estructura de los estudios superiores como un cambio de concepción de los contenidos profesionales hacia un enfoque competencial a la hora de perfilar los currículo de las titulaciones universitarias (López Nuñez et al 2010). En este nuevo paradigma educativo, existe el reto de caminar hacia un modelo de docencia más centrada en el proceso de aprendizaje de los estudiantes de modo que se facilite el desarrollo de las competencias. En consecuencia se trata de instaurar un proceso de enseñanza-aprendizaje en el que exista una participación activa del alumno. El Comité Consultivo para la formación de médicos de la Unión Europea, al amparo de las Directivas Europeas existentes al respecto (75/363 y 364 CEE), ha establecido, asimismo, que el alumno ha de ser el eje fundamental en el proceso formativo y debe, como consecuencia de ello, adquirir un conjunto de competencias específicas relacionadas con el saber y el saber hacer en las actividades vinculadas a su desempeño profesional. En el ámbito de la medicina y de las ciencias de la salud resulta asimismo fundamental adquirir competencias transversales absolutamente necesarias para el desempeño eficaz de su actividad profesional (Carreras, 2008).

Frente al paradigma tradicional que centra el eje de la enseñanza sobre la tarea del profesor, el Espacio Europeo de Educación Superior (EEES) y el Comité Consultivo para la formación de Médicos, promueven el desarrollo y el impulso del autoaprendizaje como instrumento para el logro de los objetivos arriba indicados. Analizar la naturaleza y los componentes del autoaprendizaje en la didáctica de las ciencias experimentales y de la salud constituye por tanto, en estos momentos, uno de los objetivos de investigación más importantes para la implementación del Espacio Europeo de Educación Superior.

El autoaprendizaje en sus distintas variantes se ha relacionado e interpretado en el marco de distintas teorías y conceptos educativos en el ámbito de las ciencias de la salud incluyendo entre otros, según Mann y Gelula (2003), la teoría de la educación de adultos, el constructivismo o los modelos de Schön y Kolb.

La teoría de educación de adultos parte del hecho de que los adultos muestran atributos vinculados con la madurez, la independencia, la responsabilidad, etc. y de que su aprendizaje está vinculado a su rol social y a su experiencia previa. Parece por tanto más apropiado para estudiantes adultos -y los estudiantes universitarios formalmente lo son- utilizar modelos de aprendizaje menos paternalistas que los que representan los modelos didácticos más tradicionales (Mann y Gelula, 2003; Beckert et al., 2003). La incardinación del autoaprendizaje en el constructivismo se debe a que el conocimiento no es el resultado de un trasplante a un espacio vacío sino que su adquisición requiere de una construcción sustentada en conocimientos y experiencias previas (Peter, 2000).

Los modelos de Schön y Kolb son congruentes con el autoaprendizaje en el sentido de que planteada una pregunta específica o general, que requiere conocimientos, actitudes y habilidades que los alumnos no poseen en sus áreas de dominio, estos se ven abocados a una sorpresa generadora del futuro aprendizaje. Los estudiantes van sucesivamente progresando a través de distintas fases adquiriendo conocimientos y habilidades retornando luego a la primera fase para comenzar el ciclo de nuevo (Svinicki Dixon, 1987; Schön, 1987; Borduas et al., 2001; Mann y Gelula, 2003).

Con independencia de la interpretación en el que el proceso de autoaprendizaje pueda incardinarse y de que dicha modalidad sea activamente recomendada para acceder al conocimiento de las ciencias experimentales y de la Salud, el propio concepto de autoaprendizaje y de su implementación sigue siendo difícil de definir y de valorar tanto por parte de los estudiantes como por parte de los educadores (Murad y Varkey, 2008; Murad et al, 2010).

En relación con los distintos elementos que deben caracterizar el autoaprendizaje Murad y Varkey (2008) han identificado, en continuidad con los criterios establecidos en su día por Knowless (1975), varios componentes que a juicio de dichos autores deberían estar presentes en cualquier proceso de autoaprendizaje vinculado a la didáctica de las ciencias experimentales y de la salud.

El primero es el papel del educador como facilitador del proceso. Aunque, como es sabido, el autoaprendizaje suele implicar la carencia de educador, los estudiantes necesitan a menudo que se les instruya en los principios del proceso de autoaprendizaje incluyendo la evaluación de las necesidades o el logro de las metas a alcanzar. El profesor es por tanto en el autoaprendizaje un facilitador de habilidades más que un suministrador de conocimientos (Abraham et al., 2005).

El segundo y el tercer componente a tener en cuenta en el proceso de autoaprendizaje en ciencias experimentales y de la salud son por un lado la identificación de las necesidades educativas y por otro el desarrollo de los objetivos de aprendizaje (Murad y Varkey, 2008). A este respecto Beckert et al., (2003) ha demostrado que el resultado del aprendizaje cuando está basado en las necesidades del estudiante y es autodirigido, es más eficaz que cuando está dirigido externamente. Los estudiantes según Stuart et al., (2005) trasladan las necesidades a objetivos y posteriormente los priorizan para facilitar la futura evaluación de su aprendizaje.

La identificación y elección de los recursos necesarios para el autoaprendizaje y el conocimiento del modo de implementar el proceso por parte de los alumnos constituyen también, a juicio de Murad y Varkey (2008), dos importantes componentes -el cuarto y el quinto- que deberían estar presentes en cualquier proceso de autoaprendizaje vinculado a las ciencias experimentales y de la salud. A este respecto la importancia de estos dos componentes en la eficacia y el éxito del autoaprendizaje ha sido puesta de relieve por distintos autores (Knowless, 1975; Stuart et al., 2005; Allen et al., 2005).

El compromiso con un denominado contrato de aprendizaje y la evaluación de este último conforman los dos últimos componentes identificados por Murad y Varkey

(2008) a partir de los trabajos iniciales de Knowles (1975). El contrato de aprendizaje es, según la descripción inicial de Fox y West (1983), el componente del proceso de autoaprendizaje que resulta del compromiso formal que elabora y asume el alumno, de acuerdo con su instructor, sobre todo aquello que debe aprender, sobre el modo de aprenderlo y sobre el modo en el que habrá de evaluarse el autoaprendizaje realizado. La existencia, por último, de un portfolio o cartera de aprendizaje que sirva para comprobar la adquisición de conocimientos, habilidades, actitudes y logros en el proceso de autoaprendizaje constituye de acuerdo con Parboosingh (1996) un componente asimismo esencial en este proceso formativo.

En los diferentes modelos de autoaprendizaje aplicados a las distintas materias y programas vinculados a las ciencias experimentales y de la salud se ha hecho más o menos énfasis en unos u otros de los componentes arriba enumerados sin que exista, de acuerdo con Murad y Varkey (2008) y Murad et al., (2011) una evaluación clara de la eficiencia o la prominencia de los distintos componente individualmente tratados. Si a ello añadimos la evidente interrelación que existe entre los distintos componentes del autoaprendizaje y los distintos componentes que participan en otros factores educativos, como por ejemplo la motivación, es fácil deducir que el ámbito de investigación en este campo esta extraordinariamente abierto.

2.3 La motivación y el autoaprendizaje en la docencia de la histología

Aunque la motivación en la educación de las ciencias de la salud (medicina, farmacia, odontología, etc.) se considera un factor fundamental para que los estudiantes logren el éxito académico y lleguen a ser buenos profesionales, la investigación educativa dirigida a la motivación en este campo es relativamente escasa (Mann et al., 1997; Crossley y Mubarik, 2002; Kusurkar et al., 2010, 2011, 2012). Esto es especialmente importante en relación con la motivación para aprender las ciencias básicas de la medicina -Anatomía, Histología, Fisiología, etc.- en los curricula de las ciencias de la salud.

Si como antes se ha comentado en el **apartado 2.1** la relación entre la motivación y el aprendizaje autoregulado es importante; el conocer la dimensión motivacional en el aprendizaje de estas ciencias es fundamental dado que las nuevas estrategias didácticas aplicadas a las mismas, a las que hemos hecho referencia en los apartados anteriores, hacen especial hincapié en los procesos de autoaprendizaje. A este respecto es importante recordar que el autoaprendizaje regulado ha sido interpretado como un proceso intrínseco cuyo motivo no es otro que disminuir la distancia entre el yo, percibido como real, y el yo ideal, lo que contribuye, sin duda, a facilitar un contexto de metas e identidades personales futuras (McCombs, 2001; Salmerón y Gutiérrez, 2012). A ello hay que añadir que un estudiante se esforzará mas y autorregulará mas si el contexto en el que aprende presenta actividades con significado y valores relevantes para alcanzar las futuras identidades que desea (Oyserman et al., 2004; Oyserman y Destin, 2010).

En consecuencia, solo conociendo la incidencia de la dimensión motivacional por un lado y los contextos educativos por otro podrán diseñarse instrumentos validos para mejorar con eficacia el proceso educativo en lo que a las ciencias experimentales y de la salud se refiere. Dada, por otra parte, la progresiva feminización de las profesiones sanitarias y la importante investigación al respecto que se lleva a cabo en nuestros días (Xie y Shauman, 2003; Hulsman et al., 2007), la incidencia del género en los distintos ámbitos del proceso educativo y especialmente en lo que respecta a la motivación y el autoaprendizaje debe ser un importante objeto de estudio.

Por todo ello y aunque la investigación sobre la motivación para aprender ciencia y sobre las modalidades de autoaprendizaje se ha incrementado en las dos últimas décadas es mucho lo que ha de investigarse en este campo sobre la incidencia y la interrelación entre una y otra en las distintas ciencias básicas presentes en los curricula de las ciencias de la salud (Osborne et al., 2003; Koballa y Glynn, 2007, Drake et al., 2009; Glynn y Koballa, 2006; Glynn et al., 2007, 2009).

La tesis que se presenta se sustenta en estos principios y objetivos y tiene como finalidad identificar en relación con la Histología, ciencia básica de los curricula de ciencias de la salud, los componentes motivacionales vinculados a su aprendizaje y a su didáctica y establecer a partir de ello una propuesta motivacional de instrumento pedagógico vinculada al autoaprendizaje.

II. OBJETIVOS

OBJETIVOS

OBJETIVO GENERAL:

- Analizar los componentes motivacionales vinculados al aprendizaje de la histología y a su didáctica en los curricula de ciencias de la salud con el objeto de establecer una propuesta motivacional desde el autoaprendizaje.

OBJETIVOS ESPECÍFICOS:

- Identificar los componentes de la motivación vinculados con el aprendizaje de la histología en los curricula de medicina, odontología y farmacia.

El objetivo se desarrolla en el artículo 1

- Identificar los componentes de la motivación vinculados a las modalidades didácticas de la histología sustentadas en el autoaprendizaje.

El objetivo se desarrolla en el artículo 2

- Desarrollar un instrumento pedagógico para la histología que articule la motivación vinculada al curriculum y la vinculada a las modalidades didácticas de autoaprendizaje.

El objetivo se desarrolla en los artículos 3 y 4.

III. METODOLOGÍA Y DISEÑO DE LA INVESTIGACIÓN

III. METODOLOGÍA Y DISEÑO DE LA INVESTIGACIÓN

En la presente Tesis Doctoral, se ha desarrollado una metodología descriptiva y de intervención basada en la utilización de cuestionarios sustentada en los criterios establecidos para el método científico en el ámbito de la investigación educativa (Cohen y Manion, 1990). A este respecto, el método ha de ser adecuado al tipo de objeto de estudio y problema planteado y ha de insertarse en el contexto de los tres grandes bloques fundamentales de la investigación social (Colás Bravo, 1994) el cuantitativo, el cualitativo y el enfoque crítico. En la presente Tesis Doctoral, se ha abordado el enfoque cuantitativo para dar respuesta a los objetivos planteados en la misma.

La utilización de los cuestionarios aplicados a la presente investigación permitió la recogida de información durante un período de tiempo de corta duración, con el objetivo de captar ciertos fenómenos presentes en el momento de la realización de la encuesta (Anguera, 1995). La metodología por encuesta posee las siguientes ventajas que encajan perfectamente con los objetivos de nuestra investigación (Buendía, 1997):

- Se pueden generalizar los resultados a una población definida por ser mayor el número de elementos que forman la muestra que en otras metodologías.
- Es una alternativa válida cuando no se puede acceder a toda la población.
- Es la metodología más indicada para recoger opiniones, creencias o actitudes.

Los estudios de encuesta tienen como principales objetivos describir la naturaleza de las condiciones existentes, identificar valores estándar con los que poder comparar las condiciones existentes y determinar las relaciones existentes entre eventos específicos (Colás Bravo, 1992). Otra ventaja que nos ofrecen los estudios de encuesta mediante el uso de cuestionarios es que no solamente se puede llegar a caracterizar a una población sino que, además, se pueden establecer comparaciones entre los sujetos estudiados en función de las variables establecidas en el cuestionario (Bisquerra, 1989).

En la presente Tesis Doctoral se han utilizado cuestionarios específicos diseñados y validados previamente, así como cuestionarios *ad hoc* que, en el caso de la investigación en ciencias sociales, constituyen la práctica habitual cuando no se dispone de otros instrumentos de recogida de información adaptados al contexto específico en el que se desarrolla la investigación (López Núñez et al., 2010).

Los datos técnicos de los cuestionarios se encuentran recogidos en cada uno de los artículos, aunque en todos ellos se ha seguido el mismo protocolo de actuación:

1.- Dotar de validez a los instrumentos. Se ha conseguido mediante el juico de expertos tanto del área de Didáctica como del área de Histología. De esta forma, la validez de constructo de los cuestionarios ha quedado garantizada.

2.- Calcular la fiabilidad de cada uno de ellos mediante procedimientos estadísticos (siempre con un valor superior a 0,7).

3.- Selección de la muestra cumpliendo siempre los parámetros de representatividad.

