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Self-efficacy's Influence on Student Academic Achievement in the Medical Anatomy Curriculum

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Self-efficacy is defined as a person's beliefs in his or her own abilities to successfully complete a task and has been shown to influence student motivation and academic behaviors. More specifically, anatomical self-efficacy is defined as an individual's judgment of his or her ability to successfully complete tasks related to the anatomy curriculum; these include dissecting, learning anatomical concepts, and applying anatomical knowledge to clinical situations. The purpose of this study was to investigate the influence of anatomical self-efficacy on the academic performance of students enrolled in a medical gross anatomy course. To obtain students' anatomical self-efficacy ratings, surveys containing the same anatomical self-efficacy instrument were completed by first-year medical students at a southeastern United States allopathic medical school after each of four gross anatomy assessments. Additional data collected included student demographic information, Medical College Admission Test® (MCAT®) scores, and anatomy assessment scores, both written examination and laboratory practical. To investigate the potential predictive nature of self-efficacy for academic performance on both the written examination and the laboratory practical components of medical anatomy assessments, hierarchical linear regression analyses were conducted. For these analyses, academic ability (defined as the sum of the physical sciences and biological sciences MCAT scores) was controlled. The results of the hierarchical linear regressions indicated that all four laboratory practical scores were predicted by the corresponding self-efficacy ratings, while two (i.e., thorax/abdomen and pelvis/lower limb) of the four written examination scores were predicted by the corresponding self-efficacy ratings ($P \leq 0.05$). Anat Sci Educ 5: 249–255. © 2012 American Association of Anatomists.

Key words: self-efficacy; medical education; gross anatomy education; academic achievement; summative assessment; laboratory practical score; written examination score; MCAT score

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Grant sponsor: Fund for the Improvement of Postsecondary Education (FIPSE); Grant number: P116B010181.

Received 31 December 2011; Revised 23 March 2012; Accepted 28 March 2012.

Published online 31 May 2012 in Wiley Online Library (wileyonlinelibrary.com). DOI 10.1002/ase.1283

INTRODUCTION

Albert Bandura, the author of the theory of self-efficacy, defined perceived self-efficacy "as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986). In other words, perceived self-efficacy is a personal judgment an individual makes about his or her own capabilities or abilities to successfully perform a task (Schunk, 1991). When a person has high self-efficacy, the individual perceives that they have the skills to succeed at a task, while a person with low self-efficacy perceives that they do not have the skills to succeed at a task. Self-efficacy is a self-perception of capability (Morris, 2004) and is considered task, situation, or domain specific (Pajares, 1996).

Constructing one's own self-efficacy is a cognitive process which integrates information (Hampton, 1998) of varying influence and derived from a variety of sources (Bandura, 1977, 1986). Bandura (1977, 1986) theorized that self-efficacy beliefs are acquired through four main sources of information, namely: (1) personal performance accomplishments (also called enactive attainment or mastery experiences); (2) vicarious or observational experiences; (3) social verbal persuasion; and (4) physiological and emotional states. It is important to note that these four sources are not inherent, but must be cognitively processed to gain value when constructing self-efficacy (Hampton, 1998).

Self-efficacy is a factor that impacts student motivation and has been found to influence a number of academic behaviors (Schunk, 1984, 1991). This perceived judgment of capability influences a person's choice in activities (Bandura, 1994), their persistence (Schunk and Pajares, 2002), and the amount of effort the individual puts forth (Zimmerman, 2000). Of particular interest to this study is the positive correlation observed between self-efficacy and academic achievement (Lent et al., 1984; Pintrich and De Groot, 1990; Multon et al., 1991; Schunk, 1995; Pajares, 1996; Schunk and Pajares, 2002). Although most often studied at the primary and secondary school level, the capability of self-efficacy to predict academic achievement has also been demonstrated at the collegiate level (Cavallo et al., 2004).

