

Original Communications**PEER TEACHING GROSS ANATOMY TO STUDENT TUTORS****Georg Feigl***Institute of Macroscopic and Clinical Anatomy, Medical University of Graz, Graz, Austria***RESUMEN**

Objetivos: Los tutores estudiantiles de anatomía tienen que poseer grandes habilidades para poder guiar a otros estudiantes durante los cursos de disecciones. Para mejorar la calidad de los tutores estudiantiles es necesario establecer conceptos de aprendizaje entre pares. Métodos: Los tutores estudiantiles recibieron una formación bajo el concepto de aprendizaje entre pares por parte de un médico anatomista certificado con mucha experiencia en el ámbito. El entrenamiento incluyó disecciones en vivo del programa de disecciones de dos módulos (aparato locomotor y anatomía topográfica) en un quórum abierto. El entrenamiento duró dos a tres horas por cada sesión. Adicionalmente, los tutores pudieron observar instrucciones de disecciones en videos. En la sala de disecciones, se aplicó un sistema jerárquico de supervisión. El resultado del aprendizaje entre pares (supervisión, apoyo en general, interés en el éxito de aprendizaje, apoyo en la conducta de aprendizaje) fue comparado por medio de un sistema de evaluación oficial para los estudiantes (escala de Likert 1-5 [1 buena – 5 mala]) previamente y posteriormente a la aplicación de este sistema de entrenamiento. Resultados: La valoración de los tutores aumentó significativamente en todos los parámetros comparados (aparato locomotor: supervisión [previamente a la aplicación: 2,25; posteriormente a la aplicación: 1,45]; interés en la conducta de aprendizaje [previamente: 2,33; posteriormente: 1,45]; interés en el éxito de aprendizaje [previamente: 2,61; posteriormente: 1,45]; apoyo en general [previamente: 2,03; posteriormente: 1,6]; observaciones personales positivas [previamente: 25 comentarios; posteriormente: 150 comentarios]; anatomía topográfica: supervisión [previamente: 1,89; posteriormente: 1,6]; interés en la conducta de aprendizaje [previamente: 1,93; posteriormente: 1,4]; interés en el éxito de aprendizaje [previamente: 2,1; posteriormente: 1,78]; apoyo en general [previamente: 1,88; posteriormente: 1,68]; observaciones personales positivas: [previamente 0; posteriormente: 120 comentarios]). Conclusión: El método de aprendizaje entre pares aplicado para la docencia de tutores estudiantiles en la anatomía mejora significativamente la calidad y la satisfacción de los tutores.

Palabras claves: aprendizaje entre pares, anatomía macroscópica, tutores estudiantiles

ABSTRACT

Objectives: Anatomical student tutors have to provide high skills for teaching students in dissection courses. To increase the quality of these student tutors, peer teaching concepts need be introduced. Materials and Methods: Student tutors received peer teaching by an experienced board-certified anatomist. The training included live dissections of the dissection program of two modules (Locomotion and topographic anatomy) in an open quorum. The training lasted for two to three hours per session. Additionally, the tutors could view video instructions. In the dissection hall, a special hierarchical supervising system was used. Official online student's evaluation (Likert scale 1-5 [1 good-5 poor]) "before" and "after" implementation of this training system was compared to assess the result of the peer teaching method (supervision, interest in learning behaviour, interest in learning success, support in learning). Results: The assessment of tutors significantly increased in all statements (Locomotion: supervision [before implementation: 2.25; after implementation: 1,45]; interest in learning behaviour [before: 2.33; after: 1,45]; interest in learning success [before: 2.61; after: 1,45]; support in learning [before: 2.03; after: 1,6]; positive personal comments [before: 25 comments; after: 150 comments]; Topographical anatomy: supervision [before: 1,89; after: 1,6]; interest in learning behaviour [before: 1,93; after: 1,4]; interest in learning success [before: 2,1; after: 1,78]; support [before: 1,88; after: 1,68]; positive personal comments [before: 0; after: 120 comments]). Conclusions: The implemented teaching method seems to increase the quality of the student tutors successfully.