A continuación, describimos las características generales de la metodología utilizada a través de cuestionarios, así como el análisis estadístico aplicado en cada caso. Dicha metodología y dichos análisis estadísticos se detallan pormenorizadamente en el apartado *Materiales y Métodos* de los trabajos presentados que conforman la Tesis Doctoral:

1 Metodología

1. En relación con la metodología desarrollada para alcanzar el primer objetivo (artículo 1 de la Tesis Doctoral), se ha utilizado el cuestionario previamente validado *Science Motivation Questionnaire II* (SMQII) (Glynn et al., 2011) adaptado a la enseñanza de la Histología. Este cuestionario tiene por objeto evaluar los diferentes componentes de la motivación para aprender ciencia, y ha sido aplicado a los estudiantes de Histología de los Grados en Medicina, Farmacia y Odontología.

2. Para alcanzar el segundo objetivo (artículo 2 de la Tesis Doctoral), se utilizaron dos cuestionarios desarrollados *ad hoc* adaptados al contexto donde se desarrolla la investigación (López Núñez et al., 2010). El primero de estos cuestionarios tenía como objeto evaluar la motivación del estudiante hacia el aprendizaje receptivo y el autoaprendizaje. El segundo cuestionario se utilizó para evaluar las distintas estrategias de aprendizaje complementario que sigue el alumno tras la utilización de las dos modalidades de aprendizaje arriba indicadas.

3. En relación con el tercer objetivo (artículos 3 y 4 de la Tesis Doctoral), se utilizaron, respectivamente,

- Para evaluar la percepción de los alumnos y profesores sobre la elaboración de un cuaderno audiovisual como instrumento pedagógico para el autoaprendizaje (artículo 3), cuatro cuestionarios elaborados *ad hoc* adaptados al contexto donde se desarrolla la investigación (López Núñez et al., 2010). Estos cuatro cuestionarios se emplearon para evaluar la información, las imágenes, el texto y la música y la realización fílmica del cuaderno audiovisual.

- Para evaluar la percepción de los alumnos sobre el empleo de la microlección como instrumento pedagógico para el autoaprendizaje (artículo 4), dos cuestionarios elaborados *ad hoc* adaptados al contexto donde se desarrolla la investigación (López Núñez et al., 2010). Ambos cuestionarios evaluaban las estrategias que el alumno utilizaría tanto para elaborar como para exponer una microlección antes y después de la implementación de dicho instrumento pedagógico.

2 Análisis estadístico

Para el análisis de los datos, en todos los casos, se calcularon medidas centrales y de dispersión (medias y desviación estándar) para cada grupo de estudiantes. Para la comparación de los resultados entre diferentes grupos de estudiantes, se utilizaron las siguientes pruebas estadísticas:

- Para determinar la normalidad de las distintas distribuciones, se utilizó la prueba estadística de Kolmogorov-Smirnov.

- Para la comparación por pares de los resultados obtenidos mediante el SMQII y los cuestionarios correspondientes a los cuadernos audivisuales y las microlecciones, se utilizó el test no paramétrico de Mann-Whitney.

- Para comparar varias variables no paramétricas entre sí, se aplicó la prueba estadística de Kruskal-Wallis. Específicamente, esta prueba se utilizó para comparar globalmente los cuatro cuestionarios diseñados para evaluar la percepción de alumnos y profesores en relación con la elaboración de un cuaderno audiovisual.

- Para la comparación de los resultados correspondientes a los cuestionarios de motivación hacia el aprendizaje receptivo y el autoaprendizaje y de estrategias de aprendizaje complementario en histología, se utilizó la prueba estadística del análisis de varianza (ANOVA).

- Para el análisis de correlación entre diferentes variables, se utilizó la prueba estadística tau de Kendall.

En todos los casos, se consideraron estadísticamente significativos los valores de *p* inferiores a 0,05 para los tests de doble cola.

IV. ARTÍCULOS CIENTÍFICOS Y DOCUMENTOS RELACIONADOS CON LOS OBJETIVOS DE LA TESIS

ARTÍCULOS CIENTÍFICOS Y DOCUMENTOS RELACIONADOS CON LOS OBJETIVOS DE LA TESIS

1. Motivational component profiles in university students learning histology. A comparative study between genders and different health science curricula

Campos-Sánchez A, López-Núñez JA, Carriel V, Martín-Piedra MA, Sola T, Alaminos M.

Documentación inédita para la tesis

2. Reception learning and self-discovery learning in histology: students' perceptions and their implications for assessing the effectiveness of different learning modalities.

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

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4. Microteaching as a self-learning tool. Students´perception in the preparation and exposition of a microlesson in a tissue engineering

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TITLE:

Motivational component profiles in university students learning histology. A comparative study between genders and different health science curricula

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Abstract

Background: The students' motivation to learn basic sciences in health science curricula is poorly understood. The purpose of this study was to investigate the influence of different components of motivation (intrinsic motivation, self-determination, self-efficacy and extrinsic -career and grade- motivation) on learning human histology in health science curricula and their relationship with the final performance of the students in histology.

Methods: Glynn Science Motivation Questionnaire II was used to compare students' motivation components to learn histology in 367 first-year male and female undergraduate students enrolled in medical, dentistry and pharmacy degree programs.

Results: For intrinsic motivation, career motivation and self-efficacy, the highest values corresponded to medical students, whereas dentistry students showed the highest values for self-determination and grade motivation. Genders differences were found for career motivation in medicine, self-efficacy in dentistry, and intrinsic motivation, self-determination and grade motivation in pharmacy. Career motivation and self-efficacy components correlated with final performance in histology of the students corresponding to the three curricula.

Conclusions: Our results show that the overall motivational profile for learning histology differs among medical, dentistry and pharmacy students. This finding is potentially useful to foster their learning process, because if they are metacognitively aware of their motivation they will be better equipped to self-regulate their science-learning behavior in histology. This information could be useful for instructors and education policy makers to enhance curricula not only on the cognitive component of learning but also to integrate students' levels and types of motivation into the processes of planning, delivery and evaluation of medical education.

Keywords: motivation, components, curriculum, histology, health sciences

Background

The affective or motivational dimension of the educational process is important because of its influence on students' learning behavior. Motivation affects the not only the decision to begin, persevere in or end a specific learning behavior, but also the choice of a specific behavior [1]. Accordingly, motivation constitutes a key element in education research, and many theories have been put forward to account for the nature and influence of motivation in the learning process [2-4].

According to Social Cognitive Theory [5, 6], motivation is understood as a series of reciprocal interactions among environmental contexts, behaviors and personal characteristics [7]. This theory views students' learning as most effective when, according to Glynn et al. [8], it is self-regulated, which occurs when students assume conscious control over their motivation and behavior in a way which leads to desirable learning outcomes. Within this theoretical framework, the motivation to learn science is defined as an internal state that maintains science-learning behavior, and as a multicomponent construct made up of, among other components, intrinsic motivation, extrinsic motivation, self-determination and self-efficacy [3, 8]. All components that favor motivation contribute to the establishment of students' science-learning behavior and therefore to the outcomes of the learning process.

Motivation is recognized as an important factor in health science education because it helps students achieve good academic performance, well-being and satisfaction, and also helps them to become good professionals. However, research that centers on motivation in the health science disciplines is scarce [9-11]. This factor is especially important in learning basic sciences such as gross anatomy, histology and physiology in health science curricula. Although research on students' motivation to learn science has increased during the last two decades, little attention has focused on motivation to learn basic sciences that are considered essential requirements in health science curricula [12-15].

Human histology is a branch of Biology and Health Sciences dealing with the study of levels of organization that are intercalated between the atomic-molecular level (Biochemistry) and the gross morphological level (Anatomy) in the human body. Medical, Dentistry and Pharmacy programs include histology as part of their basic or preclinical curricula [16-18]. Although histology has traditionally been taught as a lecture- and microscopy-based course, new approaches have recently been used to emphasize self-learning processes such as virtual microscopy, team-based peer teaching and learning, and clinical-histologic conferences [19-21]. Nonetheless, histology is perceived by students as an abstract subject which is generally difficult to understand, and many students find it challenging to connect theory with practice [22]. Furthermore, health sciences students often fail to appreciate the relevance of learning and understanding the normal structures and functions of the body for their future clinical or professional activities [17, 23].

Research into the motivations to learn science has thus far paid little attention to basic sciences in the health science curricula [24]. Motivation is especially important in human histology not only because of the conceptual difficulty of the subject, but also because of the difficulty of projecting the affective factors associated with its applications to medicine and other health sciences to the learning process [25]. As a result, the influence of different components of motivation (e.g. intrinsic motivation, self-determination, self-efficacy and extrinsic motivation) on human histology learning in health science curricula is poorly understood.

In the present study we investigated male and female students' motivations to learn human histology in medical, dentistry and pharmacy curricula. We approached this topic not only as a general issue but also as a platform to determine which components of motivation influence different groups of students in different degree programs. As noted by Brian et al. [7], the different components of motivation have been studied in science education, but usually alone rather than in relation to each other. A goal of the present study, therefore, was to investigate the interrelations among different components in students of human histology enrolled in three different undergraduate health science programs, and to determine if the components of motivation are related to histology course performance. Because different components of motivation can influence students' science-learning behavior, knowledge about the influence of each component will be useful to more effectively foster students' motivation to learn histology in health sciences [7, 26].

Methods

Sample

The study was done at the School of Medicine, School of Dentistry and School of Pharmacy at the University of Granada in Granada, Spain. The sample consisted of 367 first-year undergraduate students (average age 18 years) enrolled in the histology course that formed part of their medical, dentistry or pharmacy curriculum in accordance with European Union regulations. There were 132 participants (43 males and 89 females) at the medical school, 125 (44 males and 81 females) at the dentistry school and 110 (31 males and 79 females) at the pharmacy school. All participants agreed to participate in the study, which was approved by the Ethics and Research Committee of the University of Granada. The students' participation was voluntary and consistent with the procedures of the university research review boards. The students were given no extra credit or compensation for participating. They were informed that their participation would help improve histology instruction. The final performance of the students in the histology subject was recorded at the end of the course to be used in the study.

Instrument

To evaluate the different components of the motivation to learn histology in students at the medical, dentistry and pharmacy schools, all participants responded to the Science

Motivation Questionnaire II (SMQII) [8], which uses five items to assess each of the five components of motivation: intrinsic motivation, self-determination, self-efficacy, career motivation and grade motivation. As recommended by DeVellis [27], the items were randomly sorted, strongly worded, unambiguous declarative statements in the form of short, simple sentences without jargon. Students rated each item on a five-point type scale: never, rarely, sometimes, often or always. The questionnaire was administered during classroom instruction. The students were first briefed on the purpose of the instrument and given instructions about how to complete the questionnaire, which took about 15 min to complete. The questionnaire was used with permission from the SMQII website hosted by the University of Georgia at http://www.coe.uga.edu/smq/.

Statistical analysis

Average values and standard deviations were calculated for each item at each group of students and for each gender. Mean values were also calculated for each component of motivation. To compare the results between males and female students or between two different curricula (medicine vs. dentistry, medicine vs. pharmacy and dentistry vs. pharmacy) we used the Mann-Whitney test. Finally, to determine if the final performance of the students in each curriculum was correlated with the components of motivation, we used the Kendall tau correlation test.

All statistical analyses were two-tailed and values of p less than 0.05 were considered statistically significant.

Results

The average scores obtained for each component and for each item in each group of students (medicine, dentistry and pharmacy) are shown in Table 1, whereas the overall mean scores for each component of motivation are shown in Table 2. For the intrinsic motivation component, the overall mean score was 3.48 ±1.00 in medical students (MS), 3.07 ± 1.03 (mean ± standard deviation) in dentistry students (DS), and 3.42 ±

1.07 in pharmacy students (PS). For the career motivation component the results were 3.91 ± 0.92 in MS, 3.63 ± 1.05 in DS, and 3.39 ± 1.09 in PS. For the self-determination component the scores were 3.88 ± 0.89 in MS, 3.89 ± 0.95 in DS, and 3.54 ± 1.09 in PS. For the self-efficacy component the scores were 3.83 ± 0.94 in MS, 3.79 ± 0.92 in DS, and 3.72 ± 1.05 in PS. For the grade motivation component the results were 3.87 ± 1.05 in MS, 4.01 ± 1.07 in DS, and 3.68 ± 1.17 in PS. Figure 1 compares the data for each of the five components of motivation in each of the three groups of students according to degree program.

Statistical analysis showed that there were significant differences ($p<0.05$) for the three comparisons between groups of students in the overall mean scores for components 2 and 5 (medicine vs. dentistry, medicine vs. pharmacy and dentistry vs. pharmacy students). In addition, we found significant differences in component 1 scores between dentistry and pharmacy students, and between dentistry and medical students. Significant differences ($p<0.05$) were also found in component 3 scores between medical and pharmacy students, and between dentistry and pharmacy students (Table 3). Furthermore, significant differences were found for several specific items corresponding to all 5 components (Table 3).

Moreover, significant differences ($p<0.05$) between genders were found in medical students in overall mean scores for component 2, in dentistry students for component 4 and in pharmacy students for components 1, 3 and 5 (Table 4). In addition, significant differences ($p<0.05$) were found for several specific items corresponding to components 1, 3, 4 and 5 (Table 4).

When the overall mean scores for the different components were correlated with the final performance in histology of the students corresponding to the three curricula, we found a significant positive correlation ($p<0.05$) for the components 2 and 4. Specifically, all 5 items in component 2 were positively correlated ($p<0.05$) with performance, whereas items 2, 4 and 5 were correlated with performance in component 4.

Discussion

Evaluating the main components of motivation for learning histology in medical, dentistry and pharmacy students is important because it can help instructors to help their students, aid in monitoring their motivation to learn science, and support efforts to better organize collaborative learning activities based on an appropriate selection of highly motivated students [21]. In this connection it is worth noting that the elements essential for stimulating motivation in health science students appear to be absent as a primary aim in many curricular plans [1].

Recent studies [8, 13, 28, 29] have provided substantial contributions to research on the motivations to learn science, and have yielded a validated questionnaire to assess these motivations with a set of observable variables (items) that serve as empirical indicators. The items in the SMQII developed by Glynnn et al. [8] and used in this study were designed to serve as empirical indicators of components of students' motivation not only to learn science in university courses but also to learn a specific science discipline. The instrument is readily adapted to specific disciplines by replacing the word "science" in each item with the name of the discipline of interest, as noted by Glynn et al. [8]. In the present study we used the word "histology" instead of "science" to focus on this specific course, which is taught as part of three different undergraduate health science degree programs at our university. We previously used basic criteria reported previously [30] to verify that each item was representative for the target discipline, which is taught by instructors from the same department at the University of Granada.