Predictors for medical student success in the gross anatomy curriculum have been addressed by studies conducted by Forester et al. (2002), as well as Peterson and Tucker (2005). Both studies specifically investigated the role of premedical coursework as predictors of medical gross anatomy performance. Forester et al. (2002) found that students completing premedical gross anatomy and/or histology earned significantly more points in corresponding medical courses than those lacking those same premedical coursework experiences. Peterson and Tucker (2005) found similar results except that instead of correlating the prior coursework with points earned in the medical anatomy course, they investigated class rank in the medical anatomy course and the score earned on the comprehensive final examination. There has been, however, no previous published research that has investigated student motivation for first year medical core courses and the influence that medical student motivation may have on academic achievement. Included in this lack of motivational research is the investigation of student self-efficacy for the medical gross anatomy curriculum and self-efficacy's predictive properties for that course. Within the context of the medical anatomy curriculum, perceived anatomical self-efficacy includes an individual's judgment of his or her ability to complete tasks such as dissecting, learning anatomical knowledge, and applying anatomical knowledge to clinical situations.

The purpose of this study was to investigate whether anatomical self-efficacy ratings predict measures of academic performance (i.e., written examination score and laboratory practical score) in a medical gross anatomy course, when controlling for academic ability. This research was undertaken due to: (1) the importance of anatomy in medicine (Leonard et al., 1996; Cottam, 1999; Day and Ahn, 2010); (2) the significant gap in the self-efficacy research at the post-secondary education level (Bailey, 1999; Morris, 2004); and (3) the lack of studies investigating the role motivation plays in predicting medical anatomy curricular success.

EXPERIMENTAL PROCEDURES

Participating students were members of the first year medical student class (MS1) in the fall of 2004 at a southeastern United States allopathic medical school. These students completed a combined gross human anatomy, radiology, and embryology course as part of their first year medical school coursework. In total, five surveys were completed by the participating MS1 students; one pre-survey administered prior to beginning the medical anatomy course and four post-surveys administered immediately after students completed assessments in the course. All five surveys administered to MS1 participants contained the same embedded anatomical self-efficacy instrument, while the pre-survey also provided students with the opportunity to report information regarding their anatomical experiences prior to medical school and demographic information. For this particular research question, which investigates the predictive nature of self-efficacy for medical anatomy academic performance, only the self-efficacy ratings obtained through the post-surveys taken at the time of each assessment were of interest. Lastly, with participants' informed consent, all of their anatomy assessment scores (both written and laboratory practical) and their Medical College Admission Test® (MCAT®) scores were obtained from the medical school registrar.

The anatomical self-efficacy instrument (Figure 1) embedded in the surveys consisted of 16 anatomical self-efficacy items, based on the college biological literacy self-efficacy instrument for non-majors described by the Baldwin et al. (1999). Principal axis factoring (PAF) of the 16 self-efficacy survey items was used to investigate how well these items related to one another by extracting underlying factors which correspond to unobservable constructs (Green and Salkind, 2004), such as self-efficacy. PAF produced an eigenvalue (i.e., variability) for each extracted factor and an extracted factor was of interest when its eigenvalue was 1 or higher [e.g., eigenvalue-greater-than-one criterion (Kaiser, 1960; Green and Salkind, 2004)]. The PAF also produced factor loading scores (i.e., correlation) for each item to a particular extracted factor. When interpreting the factor loadings, any item that presented a loading (i.e., correlation) of 0.3 or higher on an extracted factor was retained. PAF also produced an overall factor score for each extracted factor for each participant. This factor score was used as the self-efficacy rating of a student at a particular assessment point within the course. Therefore, a separate PAF was conducted for each self-efficacy data set obtained during a respective survey administration period within the course.

Students needed to respond to at least 75% (or 12) of the self-efficacy items to be included in the self-efficacy analyses, including PAF, related to a particular assessment point. For those students who completed at least 75% of the self-efficacy items at a particular assessment point, any missing data were substituted with the average of the remaining items completed by the student at that respective time point, otherwise the statistical software package would drop incomplete cases from the factor analysis.

Students completed four in-class summative assessments as part of the medical anatomy course; assessment 1 covered the back and upper limb, assessment 2 covered the thorax and abdomen, assessment 3 covered the pelvis and lower limb, and assessment 4 covered the head and neck. Each assessment included a written multiple-choice question examination component (worth 50%) and a laboratory practical component

SELF-EFFICACY--*Please CIRCLE the number that applies.*

The answers to these questions can be the following:

1—If you are **not at all** confident that you can do the task.
2—If you are **only a little** confident that you can do the task.
3—If you are **fairly** confident that you can do the task.
4—If you are **very** confident that you can do the task.
5—If you are **totally** confident that you can do the task.