Key words: peer teaching, gross anatomy, student tutors

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INTRODUCTION

Teaching is one of the main domain of Institutes of Anatomy all over the world. Lectures and dissection courses regularly are part of the medical curriculum to provide best manual, practical skills and sound knowledge for medical students before reaching the clinical field. However, due to the fact that the number of highly skilled anatomists at universities decreases, the idea to include students working as tutors facilitated the supervision and teaching of high number of students and to provide peer teaching for such tutors.

This is not a new idea of Institutes of Anatomy but has been used for decades in the medical field. Interestingly, publications focused on these peer teaching models came up about a decade ago (Dandavino et al 2007; Lachmann et al 2013; Pasquinelli and Greenberg, 2008; Moxham and Plaisant, 2014). Almost at the same time, anatomical concepts of such peer teaching systems in the anatomical gross anatomy courses were mentioned by Youdas et al (2008), Jay et al (2013) and Boeckers et al (2010). One of the major problems mentioned in these publications was, that the quality of such students tutors highly depended on their self-reflection and self-studying. Working as a tutor is a very demanding job with high responsibilities to the students, the Institute of Anatomy, the University and also themselves. To improve the quality of student tutors, many German Universities started to evaluate different factors and needs for student tutors (Shiozawa, 2010; Horneffer, 2016; Walser, 2017) which were found to be improvement of content knowledge, technical and didactical competencies.

The Institute of Macroscopic and Clinical Anatomy (IoA) of the Medical University of Graz (MUG) has faced exactly the same problems. Student tutors do have different pre-knowledge and experience because they are third to sixth year students. As third year students, they could start working as tutors at the IoA. Precondition was good marks in the modules "Locomotion", "Communication" (Neuroanatomy) and the track "Topographic Anatomy". However, anatomical knowledge of the entire human body is not covered during these modules or track. Additionally, they do not have an oral exam of the entire human body anymore. As a consequence, student tutors start working at the IoA with partially good and poor anatomical knowledge and dissection skills, because during their own dissection course as tutees, they only dissect on large region of the body. The other regions are studied during the course theoretically with oral

exams on this region or are not dissected, learned and examined at all.

With their University career as student tutors, they have to study a lot on their own to get the knowledge and experience to supervise and support the tutees because one of the major demands for student tutors are dissection skills on the entire body for optimal supervision. The last three decades, these student tutors learned their skills during their work as pre-academic staff, which means that these staff members still are students of the 3rd to 6th (or higher) year of medical school. As a consequence, the evaluation of these student tutors differs a lot and was not satisfying at all and highly depended on the experience of the student tutor. We recognized a good evaluation when tutors had worked at the IoA for at least 2 years whereas evaluation was not as good for student tutors in their first or second year at the IoA.

The aim of this new improved concept was, to minimize the missing pre-knowledge and manual skills on dissection and to improve the quality of student tutors but also the young assistants of their first and second year. So, it includes a peer teaching in combination with near-peer teaching, where experienced tutors assist, supervise and "teach" not experienced tutors in the dissection hall. Results were assessed by comparing online evaluation before and after implementation.

Additionally, this system was implemented to ease work of the permanent academic staff of the IoA which consists in 2 Professors, 2 habilitated anatomists, 2 board certified anatomists, 1 senior scientist, 1 senior lecturer, 2 assistants who regularly have to supervise and teach 540 students per year

MATERIALS AND METHOD

The student tutors training program was implemented for two dissection courses; module "Locomotion" (2nd semester) and track "Topographic Anatomy" (3rd semester) for students of human medicine. Training was optional for all 42 student tutors and two assistants.

- General Frame:

Module "Locomotion" (2nd semester students):

This module is held in the summer semester (SS), includes lectures of joints of the limbs, vertebral column and general and special anatomy of the muscles. The dissection course lasts for four weeks, two weeks of joints and two for limbs. The 540 tutees have to dissect one joint, a second one has to be studied (the order of joints to be dissected and studied is predetermined; as an example: hip joint is

dissected, elbow joint has to be studied). For the “muscle” part, one limb (e.g. lower limb) has to be dissected and the other one to be studied. Tutees have to pass 4 oral exams during the dissection course (2 joints, 2 limbs). With the first day of dissection course, tutees have to dissect all major joints of the limbs (groups of 2 students): shoulder, elbow, hand, hip joint (including pelvic girdle), knee, foot. 4 to 5 students/ group were allocated to upper limb and 5 to 6 students formed a group to dissect lower limb. As a consequence, the tutors have to know the principles and instructions for dissections of all six specimens with the first day of dissection. The same request has to be fulfilled with the first day of dissection of muscles of lower and upper limb. Dissection course for Track “Topographic Anatomy” (3rd semester; always in winter semester [WS] from second week of October until Christmas time; dissection of the entire body):