The five components of motivation we studied in university students enrolled in three different degree programs were those identified previously by Glynn et al. [8].

Inherent satisfaction reflects the satisfaction derived from the process itself of acquiring new knowledge; self-determination refers to the control students believe they have over their science learning; self-efficacy refers to students' belief that they can achieve well in science; and extrinsic motivation involves learning science as a means to a concrete end. Several authors have investigated these components in other science disciplines and reported that they are important elements of motivation, and thus influence behavior and self-regulation in students' learning process [31-33].

One of the innovative aspects of the SMQII is the transformation of the classical scale termed extrinsic motivation (or ‘‘learning science as a means to a tangible end") into two scales, i.e. grade motivation and career motivation, which more clearly target the objectives that students perceive to be important in this stage of their education. This is especially important in health science education because the motivation to learn health science disciplines is influenced differently by short-term goals such as obtaining a high course grade and long-term goals such as success in their professional career practice, which in health science professions is explicitly regulated by professional and government bodies.

The results of the present study show that in relation specifically to learning histology, the profiles for components of motivation defined as career motivation and self-efficacy were similar in all three degree programs. The scores for both components were highest in the group of medical students, followed in decreasing order by dentistry and pharmacy. In the career motivation component there were significant differences when the overall mean scores for the three groups were compared (medicine vs. dentistry, medicine vs. pharmacy and dentistry vs. pharmacy students) whereas differences were not significant in self-efficacy. Interestingly, both profiles were positively correlated with the students' final performance in histology, pointing out that the extent of career motivation and self-efficacy are clearly influencing the final outcome of the students in histology. The relationship between these two components of motivation and their correlations with each of the three groups of students reflects the relationship between the primary long-term goals that students focus on, which is what characterizes career motivation, and students' beliefs about their capabilities in a specific area (e.g. histology), which is what characterizes self-efficacy and influences the choice of activities that allow individuals to decide which tasks to focus on [34-38].

In the health professions the long-term goal of professional career practice is an important component of motivation, which is related more closely with future competencies to be used in regulated professional practice than with knowledge and skills to be acquired in the learning process during university study. In this regard our results are consistent with several studies which found that compared to dentistry students, medical students had a more professional attitude, whereas dentistry students showed a greater commitment to personal and financial gain (9, 39, 40]. Regardless of these observations, the higher scores in our group of medical students are most likely related with a more highly developed system of regulations for professional practice. The lower scores among pharmacy students are most likely related with the fact that this area, according to Figgs and Cox [16] is a profession that lends itself to many career avenues. The intermediate scores in our group of dentistry students are most likely related with the lack of a sense of public service among these students – a perception that results in attitudes detrimental to the public perception of the dental profession as a whole [9]. The results we obtained with the SMQII for histology learning are consistent with our earlier finding of a high level of motivation for professional practice among medical students who were offered a choice of different learning methods [25].

In the present study the self-determination and grade motivation components yielded a similar motivational profile in all three groups of students. Mean scores for these components were highest in dentistry, followed in decreasing order by medicine and pharmacy. The differences between degree programs were statistically significant for the grade motivation, and between pharmacy and medicine students and between pharmacy and dentistry students for self-determination. The similarities in the response profiles for these components among the groups shows that a relationship exists between self-determination, and hence the control that students believe they have over their learning process, and the grade motivation, that is, the short-term primary goals of students enrolled in different degree programs. It is therefore unsurprising that dentistry students scored highest in both of these components of motivation, especially in grade motivation. Our results suggest, as Boiche et al. [41] showed for physical education, an adaptive role for the self-determination component of motivation towards histology among dentistry and medicine students, with high levels of self-regulation thanks to which individuals do not act without feelings of control or competence to achieve success during their undergraduate degree program. Self-determination, i.e. the option to control the learning process for histology and therefore to self-regulate this activity during undergraduate education, is seen by dentistry and medicine students as a more attainable goal under these circumstances. When the overall mean scores for these two components were correlated with the final performance in histology of the students corresponding to the three curricula, we did not found a significant correlation. This could mean that self-determination and grade motivation will not determine the final score of the students enrolled in the histology matters.

The use of this questionnaire allowed us to analyze independently the two major components of the extrinsic motivation -career motivation and grade motivation-. Our data illustrates clear differences in the results obtained for these components among groups of students, and suggests that it may be possible to identify relationships between components that might otherwise be overlooked. In addition, our results show that both components have different influence on motivation for learning histology in health sciences curricula. Whereas the career motivation, which showed the same profile that self-efficacy, was correlated with the final outcome of the students, grade motivation, whose profile was similar to that of self-determination, was not correlated with the final performance.

Finally, intrinsic motivation showed the highest mean scores in medicine, followed in decreasing order by pharmacy and dentistry. The differences between medical and pharmacy students vs. dentistry students were statistically significant. The lower mean scores for this component in dentistry students vs. medicine and pharmacy students is likely related with the general perception, supported by several studies, that there is no statistical correlation between the amount of undergraduate basic science education and performance in dentistry school or on board exams, although dentistry graduates and practitioners do perceive the importance of these science a posteriori, including histology [17, 42]. No correlation with the final histological performance was found for this component, thus confirming that this important component of motivation is not as relevant as career motivation and self-efficacy for the academic achievement.

Regarding the differences between genders, our results suggest that only one of the components of motivation was different in the case of medicine and dentistry students, although three components were statistically different in pharmacy students. Although Hulsman et al. [43] reported no differences between males and females in the strength of motivation, more recent work by Kusurkar et al. [44], showed that strength of motivation appears to be a dynamic entity, changing primarily with age and maturity and to a lesser extent with gender and experience. In the present study we found no differences between male and female medical students for any of the components except career motivation, which was higher in male than in female students, although none of the specific items in this component was significantly different between males and females. Among dentistry students there were no gender differences for intrinsic motivation, career motivation, self-determination and grade motivation, whereas men and women differed with regard to self-efficacy. Among pharmacy students we found gender differences for intrinsic motivation, self-determination and grade motivation but not for self-efficacy or career motivation. Although the differences between genders in the motivation to learn sciences remain poorly understood, they may result from factors such as role modeling and socialization by parents, teachers, peers and the media, and not from “innate or natural differences” between women and men [7, 8, 45].

Our findings with regard to the relative influence of different components of motivation in different groups of health science undergraduates are potentially useful in future efforts to answer some interesting questions. For example, are there gender differences in how students self-regulate in order to control their motivation and behavior? What role do the different components of motivation play in the overall motivation of males and females to perform well in these degree programs?

The motivational process is a substantially undervalued factor in curriculum development [1]. Because the motivation to learn, as conceptualized in social cognitive theory, is a multicomponent construct, determining the role of each component of motivation is useful not only to help individual students succeed in the learning process according to their motivational background, but also to help instructors develop appropriate teaching strategies based on their knowledge of specific motivational profiles among students enrolled in different programs.

A strength of our study is that the histology course of interest was taught with the same methods by instructors from the same department to all participants, who were enrolled in different undergraduate programs at the same university. We do not know to what extent we can generalize our findings, but we feel our results contribute to our knowledge about the close relationships among different components of motivation in specific disciplines within different health sciences curricula. Ultimately, these findings can support improved efforts to develop more effective medical education curricula.

Conclusions

Our results show that our histology students enrolled in each of three undergraduate health science programs differed in their personal motivational profiles. This finding is potentially useful to foster their learning process, because if they are metacognitively aware of their motivation they will be better equipped to self-regulate their science-learning behavior in histology. But our results also show that the overall motivational profile for learning histology differs among medical, dentistry and pharmacy students, and that instructors as well as education policy makers can use their awareness of these differences to enhance curricula so that they focus not only on fostering the cognitive component of learning but also integrate students' levels and types of motivation into the processes of planning, delivery and evaluation of medical education. Although the differences between genders were not significant for many of the components of motivation, certain differences stand out. These differences suggest a need to increase our knowledge of possible variations and take advantage of them in developing both individually-targeted and curriculum-based teaching processes.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

ACS participated in the design of the work, analysis of the results, discussion and writing the manuscript.

JALN contributed to the study design, selection of literature and critical review of the manuscript.

VC took part in the analysis and interpretation of the data, and literature review.

MAMP participated in data collection and management of the results.

TS contributed to writing the manuscript and critical review of the literature.

MA contributed to design the work and interpret the data, revising the article and critically appraising the content.

All authors have approved the final version of the article submitted.

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Reception Learning and Self-Discovery Learning in Histology: Students' Perceptions and Their Implications for Assessing the Effectiveness of Different Learning Modalities

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Two questionnaires were used to investigate students' perceptions of their motivation to opt for reception learning (RL) or self-discovery learning (SDL) in histology and their choices of complementary learning strategies (CLS). The results demonstrated that the motivation to attend RL sessions was higher than the motivation to attend SDL to gain new knowledge ($P < 0.01$) and to apply this acquired knowledge to diagnosis ($P < 0.01$), therapy ($P < 0.01$), and research ($P < 0.05$). Students also showed a stronger preference for RL based on motivations related to leadership ($P < 0.01$) and competition ($P < 0.01$), although the rates were very low in both cases ($\leq 1.9 \pm 1.1$). Statistically significant differences were found between male and female students for leadership (higher in males), responsibility (higher in females), and acquiring new knowledge (higher in females only in RL). This study's findings for students' preferred CLS strategies suggested a greater need for additional complementary resources after RL than after SDL ($P < 0.01$). In conclusion, RL was associated with a greater need for complementary training resources such as textbooks, atlases, the internet, audiovisual media, and tutorials, whereas SDL was associated with a greater need to orient teaching and training toward medical practice. These results suggest the need to reorient both types of learning processes to enhance their effectiveness in teaching histology, especially in the case of SDL, which should place more emphasis on clinically oriented knowledge. Anat Sci Educ 5: 273–280. © 2012 American Association of Anatomists.

Key words: histology education; microscopic anatomy; reception learning; self-discovery learning; complementary learning strategies; motivation; students' perceptions; application to medicine

INTRODUCTION

The student's role in the learning process has been examined from many different points of view in recent decades (Sandoval and Harven, 2011). Students' motivations, beliefs, and perceptions are variables or constructs that form the foundation of their learning processes (Schommer, 1990; Schommer et al., 1997; Sandoval, 2005; Koballa and Glynn, 2007; Çam and Geban, 2011; Chan, 2011). These constructs, also known as students' characteristics, can be defined as the way in which students conceptualize and relate to the learning process and are assumed to affect their learning and achievements (Nolen, 1988; Wolters, 2004; Mattern, 2005). Students' perceptions are constructs that refer in particular to students' expectations regarding the tasks in which they should acquire skills.

Although some students' characteristics, particularly their epistemological beliefs, attitudes, and perceptions, have been investigated in some disciplines, most studies have focused on assessing these characteristics in the context of teaching or learning activities at different levels of education or other aspects of science learning (Schommer, 1990; Schommer

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et al., 1997; Koballa and Glynn, 2007; Çam and Geban, 2011; Chan, 2011; Sandoval and Harven, 2011). On the other hand, 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 (Norman, 2002). Education research in basic medical sciences like anatomy, histology, and physiology has centered mainly on improved teaching methods (Rao and DiCarlo, 2001; Khalil et al., 2010; Higazi, 2011; Vorstenbosch et al., 2011), and it is only in recent years that students' perceptions have become a focus of research as an important factor in learning and academic achievement (Higgins-Opitz and Tufts, 2010; Ivanusic et al., 2010).

Medical histology is a basic science that deals with concepts and facts regarding the structure of the human body. 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 (Stevens and Lowe, 2005; Shaw and Friedman, 2012). Histology has traditionally been taught as a lecture- and microscopy-based course (Hightower et al., 1999). However, new approaches have recently been implemented that emphasize self-learning processes. Among these approaches, virtual histology is becoming increasingly important in medical schools around the world (Husmann et al., 2009; Paulsen et al., 2010; Shaw and Friedman, 2012), not only because this method places 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 paradigm for teaching histology (Pinder et al., 2008; Shaw and Friedman, 2012).

Reception learning (RL) and self-discovery learning (SDL) are the main approaches that have been used to teach histology in medical and health science institutions (Hightower et al., 1999). RL is based on the participation of an instructor or professor, who communicates to students a systematized set of information about the topic being taught (O'Brien and Shapiro, 1977). 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. In contrast, SDL 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 (Sudzina, 1997; Harris et al., 2001; Drake et al., 2009). 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 (Hightower et al., 1999).

Knowledge about students' perceptions and motivations that lead them to prefer RL or SDL approaches, as well as their preferences for CLS, is necessary to better understand students' learning processes in medical histology (Hilliard, 1995). Different studies have identified several factors that may influence the educational process significantly, including gender, attitude, and the instructional methods used (Barnes et al., 2005; Golda, 2011). A further consideration is that in medical education, gender issues have become more important for academicians, health administrators, and society in general, mainly because of the increasing feminization of the medical profession. In this connection, some studies have found that female undergraduate students usually achieve better results than their male peers in basic and clinical sciences, based on comparisons of course grades (Hedges and Nowell, 1995; McDonough et al., 2003; Castagnetti and Rosti, 2008).

Although morphological sciences like histology are an important part of the medical core curriculum not only in the United States but also in Europe, students' perceptions of the learning methods used in educational processes have been little investigated (Bacro et al., 2010; Ivanusic et al., 2010). This study seeks to investigate male and female students' perceived preferences for RL or SDL in a medical histology course. An additional investigation was performed on students' preferences for different types of CLS after the undergoing above learning processes.

METHODS

Study Design

This study was performed at the Medical School of the University of Granada in Granada, Spain. The sample consisted of 236 first-year undergraduate medical students enrolled in the "Medical Histology" course, a core course in the basic medical degree program. The undergraduate program consists of six academic years in accordance with European Union regulations. The average age of the participants was 18.7 years. The male/female ratio of students enrolled in the study was 93/143 individuals (39.4% vs. 60.6%). 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.