	Not at All	Only a Little	Fairly	Very	Totally
1) I am confident that I can make the proper cuts in the cadaver as outlined in the lab manual.	1	2	3	4	5
2) I am confident that I can successfully answer questions from the professors **during dissection laboratories**.	1	2	3	4	5
3) I am confident that I can use dissection tools.	1	2	3	4	5
4) I am confident that I can successfully complete the dissections.	1	2	3	4	5
5) I am confident that I can correctly pronounce anatomical terms.	1	2	3	4	5
6) I am confident that I can learn anatomical relationships (i.e. how one item relates to another in position in the body).	1	2	3	4	5
7) I am confident that I can learn anatomical terms and definitions.	1	2	3	4	5
8) I am confident that I can perform successfully on the anatomy course **written** exams.	1	2	3	4	5
9) I am confident that I can perform successfully on the anatomy course **lab practical** exams.	1	2	3	4	5
10) I am confident that I will be able to retain and recall anatomical knowledge **for use in a clinical setting**.	1	2	3	4	5
11) I am confident that I can actively participate in anatomical discussions **with the professors in the dissection laboratories**.	1	2	3	4	5
12) I am confident that I can locate anatomical structures in the human cadaver.	1	2	3	4	5
13) I am confident that I can identify anatomical abnormalities in the human cadaver.	1	2	3	4	5
14) I am confident that I can describe anatomical structures to a **non-medical** person.	1	2	3	4	5
15) I am confident that I can successfully answer **anatomical-based** questions **during clinical rotations**.	1	2	3	4	5
16) I am confident that I can learn the anatomical content of this anatomy course.	1	2	3	4	5

Figure 1.

Anatomical Self-Efficacy Instrument. This anatomical self-efficacy instrument was incorporated into surveys and administered five times during a medical gross anatomy course, once before the course began and once after each of the four assessments during the course. The coefficient alpha for the anatomical self-efficacy instrument (composed of all 16 items) ranged from 0.90 to 0.96 depending on the survey administration, indicating the scale had a high degree of internal reliability. The statements in this instrument were based on the self-efficacy instrument developed by Baldwin et al. (1999) to measure the self-efficacy of undergraduate non-biology majors for biology.

(worth 50%). Each component (i.e., the written examination and the laboratory practical) was worth 100 points, with the final score for the total assessment obtained by averaging the two components. The written component's multiple-choice questions required students to demonstrate anatomical knowledge in terms of classical relationships, imaging (e.g., X-rays, MRIs, and CTs), embryology, function, general terminology, and clinical correlations. The laboratory component consisted of fill-in-the-blank identifications on labeled cadavers, models, skeletons, and images (e.g., X-rays, MRIs, CTs, and embryological scanning electron micrographs). The laboratory practical questions were timed, with the students limited to 1 minute per question.

Academic ability for each student was defined by the sum of the student's scores obtained on the Medical College Admission Test (MCAT) Physical Sciences section and the MCAT Biological Sciences section. The MCAT examination serves as a predictor for academic success in medical school, as MCAT scores have been shown to predict medical school grades and the United States Medical Licensing Examination® (USMLE®) Step 1, Step 2, and Step 3 scores (Jones and Thomae-Forgues, 1984; Julian, 2005; Callahan et al., 2010). The science sections of the MCAT were only used for this study as MCAT science knowledge sections have been shown to have a higher average correlation with first year medical student grades than other MCAT sections (Jones and Thomae-Forgues, 1984).

To investigate whether anatomical self-efficacy ratings predict academic performance on the four written examination components and the four laboratory practical examination components, hierarchical linear regression analyses using SPSS statistical package for Windows, version 11.5.0 (SPSS Inc., Chicago IL) were conducted. For these analyses, academic ability, defined as the sum of the MCAT Physical Sciences section and MCAT Biological Sciences section scores, was controlled.

This research protocol was reviewed and approved by the Committee on the Protection of the Rights of Human Subjects [Medical Institutional Review Board (IRB)] of the participants' home institution. As part of this protocol, informed consent was obtained from all participants.

RESULTS

Response Rates

The response rates decreased throughout the duration of survey administration (i.e., throughout the course), from mid-August to mid-December. Initially, 157 MS1 students consented to participate in the study and completed the pre-survey, along with a consent form that requested permission to obtain and use all student survey data, MCAT scores, and all anatomy assessment scores (i.e., written and practical) for the project. However, responses dropped to 147 (93.6%) for post-survey 1, to 137 (87.3%) for post-survey 2, to 125 (79.6%) for post-survey 3, and to 113 (72.0%) for post-survey 4.