Tutees form groups of 10 students per cadaver; 540 students attend the course per year. The groups are divided into two groups (each 5 tutees). One group dissects on Tuesday and

Thursday (1 student Head/Neck; 2 students Thorax; 2 students Abdomen/Pelvis), the second group on Wednesday and Friday (1 student Head/Neck; 2 students for upper limb; 2 students for lower limb). Tutees have to dissect these regions by following a dissection program (online downloadable) and they have to pass oral exams on other regions (Peritoneal cavity, thoracic cavity, neck) partially without dissecting them. The final exam is on the region, they dissected (Abdomen/ pelvis/ lower limb; thorax/ upper limb; head/neck). Student tutors have to provide dissection skills of all regions. Unfortunately, first year tutors cannot provide experience on the entire dissection program.

- Training program:

The training program consists of following parts, which were individually adapted to the two courses:

1. Pre-dissection
2. dissection videos
3. special hierarchical supervising system in the dissection course
4. additional: lectures

Region-Seziertag	Mo., 16.10.2017	Di., 17.10.2017	Mi., 18.10.2017	Do., 19.10.2017	Fr., 20.10.2017	Sa., 21.10.2017	So., 22.10.2017
Fig. 1							
Hals I rechts		A. u. V. facialis, Ductus parotideus, N. buccalis, Regio temporalis superficialis		Trigonum caroticum: V. jug. int., N. XI, Ansa cervicalis prof., A. carotis, N. X, N. laryngeus sup., Truncus sympathicus			
Kopf-Hals II links			Glandula parotidea mit Nerven-, Gefäß- und Ductusaustritt		A. u. V. facialis, Ductus parotideus, N. buccalis, Regio temporalis superficialis		
Brust I re.-li.		Trigonum deltoideopectorale, tiefe Schichte		Fascia axillaris superficialis			
Brust II re.-li.			Regio cubiti profunda		A. u. V. radialis, A. u. V. ulnaris, N. medianus, Flexoren am Unterarm		
Bauch I re.-li.	17h00: Pre-dissection	Regio inguinalis (beim Mann: Funiculus spermaticus, Scrotum u. Inhaltsgebilde)		M. rectus abdominis, M. pyramidalis, A. epigastrica inf., M. rectus- Durchtrennung			
Bauch II re.-li.			Fascia cruris mit N. saphenus, V. saphena magna		A. u. V. tibialis ant., N. peroneus profundus u. superficialis		

Figure 1.- Shows the program of one week of the Track “Topographic Anatomy” of the last year. On The pre-dissection is scheduled on Monday where the entire program of the day Tuesday to Friday is dissected.

Course "Locomotion":

Pre- dissection started about four weeks prior the dissection course. These "training sessions" were organised on Monday evening (5pm) that all student tutors could attend. In total, 4 sessions were performed (3 sessions for joints, 1 for limbs). One session of joints included 2 joints, starting with shoulder and elbow. The other sessions included hand/hip, knee/foot and instruction for dissection the muscles of the limbs in the final session. Sessions lasted about two to three hours each. An experienced habilitated and board certified anatomist performed live dissections transferred on screens in an open Quorum, that student tutors or assistants could interrupt and ask questions at any time. The program of each session was sent to the tutors three weeks prior that they could prepare theoretically. To reflect the instructions, tutors could regard the dissection instructions which were available online for all tutees, tutors and

assistants. In addition, tutors could attend the lectures of the module optional.