Some units were taught with the RL method with lectures by one or more professors, and the remaining units were taught with an SDL method based on self-learning with a specially designed guidebook in which the objectives of each session (unit) were specified. The order of the RL and SDL units was identical, and all students received part of the course with the RL method and the other part with SDL simultaneously. Each student received both methods during the course without interruption or switching. With the RL method, 30 one-hour lecture sessions were used, and these were taught in groups of 80 students in lecture halls. With the SDL method, 25 sessions were held with groups of 10 students. Both methods were implemented during the "Medical Histology" course (4 months). In the SDL method, the students used light microscopes to examine a set of glass slides by themselves in the histology laboratory. An instructor previously showed students how to use the microscopes and was available in case students required the instructor's presence.

This design ensured that all participants took part in learning medical histology with both methods. All sessions were given equal importance, and RL lectures were not available for future viewing. After each learning method, students were offered the opportunity to complete their training with a choice of several complementary resources, including, among others, books and internet web pages.

Each student completed two different questionnaires. The first was completed before they took part in RL or SDL sessions and was used to evaluate the students' perceived motivation to attend sessions designed with each learning method. The first questionnaire consisted of a single item "What is your motivation to attend this session?" with ten possible answers that the students were asked to rate. These ten options were selected based on the two different conceptions of learning described previously by other authors (Marton et al., 1993; Purdie and Hattie, 2002): learning to increase knowledge and learning as personal fulfillment. The following five options were related to the first type of learning conception: "I like to learn new things," "It is useful to learn how to diagnose," "It is useful to learn therapy," "I like research," and "It will allow me to correlate theoretical and practical knowledge." The other five options corresponded to learning as personal fulfillment: "I am attending just because it is mandatory," "Sense of responsibility," "I want to fulfill my obligations," "I want to compete with the rest of the students in my class," and "I want to be a leader."

The second questionnaire was designed to assess students' preferences for CLS to complete and enhance the knowledge acquired with each learning method and was completed after RL and SDL teaching. In this questionnaire, the students were asked to answer the question, "How would you complete and enhance the training you received?" by choosing among the following eight options: "Consult a histology atlas," "Consult a textbook," "Consult images publically available on web sites.," "Consult internet images available on the department website," "Personally consult my professor in a tutorial session," "Consult my professor by e-mail," "Review the slides again in a new theoretical/practical session," and "Review the slides again by myself." These options were selected because they corresponded to the most widely used pedagogical methods for teaching and learning histology and other university subjects.

The students completed the first questionnaire ("What is your motivation to attend this session?") before they took part in the RL or SDL activity. The second questionnaire ("How would you complete and enhance the training you received?") was completed after the RL and SDL activities had been completed. The responses in both instruments were recorded with a symmetric agree-disagree Likert-like scale on which students indicated their level of agreement or disagreement for each option (ten in the first questionnaire, eight in the second). Each participant rated each option on a five-point Likert scale from 1 to 5, with each score corresponding to the following level of agreement: 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree. The options evaluated in each questionnaire are shown in Tables 1 and 2.

Statistical Analysis

For each questionnaire and educational approach (RL versus SDL), average results and standard deviations were calculated for each option and all participants, as well as for each gender, separately. To identify statistically significant differences between male and female students and between the RL and SDL approaches, the responses for each option were compared with analysis of variance (ANOVA). Comparisons were done for all participants as well as for each gender separately. All tests were two-tailed, and a P value below 0.05 was considered statistically significant.

RESULTS

Students' Perceived Preference for RL or SDL

As shown in Table 1, the options "I want to compete with the rest of the students in my class" and "I want to be a leader" scored lowest after both RL and SDL (1.9 ± 1.1 and 1.5 ± 0.9, respectively). The highest scores for the RL group corresponded to options related to the usefulness for learning therapy (4.5 ± 0.7) and how to diagnose (4.5 ± 0.8), whereas the highest scores in the SDL group were given to the option "It will allow me to correlate theoretical and practical knowledge" (4.3 ± 0.9).

Interestingly, ANOVA revealed statistically significant differences between male and female students regarding three of the options: "Sense of responsibility" and "I want to be a leader" in both the RL and SDL groups, and "I like to learn new things" in the RL group (Table 1 and Fig. 1). No statistically differences were found between males and females for the rest of the options.

When a comparison was undertaken of scores assigned by the students to each option in the RL group with the scores of each option in the SDL group (Table 1), the groups differed significantly for seven of the ten options for all students (males and females): "I like to learn new things," "I am attending just because it is mandatory," "I want to compete with the rest of the students in my class," "I want to be a leader," "It is useful to learn how to diagnose," "It is useful to learn therapy," and "I like research." No statistically significant differences were detected for three of the options: "Sense of responsibility," "I want to fulfill my obligations," and "It will allow me to correlate theoretical and practical knowledge." When this analysis was repeated for female students, the same differences were found, with statistically significant differences for seven of the ten options. However, when male students were analyzed, the RL and SDL groups significantly differed for six of the ten options but not for the option "I like research." For this option, the difference between SDL and RL groups was statistically significant for all students and for female students but not for male students.

Students' Preferences for Completing Their Learning Process

When students' preferences for CLS were analyzed after RL and SDL, the highest scores were found for the option, "Review the slides again in a new theoretical/practical session" in the RL group (4.4 ± 0.8), and for "Consult internet images available on the Department website" in the SDL group (4.2 ± 1.1; Table 2). In contrast, the lowest scores in both groups were for the option "Consult my professor by e-mail" (3.1 ± 1.0 in the RL group, 2.4 ± 1.2 in the SDL group). Interestingly, no statistically significant differences were found between male and female students for any of the options in either of the groups (Table 2).

When the preferences for complementary training were compared between the RL and the SDL groups, the differences were statistically significant for all eight options (Table 2). As shown in Table 2, the mean score for the option "Consult internet images available on the department website" was higher in the SDL group than in the RL group ($P < 0.01$), whereas mean scores for all other options were higher in the RL group ($P < 0.01$). Significant differences in students' CLS preferences were found not only for participants as a whole but also for female and male students analyzed separately.

DISCUSSION

In educational research, a number of theoretical frameworks compete to account for individual differences in motivations to learn and achieve in university medical schools, and there

Table 1.

Students' Perceived Preference for Self-Discovery Learning (SDL) or Reception Learning (RL) in Medical Histology Course

Options for question: What is your motivation to attend this session?	Group	All students (n = 236)		Female students (n = 143)		Male students (n = 93)		*P*-value, female vs. male
		Mean (±SD)	*P*-value, SDL vs. RL	Mean (±SD)	*P*-value, SDL vs. RL	Mean (±SD)	*P*-value, SDL vs. RL	
I like to learn new things	SDL RL	3.5 (±1.1) 4.2 (±0.8)	<0.01	3.6 (±1.0) 4.3 (±0.7)	<0.01	3.5 (±1.1) 4.1 (±0.9)	<0.01	NS <0.05
I am attending just because it is mandatory	SDL RL	3.5 (±1.2) 2.9 (±1.3)	<0.01	3.4 (±1.2) 2.9 (±1.3)	<0.01	3.6 (±1.2) 2.9 (±1.3)	<0.01	NS
Sense of responsibility	SDL RL	4.2 (±0.9) 4.2 (±0.8)	NS	4.4 (±0.8) 4.3 (±0.8)	NS	4.0 (±1.0) 4.1 (±0.9)	NS	<0.05 <0.05
I want to fulfill my obligations	SDL RL	3.9 (±1.1) 3.9 (±1.0)	NS	4.0 (±1.0) 3.9 (±1.0)	NS	3.8 (±1.2) 3.7 (±1.1)	NS	NS NS
I want to compete with the rest of the students in my class	SDL RL	1.5 (±0.9) 1.9 (±1.1)	<0.01	1.5 (±0.8) 1.8 (±1.0)	<0.05	1.6 (±1.0) 2.0 (±1.1)	<0.05	NS NS
I want to be a leader	SDL RL	1.5 (±0.9) 1.8 (±1.1)	<0.01	1.2 (±0.6) 1.7 (±0.9)	<0.01	1.6 (±1.0) 2.1 (±1.3)	<0.01	<0.01 <0.01
It is useful to learn how to diagnose	SDL RL	4.1 (±1.1) 4.5 (±0.8)	<0.01	4.2 (±1.0) 4.5 (±0.8)	<0.05	4.0 (±1.2) 4.5 (±0.7)	<0.01	NS NS
It is useful to learn therapy	SDL RL	4.0 (±1.1) 4.5 (±0.7)	<0.01	4.1 (±1.0) 4.5 (±0.7)	<0.01	3.9 (±1.2) 4.5 (±0.7)	<0.01	NS NS
I like research	SDL RL	4 (±1.1) 4.2 (±0.9)	<0.05	3.9 (±1.1) 4.3 (±0.8)	<0.01	4.1 (±1.0) 4.2 (±0.9)	NS	NS NS
It would allow me to correlate theoretical and practical knowledge	SDL	4.3 (±0.9) 4.4 (±0.8)	NS	4.3 (±1.0) 4.5 (±0.7)	NS	4.4 (±0.8) 4.3 (±0.8)	NS	NS NS

SD, standard deviation; NS, not statistically significant; SDL, self-discovery learning; RL, reception learning.

are a wide range of influences that can potentially promote or inhibit individual motivation to learn in a particular situation (Pintrich et al., 1993; Blumenfeld et al., 2006). Recent research has shown that students' beliefs and conceptions of learning are related to their learning strategies and achievement; therefore, the significance of their beliefs and conceptions of learning cannot be ignored (Chan, 2011). This study details an investigation into the perceived motivations of male and female students for preferring RL or SDL to acquire histological knowledge, as well as these students' preferences in CLS to continue their learning process. This research focused on students' perceptions of RL and SDL methods and on the kinds of CLS they would select to enhance their acquisition of histological knowledge.

According to the results of this study, in both learning modalities the highest scores for student's perceived motivations were given for options related to the application to medical practice of the knowledge students acquired in areas such as diagnosis, research, therapy, theory, and practical correlations. The lowest scores were given to the desire for leadership and the desire to compete with other students. Intermediate scores (although also high) were given to options relating to students' own responsibilities and duties.

When the two learning methods were compared, students' perceived motivations differed significantly in several ways. The motivation to attend RL was significantly higher than to attend SDL, not only for the purpose of applying the knowledge acquired to medical practice but also for seeking leadership and competing with classmates. The difference was evident for the whole sample overall, although it was larger for women than for men when the results were analyzed separately by gender. This finding suggested that students perceived the potential to apply histological knowledge to medical practice as the main motivational factor for attendance. It is significant that this motivation was more important for RL, in which information is received from the instructor in the form of concepts and histological data, than for SDL, in which students learned on their own using glass slides with

Table 2.

Students' Preferences for Complementary Learning Strategies (CLS) After Reception Learning (RL) and Self-Discovery Learning (SDL)

Options for question: How would you complete and enhance the training you received?	Group	All students (n = 236)		Female students (n = 143)		Male students (n = 93)		P-value, female vs. male
		Mean (±SD)	P-value, SDL vs. RL	Mean (±SD)	P-value, SDL vs. RL	Mean (±SD)	P-value, SDL vs. RL	
Consult a histology atlas	SDL RL	3.5 (± 1.3) 3.8 (± 0.9)	<0.01	3.6 (± 1.3) 3.9 (± 0.8)	<0.05	3.2 (± 1.3) 3.7 (± 0.9)	<0.05	NS NS
Consult a textbook	SDL RL	3.3 (± 1.2) 4.0 (± 0.8)	<0.01	3.3 (± 1.2) 4.0 (± 0.8)	<0.01	3.2 (± 1.1) 3.9 (± 0.8)	<0.01	NS NS
Consult images publically available on web sites.	SDL RL	2.9 (± 1.4) 3.7 (± 1.1)	<0.01	3.0 (± 1.4) 3.7 (± 1.0)	<0.01	2.8 (± 1.4) 3.7 (± 1.1)	<0.01	NS NS
Consult internet images available on the department website	SDL RL	4.2 (± 1.1) 3.6 (± 1.1)	<0.01	4.3 (± 1.0) 3.7 (± 1.1)	<0.01	4.0 (± 1.1) 3.6 (± 1.1)	<0.05	NS NS
Personally consult my professor in a tutorial session	SDL RL	2.7 (± 1.1) 4.0 (± 0.9)	<0.01	2.7 (± 1.2) 4.0 (± 0.8)	<0.01	2.7 (± 1.0) 4.0 (± 0.9)	<0.01	NS NS
Consult my professor by e-mail	SDL RL	2.4 (± 1.2) 3.1 (± 1.0)	<0.01	2.4 (± 1.2) 3.2 (± 0.9)	<0.01	2.3 (± 1.2) 3.0 (± 1.1)	<0.01	NS NS
Review the slides again in a new theoretical/practical session	SDL RL	3.3 (± 1.2) 4.4 (± 0.8)	<0.01	3.3 (± 1.2) 4.4 (± 0.8)	<0.01	3.2 (± 1.3) 4.4 (± 0.7)	<0.01	NS NS
Review the slides again by myself	SDL RL	2.8 (± 1.5) 3.5 (± 1.1)	<0.01	2.9 (± 1.5) 3.5 (± 1.1)	<0.01	2.8 (± 1.5) 3.6 (± 1.1)	<0.01	NS NS

SD, standard deviation; NS, not statistically significant; SDL, self-discovery learning; RL, reception learning.

the aid of microscopes or virtual images (Khalil et al., 2010). Clearly, students believed they will obtain more histological information that they can apply to medical practice from the concepts and data taught by an instructor in the RL modality than from learning independently in the SDL modality. In this connection, students in an earlier study perceived the use of RL with a lecture recording system as highly useful in histology (Bacro et al., 2010). In contrast to teaching materials available for nearly 30 years to prepare lectures in which histological knowledge was clinically oriented (Bacon and Niles, 1983; Kierszenbaun, 2007), the material available for SDL consisted mainly of histological glass slides or virtual microscopic images, in which histological information was not clinically oriented (Patel et al., 2006; Husmann et al., 2009). The results obtained in this study point toward a need to revise self-learning modules based on observations of normal histology to incorporate instruments and mechanisms that would encourage a clinical orientation in the learning process, an approach that is already being used in some settings (Kumar et al., 2006).