Descriptive Statistics

Descriptive statistics were conducted to provide demographic characteristics for the non-random sample in the areas of age, gender, MCAT score, and ethnicity. The ages of the MS1 participants reporting their date of birth ($n = 153$) ranged from 22 years of age to 39 years of age, with the mean being 24.9 years of age (sd = 3.09) on August 1, 2004. Of the MS1 participants reporting their gender ($n = 152$), 80 (52.6% of total) were male and 72 (47.4% of total) were female. The MCAT scores of MS1 participants ($n = 153$) ranged from 21 to 39, with the mean being 31.27 (sd = 3.72).

Of the 151 students that reported their ethnicity, 112 (74.2% of total) reported that they were Caucasian, 20 (13.2% of total) reported they were African American, 9 (6.0% of total) reported they were Asian American, and 6 (4.0% of total) reported they were Indian (Asian Subcontinent). The remainder of the students declared races that included 3 or fewer students, including other.

Principal Axis Factoring

The extraction method, principal axis factoring (PAF), with data obtained from the self-efficacy instrument yielded two factors for the pre-survey, four factors for post-survey 1, and three factors for post-survey 2, post-survey 3, and post-survey 4. However, the first factor for all five analyses had a much larger eigenvalue (i.e., variability) than any of the following factors and explained anywhere from 38.36 to 58.69% of the item variance. The factor loadings indicated that a few items cross-loaded at some of the time points, but not across all the time points, and their loadings were always stronger and positive on the first factor. Therefore, all 16 items were retained in one factor, the first factor, identified as the anatomical self-efficacy rating of the medical students, and the factor scores for factor 1 in all PAF procedures were retained as the student anatomical rating of self-efficacy at each respective assessment time point during the course. It should be noted that the self-efficacy ratings (i.e., the factors scores) derived from PAF are standardized scores with an overall mean of zero.

Hierarchical Linear Regression

To investigate whether anatomical self-efficacy ratings predict academic performance at each of the four assessment administrations, hierarchical linear regression analyses were conducted (Table 1). For these analyses, academic ability, defined as the sum of the MCAT Physical Sciences section and MCAT Biological Sciences section scores, was controlled. The anatomical self-efficacy ratings of students at each assessment point were the first factor scores retained from PAF. When the regression analyses were conducted, no interaction effect was observed between the self-efficacy rating and the MCAT science score for any of the laboratory practical or written examination regression analyses.

Assessment 1 (A1), consisting of a laboratory practical component (LP1) and a written examination component (WE1), was the first assessment in the medical anatomy course and covered material on the back and upper limb regions of the human body. At A1, 143 participants completed at least 75% of the self-efficacy items on post-survey 1, a requirement defined for this study, and were therefore retained for further analyses. Of those participants, the mean self-efficacy rating at the time of the post-survey 1 completion was 0 (sd = 0.97) and the mean MCAT science score was 21.15 (sd = 2.98). The score on LP1 [mean = 80.69 (sd = 10.21)] was predicted by the MCAT science score [R^2 change = 0.052, $F(1, 141) = 7.677$, $P = 0.006$]. The score on LP1 was then predicted by the self-efficacy rating at that time point [R^2 change = 0.072, $F(1, 140) = 11.478$, $P = 0.001$, $\beta = 0.269$], when MCAT science score was controlled. The score on WE1 [mean = 82.38 (sd = 7.389)] was predicted by the MCAT science score [R^2 change = 0.086, $F(1, 141) = 13.279$, $P < 0.001$]. The score on WE1 was not predicted by the self-efficacy rating at that time point [R^2 change = 0.020, $F(1, 140) = 3.172$, $P = 0.077$, $\beta = 0.143$], when MCAT science score was controlled.

Assessment 2 (A2: LP2 and WE2) was the second assessment in the medical anatomy course and covered material on the thoracic and abdominal regions of the human body. At A2, 133 participants completed at least 75% of the self-efficacy items on post-survey 2. Of those participants, the mean self-efficacy rating at the time of the post-survey 2 completion was 0 (sd = 0.98) and the mean MCAT science score was 21.20 (sd = 2.90). The score on LP2 [mean = 80.49 (sd = 8.75)] was predicted by the MCAT science score [R^2 change = 0.029, $F(1, 131) = 3.974$, $P = 0.048$]. The score on LP2 was then predicted by the self-efficacy rating at that time

Table 1.