Dissection course for Track "Topographic anatomy":

Optional "training sessions" were held on Monday evening (5pm or 6pm) (Fig. 1). Again, the same experienced habilitated and board-certified anatomist performed the entire dissection program of one week on a single cadaver. Dissections were performed live and transferred on screens to be discussed in an open quorum. Additional two cadavers were provided for dissections, which could be performed by the student tutors after the session or on other days. The dissection program of the entire course was downloadable prior the semester (Fig. 1). Old instructive videos (recorded by former head of loA Prof. Thiel) were available for tutors. As in the course "locomotion" tutors were free to attend the lectures.



Figure 2.- Shows results of the online evaluation form: The four statements important for this manuscript and included in the assessment are marked as S1-S4. Please note, that different number of answers were given (S1: n=315; S2: n= 100; S3: n= 120; S4: n= 307)

- Supervising system in the courses:
Special hierarchical supervising system for both dissection courses: New first and second year tutors had to supervise one or maximal two groups of students in the course Track "Topographic Anatomy". Tutors working at the IoA in their third or higher year supervised 4 to 6 young tutors. In the course "Locomotion", they were responsible to supervise 2 tables (maximal 6 students per table). Experienced tutors supervised two rows (maximal 8 tables). Young assistants were allocated to supervise 20 groups of students (Track "Topographic Anatomy") and 20 tables (course "Locomotion"). Board certified anatomists, habilitated anatomists and professors were not allocated to any groups to provide supervision of all staff members and students.

- Evaluation:

The training method was implemented in winter semester 2015/16 for track "Topographic Anatomy", and summer semester 2016 for course "Locomotion" for the first time. Students online evaluation of the courses (questionnaire and results of evaluation was given from the office for evaluation of the Medical University of Graz to the IoA) before and after implementation were compared. All results are downloadable on the website. The questionnaire itself was a longer one. Out of the entire questionnaire, the four statements concerning the course "Locomotion" and Track "Topographic Anatomy" were taken (Fig. 2). For answers, a five-point Likert scale was used (1 very good, 2 good, 3 moderate, 4 poor, 5 very poor) and the mean was taken and provided (Fig. 2).

1. Statement 1 (S 1): Supervision of the organizer of the course was good
2. Statement 2 (S 2): The staff of the IoA took care of me and supported my learning behaviour
3. Statement 3 (S 3): My tutor was interested in my learning success
4. Statement 4 (S 4): I was optimally supported by my tutor

In addition, personal statements of tutees about tutors were regarded if significant changes were noticeable. Personal statements are not online available and only visible to the module coordinator (Examples for countable personal statements: "my tutor was prepared", "my tutor was helpful", "thank you to my tutor Ms xx or Mr xy")

RESULTS

Online evaluation showed a significant positive evaluation of tutors in both dissection courses. Module "Locomotion" (Table 1): After implementation of the peer teaching model in the summer semester 2016, the evaluation showed significant better results as before implementation. Statements 1 to 3 had a dramatic change whereas statement 4 (optimal support of tutor) slightly got better. In addition, we had a very high return rate of completed evaluation forms in this year. Personal negative statements ("I was not supported by my tutor"; "My tutor was not well prepared") remained constant, positive comments significantly increased.

Table 1: Course „Locomotion“	SS 2012 (n= maximum 140)	SS 2014 (n= max103)	SS 2015 (n= max121)	SS 2016 (n= max315)
S1	1,92	2,25	2,19	1,45
S2	2,33	2,31	1,83	1,45
S3	2,53	2,61	2,57	1,66
S4	2,03	1,93	1,7	1,6
Positive personal statements	Not available	20	25	150
Negative personal statements	Not available	15	18	8

Table 1.- the table shows the results of the module "Locomotion". Red columns provide the results before implementation and black after implementation of the peer teaching system.

Track "Topographic Anatomy" (Table 2): Concerning all four statements, the evaluation results were better after implementation than before. Best results were noticed for statement 2 and statement 3. The statement 4 (optimal support of tutor) showed no dramatic change.

One hundred and twenty positive personal statements were documented. Not a single negative was documented. Unfortunately the course organizer did not provide any data from courses prior implementation.

Table 2: Course „TopographicAnatomy“	WS 14/15	WS 15/16	WS 16/17
S1	1,89	1,71	1,6
S2	1,93	1,76	1,4
S3	2,1	1,78	1,78
S4	1,88	1,76	1,68
Positive personal statements	Not available	Not available	120
Negative personal statements	Not available	Not available	0

Table 2.- the table shows the results of the Track “Topographic Anatomy”. Red columns provide the results before implementation and black after implementation of the peer teaching system.