With regard to the motivational factors that students perceived to favor the application of histological knowledge to medical practice in each learning modality, no significant differences between genders was found. This may be related to the findings of earlier research that reported similarities or only small differences between genders in overall performance during preclinical training (Ramsbottom-Lucier et al., 1995).

A striking result in the current sample of students was the relatively low priority they accorded to the desire for leadership and the wish to compete with classmates, regardless of which teaching modality was offered. The authors believe this finding to be related to the fact that neither modality for teaching histology favors the acquisition of leadership or competition skills. As suggested by different medical associations and authors, the implementation of new approaches in teaching histology, such as team-based peer teaching and learning and clinico-histologic conferences, contribute to the development of leadership and teamwork skills, which can be useful for medical students who later take part in interprofessional healthcare delivery teams (AAMC, 1999; Kohn et al., 2000; O'Connell and Pascoe, 2004; Shaw and Friedman, 2012).

No differences were found in students' perceived motivations between the two learning modalities for options related to sense of responsibility and fulfillment of obligations. However, this study's group of students clearly considered attending SDL to be mandatory, probably because SDL situations provided contact with real specimens (tissue preparations). In both RL and SDL modalities, statistically significant differences were observed in favor of the desire for leadership in men and in favor of a sense of responsibility in women, as well as

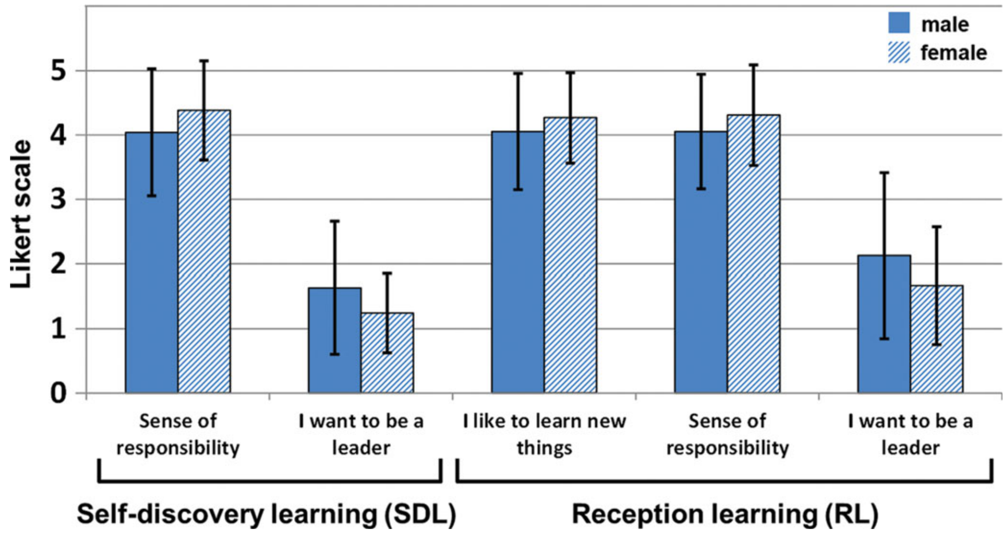

Figure 1.

Gender differences for students' perceived motivations to attend SDL or RL sessions. Only options that yielded statistically significant differences for the comparison between male and female students are shown. All options that yielded significant differences were from the first questionnaire.

in favor of learning new things in women only in the RL modality. These findings are similar, in general terms, to the classical patterns described by various authors in relation to gender and medicine (Cartwright, 1972; Kvaener et al., 1999).

Learning histology, regardless of whether the RL or SDL modality is used, requires additional resources, such as atlases, the internet, and consultation with the instructor either face-to-face or via an electronic network (McMillan, 2001). One of the aims of this study was to document students' preferences regarding resources for complementary training after RL or SDL. Male and female students did not differ significantly regarding their choices of available resources. This finding is related to the general lack of differences, as noted above, between men and women in terms of academic priorities and outcomes. However, in this study's participants, RL was associated with a stronger preference for complementary resources compared with SDL. Students in the RL group more often indicated that they would use additional information and images from books, atlases, slides, and the internet and would seek additional information from the instructor either face-to-face or via email. The only CLS option that students in the SDL group indicated they would use more frequently than students in the RL group was consulting images available on the Department website. This finding illustrates the students' willingness to review information (reinforcement) they had received previously (Sutton and Barto, 1998). In addition, it suggests that although students were generally more highly motivated to attend RL than to attend SDL when they wished to apply the knowledge acquired to medical practice, seek leadership, and become competitive, students were also more motivated to seek complementary information after RL. This motivation may have arisen from the feeling that given the receptive nature of RL, students realized that they will not receive detailed instruction on the visualization of histological specimens. Thus, they perceived that they will have no opportunities for feedback regarding their progress in acquiring knowledge except through self-learning.

Students' perceptions of the RL and SDL modalities and their views regarding which options might be most productive for their CLS have provided insights into how to implement both modalities more effectively. Although students who receive instruction with the RL modality were more motivated to acquire histological knowledge that will later serve them in their medical practice and in acquiring additional knowledge and skills, they nonetheless appreciated the need for complementary education and training based on different resources. In contrast, the perceived need for CLS was higher after RL than after SDL in these students, probably because they felt that SDL was less explicitly oriented toward medical practice and was less useful in preparing them for future clinical activity. This perception was probably related to the nature of SDL itself, which places less emphasis than RL in orienting the learning process toward medical practice.

The strengths of this study are that a classical method (RL) and a self-learning method (SDL) were compared in homogenous groups of students, not only in terms of their perceptions regarding each method but also in terms of the CLS options that the students perceived as most useful after each method. A limitation of this study is the loss of students to follow-up testing to search for correlations between outcomes and performance in histology and subsequent clinical courses. Additionally, it would be useful to perform international studies to compare RL and SDL methods not only between different countries but also between different medical school models.

CONCLUSION

In conclusion, the results of this study demonstrate that students perceived RL to be more useful for medical practice and research. Students preferentially selected RL to improve their capacity for leadership and teamwork. However, students had a tendency to supplement and enhance RL by using atlases, slides, and other resources, probably because they felt that their ability to correctly identify histological structures did not improve as much as after SDL. In contrast, these results show that students perceived SDL to be less clinically oriented, although they acquired better image identification capabilities and thus indicated a lower perceived need for CLS resources to supplement or enhance their training. For these reasons, the two learning methods are complementary, because each emphasizes a different orientation of the learning process. When SDL learning methods are used, the limitations that this study identified should be taken into account, and SDL programs should strive to emphasize clinical applications of histology knowledge. In addition, the use of CLS after SDL should also be clinically oriented (i.e., use of images from clinical cases).

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Table 1 Mean scores obtained for each item and each group of students

		MEDICINE STUDENTS			DENTISTRY STUDENTS			PHARMACY STUDENTS		
		All students	Female students	Male students	All students	Female students	Male students	All students	Female students	Male students
1. Intrinsic Motivation	03. Learning histology is interesting	3.85±0.83	3.80±0.91	3.95±0.65	3.42±0.92	3.38±0.93	3.50±0.90	3.74±0.99	3.88±0.95	3.39±1.02
	17. I am curious about discoveries in histology	3.57±0.96	3.58±0.98	3.56±0.93	3.04±1.01	2.94±1.03	3.23±0.96	3.52±1.05	3.69±1.02	3.10±1.01
	01. The histology I learn is relevant to my life	3.44±0.84	3.34±0.81	3.65±0.87	3.29±0.86	3.26±0.89	3.35±0.81	3.24±1.02	3.37±0.95	2.90±1.14
	12. Learning histology makes my life more meaningful	2.68±1.02	2.65±1.09	2.74±0.88	2.35±1.03	2.43±1.01	2.19±1.05	2.88±1.00	3.03±0.97	2.52±1.00
	19. I enjoy learning histology	3.86±0.85	3.83±0.91	3.93±0.70	3.26±0.99	3.22±0.96	3.32±1.05	3.71±1.06	3.81±1.04	3.47±1.11
2. Career Motivation	07. Learning histology will help me get a good job	3.15±1.04	3.03±1.03	3.40±1.03	3.02±1.11	3.10±1.08	2.89±1.17	2.91±0.97	2.94±0.98	2.84±0.93
	13. Understanding histology will benefit me in my career	4.28±0.75	4.21±0.78	4.42±0.70	3.90±0.92	3.89±0.94	3.91±0.91	3.68±1.12	3.79±1.07	3.39±1.20
	10. Knowing histology will give me a career advantage	4.23±0.77	4.18±0.72	4.33±0.87	3.90±0.91	3.85±0.95	3.98±0.85	3.64±1.12	3.66±1.08	3.58±1.23
	25. I will use histology problem-solving skills in my career	3.79±0.74	3.72±0.77	3.93±0.68	3.55±1.04	3.51±1.12	3.64±0.89	3.29±0.97	3.31±0.98	3.23±0.96
	23. My career will involve histology	4.08±0.80	4.08±0.76	4.09±0.89	3.78±1.02	3.75±1.07	3.82±0.95	3.44±1.08	3.53±1.10	3.23±1.02
3. Self-determination	22. I study hard to learn histology	3.67±0.86	3.73±0.84	3.53±0.91	3.71±0.88	3.74±0.89	3.66±0.86	3.29±0.98	3.40±0.93	3.00±1.05
	16. I prepare well for histology tests and labs	4.42±0.67	4.47±0.69	4.33±0.61	4.54±0.60	4.51±0.61	4.61±0.58	4.09±1.17	4.25±1.07	3.71±1.35
	05. I put enough effort into learning histology	4.11±0.87	4.15±0.89	4.02±0.83	4.05±0.81	4.09±0.85	3.98±0.73	3.74±0.99	3.86±0.99	3.45±0.93
	11. I spend a lot of time learning histology	3.55±0.85	3.60±0.82	3.47±0.91	3.67±0.93	3.67±0.92	3.68±0.96	3.17±1.03	3.25±1.04	2.97±0.98
	06. I use strategies to learn histology well	3.67±0.90	3.65±0.94	3.70±0.80	3.47±1.07	3.40±1.11	3.61±0.97	3.39±1.03	3.53±0.98	3.06±1.09
4. Self-efficacy	18. I believe I can earn a grade of “A” in histology	2.89±1.06	2.81±1.04	3.05±1.09	3.07±1.03	3.10±1.02	3.02±1.07	3.15±1.07	3.12±0.95	3.23±1.33
	14. I am confident I will do well on histology labs and projects	4.23±0.69	4.27±0.70	4.14±0.68	4.20±0.76	4.10±0.82	4.39±0.62	3.92±1.07	3.91±0.99	3.94±1.26
	15. I believe I can master histology knowledge and skills	3.74±0.69	3.70±0.66	3.83±0.73	3.67±0.68	3.60±0.72	3.81±0.59	3.75±0.93	3.78±0.85	3.68±1.11
	21. I am sure I can understand histology	4.17±0.69	4.10±0.69	4.33±0.68	3.91±0.79	3.89±0.81	3.95±0.78	3.89±0.96	3.91±0.87	3.84±1.16
	09. I am confident I will do well on histology tests	4.11±0.79	4.09±0.83	4.14±0.71	4.07±0.85	3.93±0.89	4.34±0.71	3.88±1.01	3.78±1.00	4.13±1.02
5. Grade Motivation	04. Getting a good histology grade is important to me	4.05±0.86	4.18±0.79	3.79±0.94	4.25±0.98	4.24±1.00	4.27±0.97	3.83±1.11	3.92±1.07	3.61±1.20
	08. It is important that I get an "A" in histology	3.51±1.31	3.62±1.29	3.29±1.35	4.02±1.20	4.01±1.19	4.02±1.25	3.49±1.25	3.49±1.23	3.48±1.31
	20. I think about the grade I will get in histology	3.51±1.11	3.60±1.07	3.33±1.17	3.76±1.09	3.64±1.06	3.98±1.11	3.56±1.16	3.70±1.16	3.20±1.10
	24. Scoring high on histology tests and labs matters to me	4.27±0.72	4.23±0.72	4.35±0.72	4.08±0.88	4.05±0.86	4.14±0.90	3.83±1.07	3.97±1.01	3.48±1.15
	02. I like to do better than other students on histology tests	4.00±0.94	3.93±0.96	4.14±0.89	3.94±1.12	3.96±1.17	3.91±1.03	3.66±1.24	3.68±1.23	3.61±1.31

Table 2 Mean scores obtained for each component of motivation and each group of students

	MEDICINE			DENTISTRY			PHARMACY		
	All students	Females	Males	All students	Females	Males	All students	Females	Males
1. Intrinsic Motivation	3.48±1.00	3.44±1.03	3.57±0.92	3.07±1.03	3.04±1.02	3.12±1.06	3.42±1.07	3.55±1.03	3.07±1.10
2. Career Motivation	3.91±0.92	3.84±0.93	4.03±0.91	3.63±1.05	3.62±1.07	3.65±1.03	3.39±1.09	3.45±1.08	3.25±1.09
3. Self-determination	3.88±0.89	3.92±0.90	3.81±0.87	3.89±0.95	3.88±0.97	3.91±0.91	3.54±1.09	3.65±1.06	3.24±1.11
4. Self-efficacy	3.83±0.94	3.79±0.95	3.90±0.91	3.79±0.92	3.72±0.92	3.90±0.91	3.72±1.05	3.70±0.98	3.77±1.20
5. Grade Motivation	3.87±1.05	3.91±1.02	3.78±1.11	4.01±1.07	3.98±1.08	4.06±1.06	3.68±1.17	3.75±1.15	3.48±1.21

Table 3 Statistical comparison of the scores assigned to each item and each factor by each group of students. All values are p values with Mann-Whitney test. Statistically significant p values are highlighted in bold

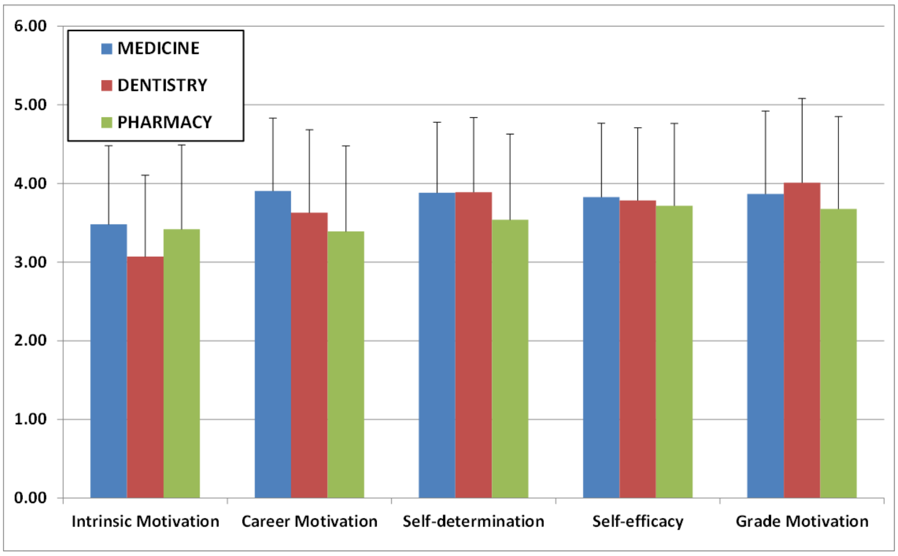
		Medicine vs. dentistry students	Medicine vs. pharmacy students	Dentistry vs. pharmacy students	Medicine vs. dentistry students	Medicine vs. pharmacy students	Dentistry vs. pharmacy students
1. Intrinsic Motivation	03. Learning histology is interesting	**0.0002**	0.5922	**0.0054**	**0.0000**	0.3681	**0.0000**
	17. I am curious about discoveries in histology	**0.0000**	0.7238	**0.0006**			
	01. The histology I learn is relevant to my life	0.1219	0.2172	0.8939			
	12. Learning histology makes my life more meaningful	**0.0080**	0.1246	**0.0001**			
	19. I enjoy learning histology	**0.0000**	0.3872	**0.0006**			
2. Career Motivation	07. Learning histology will help me get a good job	0.4167	0.1062	0.4431	**0.0000**	**0.0000**	**0.0001**
	13. Understanding histology will benefit me in my career	**0.0008**	**0.0000**	0.1917			
	10. Knowing histology will give me a career advantage	**0.0033**	**0.0000**	0.0993			
	25. I will use histology problem-solving skills in my career	0.1091	**0.0001**	**0.0452**			
	23. My career will involve histology	**0.0253**	**0.0000**	**0.0194**			
3. Self-determination	22. I study hard to learn histology	0.5548	**0.0057**	**0.0011**	0.6183	**0.0000**	**0.0000**
	16. I prepare well for histology tests and labs	0.1503	0.1346	**0.0068**			
	05. I put enough effort into learning histology	0.4562	**0.0036**	**0.0155**			
	11. I spend a lot of time learning histology	0.2837	**0.0018**	**0.0002**			
	06. I use strategies to learn histology well	0.1792	**0.0495**	0.5744			
4. Self-efficacy	18. I believe I can earn a grade of "A" in histology	0.1567	**0.0423**	0.4716	0.3597	0.2132	0.6927
	14. I am confident I will do well on histology labs and projects	0.9061	0.0742	0.1023			
	15. I believe I can master histology knowledge and skills	0.7239	0.3638	0.1884			
	21. I am sure I can understand histology	**0.0095**	**0.0463**	0.6745			
	09. I am confident I will do well on histology tests	0.9163	0.1622	0.2041			
5. Grade Motivation	04. Getting a good histology grade is important to me	**0.0151**	0.2364	**0.0015**	**0.0037**	**0.0093**	**0.0000**
	08. It is important that I get an "A" in histology	**0.0012**	0.8137	**0.0004**			
	20. I think about the grade I will get in histology	0.0706	0.6620	0.2132			
	24. Scoring high on histology tests and labs matters to me	0.1216	**0.0023**	0.1164			
	02. I like to do better than other students on histology tests	0.9226	0.0740	0.0870			

Table 4 Statistical comparison of the scores assigned to each item and each factor by male and female students. All values are p values with Mann-Whitney test. Statistically significant p values are highlighted in bold

		Medicine students	Dentistry students	Pharmacy students	Medicine students	Dentistry students	Pharmacy students
1. Intrinsic Motivation	03. Learning histology is interesting	0.4606	0.5850	**0.0153**	0.1267	0.2601	**0.0000**
	17. I am curious about discoveries in histology	0.8768	0.1280	**0.0054**			
	01. The histology I learn is relevant to my life	**0.0323**	0.4110	0.0625			
	12. Learning histology makes my life more meaningful	0.5722	0.2112	**0.0241**			
	19. I enjoy learning histology	0.6279	0.4688	0.1212			
2. Career Motivation	07. Learning histology will help me get a good job	0.0694	0.2695	0.7512	**0.0108**	0.9104	0.0963
	13. Understanding histology will benefit me in my career	0.1537	0.9128	0.1217			
	10. Knowing histology will give me a career advantage	0.1168	0.5898	0.8420			
	25. I will use histology problem-solving skills in my career	0.1547	0.7221	0.7771			
	23. My career will involve histology	0.7377	0.9269	0.2347			
3. Self-determination	22. I study hard to learn histology	0.2119	0.4284	0.0859	0.1052	0.9748	**0.0001**
	16. I prepare well for histology tests and labs	0.1131	0.3225	**0.0290**			
	05. I put enough effort into learning histology	0.3118	0.2507	**0.0214**			
	11. I spend a lot of time learning histology	0.4152	0.9346	0.1913			
	06. I use strategies to learn histology well	0.7517	0.3795	**0.0489**			
4. Self-efficacy	18. I believe I can earn a grade of "A" in histology	0.3854	0.6038	0.6002	0.2053	**0.0130**	0.0929
	14. I am confident I will do well on histology labs and projects	0.2566	0.0692	0.4412			
	15. I believe I can master histology knowledge and skills	0.2669	0.1703	0.9704			
	21. I am sure I can understand histology	0.0770	0.6827	0.8237			
	09. I am confident I will do well on histology tests	0.8523	**0.0098**	**0.0436**			
5. Grade Motivation	04. Getting a good histology grade is important to me	**0.0204**	0.8090	0.2013	0.1819	0.2887	**0.0151**
	08. It is important that I get an "A" in histology	0.1783	0.7497	0.9809			
	20. I think about the grade I will get in histology	0.1818	0.0775	**0.0289**			
	24. Scoring high on histology tests and labs matters to me	0.3413	0.4998	**0.0387**			
	02. I like to do better than other students on histology tests	0.2154	0.6028	0.8338			

Figure 1

Comparison of the results obtained for each component of motivation in each group of students



Average values obtained for each component of motivation in the medicine, dentistry and pharmacy curricula are shown. Dispersion bars correspond to mean standard deviations

RESEARCH REPORT

ASE

Developing an Audiovisual Notebook as a Self-learning Tool in Histology: Perceptions of Teachers and Students

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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. Anat Sci Educ 00: 000–000. © 2013 American Association of Anatomists.

Key words: histology education; microscopic anatomy education; medical education; self-learning modules; students' perceptions; teachers' perceptions; audiovisual notebook; teaching videos; video modules; computer assisted learning

INTRODUCTION

Video is a widely used medium in different levels of education, including medical education (Bacro et al., 2000, 2010; Woosley, 2006). 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

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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-Sánchez 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 review 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 replace 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 prerecorded lectures or podcasts has 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-Sánchez 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), that is, as a didactic instrument for self-learning, this tool must be converted into an audiovisual notebook, that is, 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 it 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).

Histology is a basic discipline dealing with concepts regarding the microscopic 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 microscopic anatomy of body organs. Each one is taught during four months in the context of the six years academic program in accordance with European Union regulations.

This study was designed to record separately and then to 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 this 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 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 histology course, and they are a requirement to pass the subject.

Each questionnaire focused on a different component or topic, that is 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). Owing to the nonparametric nature of each variable as determined by the Kolmogorov–Smirnov analysis, nonparametric 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 six 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 software, version 15.0 (SPSS Inc., Chicago, IL). 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 (e.g., "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 four 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) ($P > 0.05$) (Fig. 1). As summarized 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 shown 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

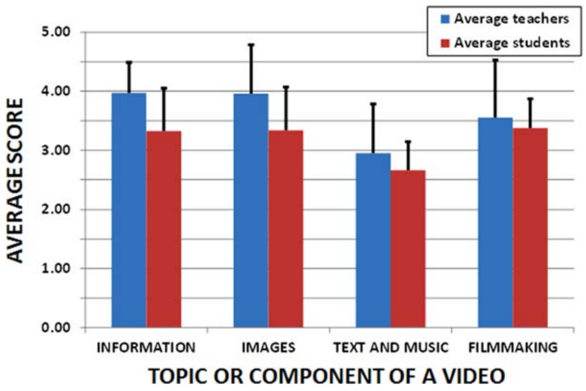

Figure 1.

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

(text and music), only Item 3.1 (a text narrated by the technician who carries out the technique), Item 3.5 (a written text shown separately between images), and Item3.10 (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 Item 4.2 (medium shots showing a closer view of the technician and the technique) and Item 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 (greater than four) 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 (less than 2) belonged to Topic 2 (images, Item 2.3—the chemical structures and formulas), and Topic 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 Item 1.3 (the chemical basis) and Item 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 (Fig. 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 as 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, this study is based on, 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 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 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

Table 1.

Mean Scores Assigned by Teachers and Students to Each Item in the Four Topics Analyzed in This Study

TOPIC	Items	Mean teachers	Mean male teachers	Mean female teachers	Male vs. female teachers MW *P*-value	Mean students	Mean male students	Mean female students	Male vs. female students MW *P*-value	Mean teachers and students	Teachers vs. students MW *P*-value	Teachers vs. students (global) MW *P*-value	Teachers vs. students (global) KW *P*-value
Information	1.1	3.39	3.37	3.44	0.9231	2.72	2.74	2.69	0.6125	3.1109	0.0103[a]	3.86E − 21[a]	1.92E-73[a]
	1.2	3.18	3.16	3.22	0.9231	2.15	2.18	2.11	0.4186	2.6739	0.0001[a]		
	1.3	3.82	3.53	4.44	0.0477[a]	3.13	3.05	3.15	0.9588	3.2152	0.0034[a]		
	1.4	4.02	4.01	4.05	0.9615	4.16	4.10	4.17	0.9975	4.1283	0.0442[a]		
	1.5	4.75	4.89	4.44	0.4982	4.55	4.56	4.53	0.6203	4.5739	0.0271[a]		
	1.6	4.68	4.84	4.33	0.6993	4.39	4.41	4.37	0.9527	4.4457	0.0198[a]		
	1.7	3.61	3.47	3.89	0.4102	3.00	2.82	3.07	0.4040	3.2500	0.0044[a]		
	1.8	4.29	4.21	4.44	0.7722	3.32	3.29	3.35	0.7835	3.7123	0.00001[a]		
	1.9	4.14	4.05	4.33	0.5950	3.20	3.21	3.20	0.7393	3.6009	0.00003[a]		
	1.10	3.71	3.63	3.89	0.7722	2.70	2.55	2.79	0.0664	2.9509	0.0001[a]		
	1.11	4.46	4.42	4.56	0.7355	3.59	3.42	3.67	0.3297	3.9439	0.0002[a]		
	1.12	3.64	3.47	4.00	0.2234	2.97	2.92	2.97	0.9656	3.1868	0.0083[a]		
Images	2.1	3.71	3.89	3.33	0.4102	2.93	3.00	2.87	0.4688	3.3652	0.0034[a]	2.27E − 16[a]	
	2.2	3.25	3.32	3.11	0.7722	2.44	2.64	2.32	0.0917	2.9717	0.0058[a]		
	2.3	2.75	2.53	3.22	0.1054	1.82	1.85	1.77	0.7244	1.8587	0.0003[a]		
	2.4	3.68	3.47	4.11	0.2051	3.09	2.95	3.13	0.5824	3.1439	0.0150[a]		
	2.5	4.61	4.63	4.56	0.8094	3.99	3.76	4.09	0.1359	4.2956	0.0009[a]		
	2.6	4.86	4.84	4.89	1.0000	4.36	4.39	4.33	0.4674	4.6298	0.0027[a]		
	2.7	4.43	4.47	4.33	0.9615	3.65	3.58	3.67	0.7872	4.0746	0.0004[a]		
	2.8	4.11	4.16	4.00	0.8849	3.46	3.37	3.49	0.5242	3.7325	0.0022[a]		

Table 1. *Continued*

TOPIC	Items	Mean teachers	Mean male teachers	Mean female teachers	Male vs. female teachers MW *P*-value	Mean students	Mean male students	Mean female students	Male vs. female students MW *P*-value	Mean teachers and students	Teachers vs. students MW *P*-value	Teachers vs. students (global) MW *P*-value	Teachers vs. students (global) KW *P*-value
	2.9	4.25	4.32	4.11	0.6291	3.50	3.42	3.54	0.5732	3.6522	0.0002[a]		1.92E-73[a]
	2.10	3.46	3.37	3.67	0.5950	3.97	3.95	3.97	0.8600	3.7868	0.1192		
	2.11	4.46	4.37	4.67	0.5296	3.50	3.32	3.57	0.2347	3.9500	0.00001[a]		
Text and music	3.1	4.00	3.89	4.22	0.4679	3.30	3.28	3.28	0.9249	3.5991	0.0142[a]	0.0015[a]	
	3.2	3.50	3.89	2.67	0.0539	3.53	3.51	3.52	0.8965	3.2655	0.9426		
	3.3	2.14	2.37	1.67	0.1564	2.10	2.03	2.14	0.6219	2.1987	0.6862		
	3.4	3.46	3.00	4.44	0.0073[a]	2.89	2.97	2.88	0.8328	3.2974	0.0541		
	3.5	3.11	3.05	3.22	0.8470	2.41	2.15	2.56	0.0703	2.6035	0.0187[a]		
	3.6	3.39	3.53	3.11	0.4102	2.88	3.05	2.77	0.2193	3.3886	0.0653		
	3.7	2.31	2.28	2.36	0.9615	2.38	2.46	2.34	0.6148	2.2386	0.2724		
	3.8	2.19	2.17	2.22	0.6993	2.29	2.54	2.18	0.2977	2.0947	0.4819		
	3.9	2.07	2.11	2.00	0.8094	2.17	2.26	2.14	0.4329	1.8833	0.8956		
	3.10	3.32	3.37	3.22	0.8470	2.63	2.74	2.59	0.6174	2.8158	0.0207[a]		
Filmmaking	4.1	3.33	3.56	2.89	0.2746	3.44	3.45	3.42	0.7449	3.3879	0.8230	0.0439[a]	
	4.2	4.22	4.06	4.56	0.1936	3.69	3.68	3.68	0.8694	3.9562	0.0118[a]		
	4.3	4.56	4.61	4.44	0.4948	3.89	4.08	3.78	0.3088	4.2802	0.0062[a]		
	4.4	3.59	3.56	3.67	0.8599	3.20	3.37	3.09	0.2590	3.4907	0.2168		
	4.5	3.04	3.01	3.11	0.8997	3.13	3.08	3.15	0.8593	2.8997	0.9496		
	4.6	2.59	2.61	2.56	0.8205	2.91	3.45	2.64	0.0023[a]	2.4558	0.2560		

[a]Statistically significant *P*-values. For each item, the *P*-value is shown for the comparison of males versus females (for teachers and for students) and for the comparison of students versus teachers using the statistical test of Mann–Whitney (MW). The *P*-value is also shown for the global comparison of each topic (all items included in each questionnaire) between students and teachers using the Mann–Whitney test and the Kruskal–Wallis (KW) test (overall comparisons among the four topics).