DISCUSSION

Some Institutes of Anatomy, as our Institute too, might have small numbers of permanent staff members who are medical doctors and board certified anatomists. Such Institutes have to include student tutors, who are all human medical or dental medical students for teaching but are facing the challenge to develop strategies in improving the quality of their tutors to keep the quality of teaching. As a consequence, the tutors have a high responsibility on teaching from the very first minute being included in the temporary faculty of the Institute. This manuscript clearly indicates that an implementation of a special peer teaching system does generally influence the student's evaluation positively.

As the tutors mainly are working with the students in the dissection lab, so at the dissection table, they need to be well prepared to motivate the group which is supervised and deal with the difficulties which might appear. Alvarez et al (2017) suggest that a preparatory training course should be included. This is especially based on the fact that the tutors at the University Heidelberg only work as tutors for one semester. As a consequence, this requires special peer teaching and training to reach highest quality of the tutors as possible. Certainly, this training has to be introduced individually for each University, because of the different curricula and therefore demands for tutors.

Shiozawa et al. (2010a) implemented a three-week combined technical and didactical program. To assess the effect of their program, Shiozawa et al (2010b) compared two groups of tutors, untrained and trained. The training included dissections as well as presentation techniques, group dynamics and activating teaching methods. They report a significant better evaluation of trained tutors. Although our training program mainly focus on the “dissection skills” and group dynamic, which is forced by the supervising system we can strongly confirm the results of

Shiozawa (2016), that such a training is highly recommended and needed. In personal debates with the tutors, the board-certified anatomist who instructed the tutors received a feedback that this kind of training highly motivated the tutors for self-studying and increasing their anatomical knowledge. In addition, this was confirmed by the results of the student's evaluations.

We just can assume that our didactic training program might influence the examination results in Graz. Unfortunately, we did not directly focus on this. However, Horneffer et al (2016) reported such an influence on examination results. Horneffer (2016) also compared two groups of tutors: Tutors participating at a “Train the tutor” educational program with tutors not participating at this program. Although the students evaluated the performance of the tutors of both groups almost equal, the examination results of the students who were supervised by the trained tutors showed better marks and lower failure rates. Nevertheless, the marks of a dissection course should be taken with caution because much more important is how much of the knowledge can be kept permanently.

Everybody will agree that this knowledge is almost impossible to be measured. On the other hand, Shiozawa et al (2016) assessed the learning behaviour of medical students coached by trained or untrained tutors. They report that students supervised by trained tutors are better organized in their learning and do learn more with their trained tutor. Indirectly this can be measured in better results in the exams, as reported by Horneffer (2016) and probably affect the permanent knowledge of the students.

In any way, anatomical peer teaching programs do influence the test scores of the peer teachers themselves (Erie et al, 2013; Evans and Watt, 2005; Nnodim, 1997; Shields et al, 2015). However, as we were interested in the general effect of the implemented training course for the anatomical tutors at the MUG this might be of particular interest in future observations. The

current results clearly indicate that, the implemented pre-dissections do affect the performance of the tutors. In addition, one can assume that the near peer teaching supports the system of the pre-dissection training.

One very important difference to the manuscripts of Shiozawa et al (2010), Horneffer et al (2016) or Alvarez et al (2017), that all these manuscripts provide no further information of the experience or level of the teacher who performed the trainings. The pre-dissections in our program are performed by a board certified anatomist with 25 years of experience in dissection. Nevertheless, concerning the current study it would be of great interest, if the performance of the tutors in the courses change, when a less experienced academic supervisor give the training lessons. Anyway, with the possible risk to decrease the quality of teaching, we will not focus on such an investigation.

Summarizing, our study and the listed manuscripts about peer teaching and near-peer teaching in the field of anatomy clearly show the advantage of such training programs. However, it is important to state, that all programs are individual programs always specially adapted to the curriculum of each university. Anyone, who wants to implement such a peer teaching system need to filter, which training programs or which parts could be implemented or adapted to be introduced and to reach best results as possible at their universities.

Conflict of interest

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Informed consent

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