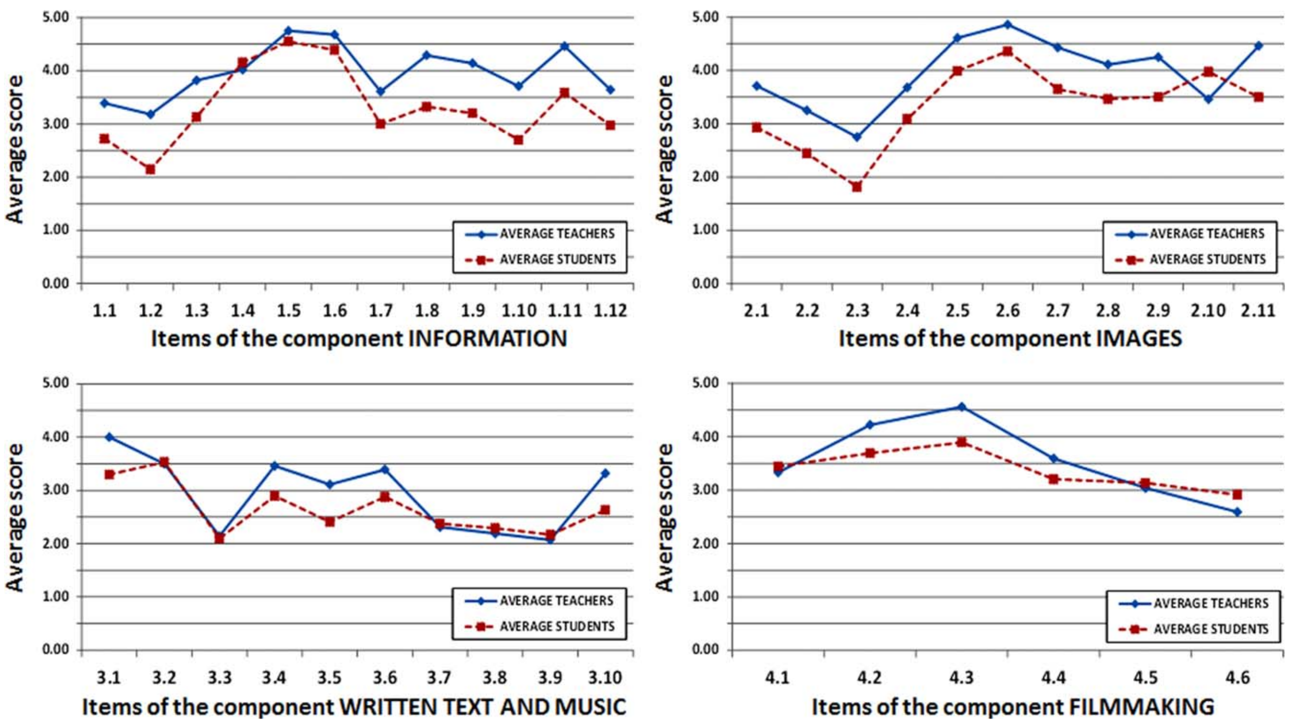

Figure 2.

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.

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 worth noting 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, that is knowledge, whereas students preferred to learn procedural competencies, that is, 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 this study, teachers believe that images representing key concepts—basis of the technique, chemical structures, and so on—could facilitate the learning process. Although the results were high for both the teachers and the 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 this 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 relationship with their learning goals for specific tasks and in the visualization of specific techniques (Roshier et al., 2011). Complementary data, that is 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 the 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 this 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 as 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 this 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. As 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 as 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 toward more didactic contents and display 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 the students for the four components allows us to hypothesize that students could confidently participate in the elaboration of the videos as self-learning tools in histology.

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MICROTEACHING AS A SELF-LEARNING TOOL. STUDENTS' PERCEPTIONS IN THE PREPARATION AND EXPOSITION OF A MICROLESSON IN A TISSUE ENGINEERING COURSE

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Abstract

Microteaching is a didactic tool of recent application to undergraduate and postgraduate students as a way to promote self-learning. In this work we compared the perceptions of the students who provide instruction in tissue engineering using microteaching and the perceptions of the same students when they receive such instructions. Two similar questionnaires with items related to the preparation and exposition of a microlesson were used to investigate the perception of 56 students before and after the microteaching session.

In our results, students significantly prefer to use specific objectives, textbooks and Internet information when they are preparing a microlesson as compared to the situation when they receive it. On the other hand, the use of a pre-programmed index during the exposition and the reduction of the use of slides are significantly more preferred by the students after receiving the microlesson. No statistical differences were found for the rest of the options analyzed.

These results show that the self-assessment generated in the microteaching session, which is linked to the feedback related to the self-learning process, makes microteaching a technique not only useful for self-learning but also an important tool to promote self-regulation across the curriculum.

Keywords **-** Microteaching, self-learning, tissue engineering, self-assessment, self-regulation.

1 INTRODUCTION

The use of microteaching as a didactic tool was introduced during the last decades of the past century as a way to improve the skills of the teachers (Ananthakrishnan, 1993; Macleod, 1987; Perrot, 1976). Recently, microteaching was implemented in different curricula as a useful self-learning instrument in undergraduate and postgraduate students (Clifford & Edwards, 1975; Kamboj, Kamboj, George, & Jha, 2010; Popovich & Katz, 2009; Sana, 2007). As it is well known, self-learning involves the active participation of the students and encourages them to construct their own learning program (Campos-Sánchez et al., 2012). Self-learning techniques are able to place students at the forefront of their own learning process, making learning more effective, efficient and meaningful (Campos-Sánchez et al., 2012; Gaikwad & Tankhiwale, 2012). In higher education, self-learning promotes active learning and critical thinking, which may effectively reinforce knowledge and skills (Gaikwad & Tankhiwale, 2012). However, these techniques require periodical guidance by mentors, and their application to novel disciplines such as tissue engineering has not been well explored yet.

Microteaching involves a simulated teaching session known as microlesson of five to ten minutes of duration in which students teach a short lecture to their classmates (Ananthakrishnan, 1993). Microteaching-microlearning exercises are effective methods to enhance and develop communication, problem-solving and critical-thinking skills in students (Popovich & Katz, 2009). In traditional reception learning strategies, a lesson is considered as an educational tool based on the participation of a teacher or instructor who transmits information to the students. In contrast, a microlesson is elaborated and taught by the students, who present the information to other students without systematic external guidance. For that reason, microlessons should be categorized as educational tools in the context of self-learning (O'Brien & Shapiro, 1977). In this sense, microteaching techniques focus on the same final goals that other types of self-learning techniques used in higher education such as virtual learning (Shaw and Friedman, 2012) and self-discovery learning (Campos-Sánchez et al., 2012), although the methods used are different.

Tissue engineering is an emerging science that applies the principles of engineering, medicine and life sciences to the generation of biological substitutes (artificial tissues, bioengineered tissues or tissue constructs) to restore, maintain, or improve tissue functions. Although the term Tissue Engineering was introduced in the eighties (Skalak & Fox, 1988), the concepts of tissue engineering and its development and application have been increasing since the work published by Langer and Vacanti (1993). Currently, the construction of artificial tissues by tissue engineering is becoming a reality, not only as a basic research line, but also as a first-rate industrial activity destined to have a huge impact on the economy and development of more advanced countries. In this context, the subject “Tissue engineering” is an open elective subject at our University in which a microteaching method of education has been implemented as a self-learning method of instruction.

The goal of this study was to assess the perceptions of how the students who provide instruction using microteaching would design such activity and to compare these with the perceptions of the same students when they receive such instruction. The study of the perceptions of the students in both circumstances could contribute to develop and implement a self-learning program using this instrument. This is especially important because the student’s perceptions are not only at the base of self-learning but also because they could be a reference to define the students’ expectations regarding the tasks and skills they should acquire in their learning process (Chan, 2011; Schommer, 1990; Wolters, 2004).

2 METHODOLOGY

This study was performed at the University of Granada, in Granada, Spain. The sample consisted in 56 third-year undergraduate medical students enrolled in the elective ‘‘Tissue engineering’’ course. None of these students had previously worked with microlesson tools. Before beginning the present study, instructors briefly explained to the students the objectives of microteaching as a self-learning tool (Ananthakrishnan, 1993), and pointed out the different possibilities that the students could use to implement this technique. No references or demo-examples were used.

In this work, two different questionnaires were used to evaluate the perceptions of the students. The first questionnaire consisted of ten items related to the question “To prepare a microlesson you would use:”. The second one had ten items related to the question “To expose a microlesson you would use:” The specific items included in each questionnaire are shown in Tables 1 and 2. The responses in both questionnaires were recorded with a symmetric agree-disagree Likert-like scale on which students indicated their level of agreement or disagreement for each item. Each participant rated each option on a five-point Likert scale from 1 to 5, with each score corresponding to the following level of agreement: 1: strongly disagree; 2: disagree; 3: neither agree nor disagree; 4: agree; 5: strongly agree.

Both questionnaires were completed by the students twice. The first time (Q1), the questionnaires were presented to the students in charge to prepare and teach a microlesson in order to evaluate their preferences on how to prepare and carry out the microteaching, before this activity was completed. The second time (Q2), the same questionnaires were answered by the students who had already received the microlessons in order to analyze their preferences as students and recipients of information.

For each questionnaire and for each specific item, mean results and standard deviations were calculated for all participants. Perception differences between the Q1 and Q2 results were identified by using the Mann-Whitney non-parametric statistical test using the SPSS 15.0 software. $P<0.05$ was considered as statistically significant for the double-tailed tests.

3 RESULTS

The average scores obtained for each item in both questionnaires are shown in Tables 1 and 2. The lowest scores in the first and second questionnaire were found for the items “to prepare a microlesson, you would use internet information“ and “to expose a microlesson you would use the same tone of voice“, both in Q2 (students who had received the microlesson) (scores 3.16 ± 1.15 and 1.85 ± 1.08, respectively). The highest scores corresponded to the items “to prepare a microlesson, you would use specific objectives“ (4.80 ± 0.44) in the first questionnaire and “to expose a microlesson you would use the relevance of the topics“ (4.55 ± 0.56) in the second questionnaire, both in Q1 (students who are preparing to teach a microlesson).

Interestingly, the Mann-Whitney test revealed statistically significant differences between Q1 and Q2 regarding five of the options: “To prepare a microlesson you would use specific objectives”, “To prepare a microlesson you would use textbooks” and “To prepare a microlesson you would use internet information” in the first questionnaire, and “To expose a microlesson you would use a programmed index” and “To expose a microlesson you would use slides”, in the second questionnaire. No statistically differences were found for the rest of the options. Figure 1 shows the options that yielded statistically significant differences for the comparison of Q1 vs. Q2.

To prepare a microlesson you would use	***Q1 (Before the Microlesson) Mean ± SD***	***Q2 (After the Microlesson) Mean ± SD***	***Q1 vs. Q2 P value***
1. Specific objectives	*4.80 ± 0.44*	*4.39 ± 1.07*	*0.043**
2. Textbooks	*4.23 ± 0.73*	*3.76 ± 1.07*	*0.026**
3. Scientific journals	*4.73 ± 0.48*	*4.39 ± 1.05*	*0.168*
4. Divulgation journals	*3.44 ± 1.14*	*3.73 ± 1.01*	*0.191*
5. Internet information	*3.66 ± 1.01*	*3.16 ± 1.15*	*0.030**
6. Pedagogic information	*3.42 ± 0.78*	*3.26 ± 0.99*	*0.346*
7. Historical information	*3.33 ± 0.93*	*3.21 ± 1.13*	*0.683*
8. Technical information	*3.73 ± 0.82*	*3.39 ± 1.03*	*0.098*
9. Tutors information	*4.64 ± 0.69*	*4.28 ± 1.18*	*0.118*
10. Students background information	*4.64 ± 0.61*	*4.5 ± 1.04*	*0.988*

Table 1. *Results obtained with the first questionnaire before the microlesson session (Q1) and after the microlesson session (Q2) and statistical comparison of both results. The results are shown as means±standard deviations, and the statistical comparison is shown as p values for the Mann-Whitney test. Statistically significant p values are labeled with asterisks (*).*

To expose a microlesson you would use:	*Q1 (Before the Microlesson) Mean ± SD*	*Q2 (After the Microlesson) Mean ± SD*	*Q1 vs. Q2 P value*
1. A Programed Index	*3.62 ± 1.00*	*4.37 ± 1.00*	*0.000**
2. Blackboard	*3.41 ± 0.96*	*3.42 ± 0.98*	*0.953*
3. Slides	*4.33 ± 0.76*	*3.56 ± 1.04*	*0.000**
4. Videos	*3.82 ± 0.76*	*3.48 ± 1.06*	*0.082*
5. The same tone of voice	*1.92 ± 1.20*	*1.85 ± 1.08*	*0.819*
6. Voice inflections	*4.30 ± 0.76*	*4.12 ± 1.07*	*0.733*
7. The relevance of the topic	*4.55 ± 0.56*	*4.28 ± 1.05*	*0.382*
8. The sense of humor	*3.75 ± 0.87*	*3.67 ± 0.95*	*0.703*
9. A take-home message	*4.44 ± 0.71*	*4.30 ± 0.97*	*0.641*
10. A solving problem	*3.85 ± 0.92*	*3.83 ± 1.14*	*0.693*

Table 2. *Results obtained with the second questionnaire before the microlesson session (Q1) and after the microlesson session (Q2) and statistical comparison of both results. The results are shown as means±standard deviations, and the statistical comparison is shown as p values for the Mann-Whitney test. Statistically significant p values are labeled with asterisks (*).*

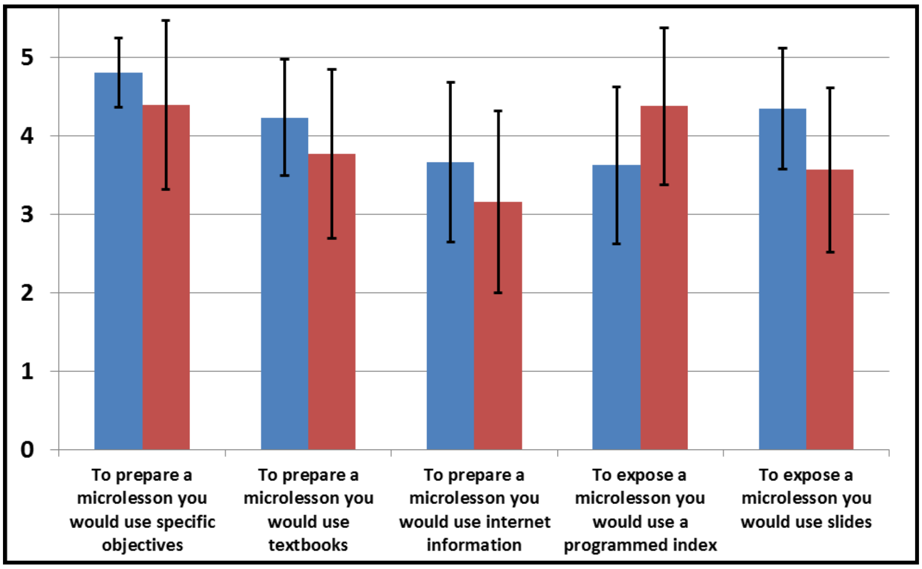

Figure 1. *Items that showed statistically significant differences for the comparison of Q1 (before the microlesson) vs. Q2 (after the microlesson) responses. Responses corresponding to Q1 are shown in blue and Q2 responses are in red. Black bars represent standard deviations.*

4 DISCUSSION

The application of microteaching as a self-learning method to tissue engineering is of interest not only as a way for students to acquire new competences and skills but also because tissue engineering is a multidisciplinary field that requires major teaching synthesis efforts (Sánchez-Quevedo, Cubero, Alaminos, Crespo & Campos, 2006). In the present work, we have analyzed the perceptions of the students in the preparation and exposition of a microlesson in a tissue engineering course. Although the study has several limitations, including the possibility that even a brief previous information might affect the results, it could shed light on our comprehension of the students' preferences involved in microteaching.

In our results, the perception of students involved in teaching and receiving a microlesson was similar for most of the items analyzed in both questionnaires. This means that in most of the items, students do not change their perceptions about preferences on how to elaborate a topic for teaching and how to expose it, before and after a microteaching session. This result implies that the application of microteaching method is useful because it will strengthen the beliefs about the teaching and learning procedure that the students previously had, and therefore, allows them to be more involved and committed with their own learning process (Gelula, 2002; Trott, 1976).

However, in our results, the perception of students also revealed statistically significant differences, before teaching a microlesson and after receiving it, in several items: three items regarding the preparation of the microlesson and two ones related to its exposition.

Interestingly, students consider they would use more significantly specific objectives, textbooks and Internet information before preparing a microlesson than after its reception. This could be linked to the information that the students consider that should be incorporated to a microlesson and to the objectives that they believe they should reach before the microteaching session. When receiving the microlesson they realize that it is impossible to teach efficiently with such extensive information. Regarding the exposition, the students showed significant differences in the use of a previously programmed index and in the use of slides. Following a pre-programmed index during the exposition and a limited use of slides are more preferred by the students after receiving the microlesson. It is paradoxical and very interesting that students give less importance to the expository order when they are preparing the microteaching session than when they are receiving it. Similarly students want less slides when they receive the microlesson that when they are in charge to prepare the microteaching session. Nevertheless, the ultimate reasons why certain items are preferred by students remain unexplained, and future qualitative studies should be carried out to investigate these reasons.

Although microteaching was initially addressed to young teachers to improve their pedagogical techniques under supervision of skilled colleagues, the extension of this technique to the students as a self-learning tool has demonstrated to be very useful to change the student's behavior and therefore, their attitude towards the learning process. As shown in our study, the main reason for this change could be in the process of self-assessment that students do. As pointed out by Popovich and Katz (2009), microteaching technique not only helps students to ''think on their feet" and be reflective, but it also provides an opportunity to get a constructive feedback.

The new teaching guidelines emphasize the need for students to engage in self-regulation of learning and practice (Brydges & Butler, 2012; Butler, 1995). As the self-assessment is linked to how individuals seek and interpret feedback as pointed out by Sargeant, Mann, van der Vleuten & Metsemakers (2008) and Sargeant et al., (2010), we consider that the use of microteaching techniques is not only useful for self-learning but also as a tool to promote self-regulation across the curriculum.

5 CONCLUSIONS

In this study we compare the students' perceptions of the students who provide instruction in tissue engineering using microteaching and the perceptions of the same students when they receive such instructions. To know the student's perceptions in both circumstances, is a key element to develop and implement a self-learning program using this instrument.

We conclude that students prefer to use more significantly specific objectives, textbooks and Internet information in order to prepare a microlesson than after the reception of such microlesson. To make use of the programmed index in the exposition and to reduce the use of slides are preferred more significantly by the students after receiving the microlesson than when they are preparing it. These results show that the self-assessment generated by the microteaching session, which is linked to the feedback related to the self-learning process, makes microteaching a technique not only useful for self-learning but also an important tool to promote self-regulation across the curriculum.

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V. CRITERIOS DE CALIDAD DE LOS ARTICULOS PUBLICADOS

La tesis doctoral está constituida por la agrupación de tres artículos científicos y de material inédito no publicado presentado en formato artículo que se relacionan con los distintos objetivos de la tesis. En dichos artículos el autor de la tesis ha sido el primer firmante de los mismos.

Los artículos científicos han sido aceptados para su publicación o publicados en papel o formato digital en Revistas Internacionales que cumplen los criterios de calidad de 1) Normalización Editorial (datos del Editor, Institución y lugar de edición, registro ISSN), 2) Gestión de Edición (instrucción de autores, comités editoriales, proceso de arbitraje, fechas sobre los manuscritos), 3) Visibilidad (distribución, inclusión en base de datos y servicios de información), 4) Contenidos (resúmenes, palabras clave, referencias, afiliación de autores) y 5) Revisión por pares.

Los artículos:

- **Reception Learning and Self-Discovery Learning in Histology: Students' Perceptions and Their Implications for Assessing the Effectiveness of Different Learning Modalities**

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

han sido publicados en **Anatomical Sciences Education**, Revista internacional editada en Estados Unidos por Wiley-Blackwell y Wiley Journal-Online Library que es la revista de referencia sobre educación para las ciencias anatómicas incluida la Histología. La revista que cumple todos los requisitos arriba reseñados y está incluida en Thomson Scientific (el antiguo ISI) en el campo de la educación, alcanzo en el año 2010 un impacto de 2.976. En la actualidad está indexada en las siguientes bases de datos:

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- Web of Science (Thomson Reuters)

El artículo:

• Microteaching as a self-learning tool. Students´perceptions in the preparation and exposition of a microlesson in a tissue engineering course.

está incluido en **Journal of Technology and Science Education, r**evista internacional editada por OmniaScience Journals que cumple todos los requisitos arriba reseñados y está orientada hacia la innovación docente en ciencia y tecnología. En la actualidad está indexada en las siguientes bases de datos:

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- RACO
- Hellenic Academic Libraries Link
- Electronic Journals Library
- ROAR
- Academic Journals Database
- OJS-Open Journal Systems

VI. CONCLUSIONES

Las conclusiones obtenidas en relación con los distintos objetivos son las siguientes:

1. En relación con el objetivo Identificar los componentes de la motivación vinculados con el aprendizaje de la histología en los curricula de medicina, odontología y farmacia.

1.1. El estudio realizado sobre los cinco componentes motivacionales (la motivación intrínseca, la autoeficacia, la autodeterminación y los dos componentes de la motivación extrínseca -la motivación de grado y la motivación de carrera-), en los estudiantes de histología de los currículos de medicina, odontología y farmacia, pone de relieve la existencia de diferencias significativas en el perfil motivacional de los estudiantes de dichos currículos, lo que debería tenerse en cuenta para fomentar el desarrollo de estrategias didácticas vinculadas a dichos perfiles.

1.2. En relación con los distintos componentes motivacionales, la autoeficacia y la motivación de carrera presentan un perfil similar, mostrando valores decrecientes de medicina a odontología y de odontología a farmacia, existiendo una correlación positiva significativa con los resultados académicos finales obtenidos por los estudiantes de dichos currículos. Los componentes autodeterminación y motivación de grado presentan, asimismo, un perfil similar, siendo superiores los valores obtenidos en odontología, seguidos de medicina, encontrándose los valores más bajos en estudiantes de farmacia. En este caso, no existe correlación estadística entre estos dos componentes y los resultados académicos finales. En el caso de la motivación intrínseca, los resultados mostraron valores decrecientes de medicina a farmacia y de ésta a odontología, no existiendo correlación significativa con los resultados académicos finales de los alumnos de dichos currículos. De todo ello se infiere que sólo los componentes motivacionales (autoeficacia y motivación de carrera) contribuyen significativamente a determinar el rendimiento académico.

2. En relación con el objetivo Identificar los componentes de la motivación vinculados a las modalidades didácticas de la histología sustentadas en el autoaprendizaje.

2.1. El estudio realizado para identificar los factores que determinan la motivación en las dos modalidades didácticas utilizadas básicamente en histología, el aprendizaje receptivo y el autoaprendizaje, pone de relieve una motivación preferente por el aprendizaje receptivo sobre el autoaprendizaje por parte de los estudiantes de histología. Dicha motivación preferente viene significativamente determinada por los siguientes factores: la obtención de nuevo conocimiento y su aplicación al diagnóstico, la terapéutica y la investigación, y la aspiración al liderazgo y la competitividad, con diferencias significativas en los alumnos a favor del liderazgo y en las alumnas a favor del sentido de la responsabilidad. De todo ello se infiere la necesidad de revisar didácticamente la modalidad del autoaprendizaje en el proceso de enseñanza-aprendizaje de la histología, incorporando a sus distintas variantes pedagógicas un conocimiento histológico orientado hacia la clínica.

2.2. El estudio realizado sobre la motivación para utilizar estrategias complementarias de aprendizaje en las modalidades didácticas de aprendizaje receptivo y de autoaprendizaje, pone de relieve una motivación significativamente mayor por parte de los estudiantes de histología, con independencia de su sexo, para utilizar recursos complementarios adicionales tras la utilización del aprendizaje receptivo que tras la utilización del autoaprendizaje. De ello se infiere que la modalidad didáctica de autoaprendizaje facilita al estudiante de histología la propia autorregulación de su proceso formativo, a diferencia de lo que ocurre con el aprendizaje receptivo y con independencia de la orientación didáctica de su contenido.

3. En relación con el objetivo **Desarrollar un instrumento pedagógico para la histología que articule la motivación vinculada al curriculum y la vinculada a las modalidades didácticas de autoaprendizaje**

3.1. El estudio realizado sobre la utilización de nuevos instrumentos pedagógicos que vinculen la adquisición de los objetivos curriculares con el desarrollo de la autorregulación a través del autoaprendizaje en el ámbito de la histología pone de relieve la utilidad de dos recursos innovadores: el cuaderno audiovisual y la microlección, los cuales satisfacen el logro de de ambos principios en lo que se refiere al proceso de enseñanza-aprendizaje de la histología.

3.2. El estudio realizado en relación con la elaboración de un cuaderno audiovisual por parte de los estudiantes pone de relieve que tanto éstos como los profesores priorizan significativamente los componentes de información, imágenes y realización fílmica. Ambos, alumnos y profesores, muestran asimismo un perfil similar en la relevancia dada al contenido informativo e iconográfico del cuaderno, si bien los primeros hacen significativamente más énfasis en las competencias procedimentales, y los profesores, en las conceptuales. En relación con la impartición y recepción de las microlecciones por parte de los estudiantes, el estudio pone de relieve diferencias significativas entre el proceso de elaboración y el de captación de las mismas, lo que promueve el proceso de autorregulación en los estudiantes que utilizan el instrumento. De todo ello se infiere que la utilización de ambos instrumentos innovadores, el cuaderno audiovisual y las microlecciones, contribuyen a alcanzar los objetivos histológicos del curriculum a través del autoaprendizaje y la autorregulación sin generar modificaciones significativas de su contenido.

VII. REFERENCIAS BIBLIOGRÁFICAS

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