Results of Hierarchical Linear Regressions Investigating the Predictive Nature of Self-Efficacy for Academic Performance Controlling for Academic Ability

Assessment component	Content	*F* change	df1	df2	*P*	Standardized β weights for self-efficacy	*R* square change
LP1	Back and upper limb	11.478	1	140	0.001[a]	0.269	0.072
WE1	Back and upper limb	3.172	1	140	0.077	0.143	0.020
LP2	Thorax and abdomen	10.130	1	130	0.002[a]	0.265	0.070
WE2	Thorax and abdomen	6.064	1	130	0.015[a]	0.207	0.043
LP3	Pelvis and lower limb	20.794	1	119	<0.001[a]	0.378	0.143
WE3	Pelvis and lower limb	6.798	1	119	0.010[a]	0.223	0.050
LP4	Head and neck	7.286	1	109	0.008[a]	0.241	0.056
WE4	Head and neck	1.189	1	109	0.278	0.097	0.009

This table shows the results of the hierarchical linear regression analyses investigating the predictive nature of anatomical self-efficacy for academic performance on each of the four unit assessments, controlling for academic ability. Academic ability was defined as the sum of the Physical Sciences and Biological Sciences MCAT section scores. Self-efficacy, when controlling for academic ability, predicted all four laboratory practical components (i.e., LP1, LP2, LP3, and LP4) and two of the four written examination components (i.e., WE2 and WE3).
[a]Statistically significant at $P \leq 0.05$

point [R^2 change = 0.070, $F(1, 130) = 10.130$, $P = 0.002$, $\beta = 0.265$], when MCAT science score was controlled. The score on WE2 [mean = 81.19 (sd = 7.50)] was predicted by the MCAT science score [R^2 change = 0.044, $F(1, 131) = 6.018$, $P = 0.015$]. The score on WE2 was then predicted by the self-efficacy rating at that time point [R^2 change = 0.043, $F(1, 130) = 6.064$, $P = 0.015$, $\beta = 0.207$], when MCAT science score was controlled.

Assessment 3 (A3: LP3 and WE3) was the third assessment in the medical anatomy course and covered material on the pelvic and lower limb regions of the human body. At A3, 122 participants completed at least 75% of the self-efficacy items on post-survey 3. Of those participants, the mean self-efficacy rating at the time of the post-survey 3 completion was 0 (sd = 0.98) and the mean MCAT science score was 21.22 (sd = 3.00). The score on LP3 [mean = 76.19 (sd = 10.00)] was predicted by the MCAT science score [R^2 change = 0.041, $F(1, 120) = 5.155$, $P = 0.025$]. The score on LP3 was then predicted by the self-efficacy rating at that time point [R^2 change = 0.143, $F(1, 119) = 20.794$, $P < 0.001$, $\beta = 0.378$], when MCAT science score was controlled. The score WE3 [mean = 79.00 (sd = 7.89)] was predicted by the MCAT science score [R^2 change = 0.077, $F(1, 120) = 10.017$, $P = 0.002$]. The score on WE3 was then predicted by the self-efficacy rating at that time point [R^2 change = 0.050, $F(1, 119) = 6.798$, $P = 0.010$, $\beta = 0.223$], when MCAT science score was controlled.

Assessment 4 (A4: LP4 and WE4) was the fourth and final assessment in the medical anatomy course and covered material on the head and neck region of the human body. At A4, 112 participants completed at least 75% of the self-efficacy items on post-survey 4. Of those participants, the mean self-efficacy rating at the time of the post-survey 4 completion was 0 (sd = 0.98) and the mean MCAT science score was 21.15 (sd = 2.97). The score on LP4 [mean = 82.04 (sd = 8.85)] was predicted by the MCAT science score [R^2 change = 0.100, $F(1, 110) = 12.178$, $P = 0.001$]. The score on LP4 was then predicted by the self-efficacy rating at that time point [R^2 change = 0.056, $F(1, 109) = 7.286$, $P = 0.008$, $\beta = 0.241$], when MCAT science score was controlled. The score on WE4 [mean = 80.55 (sd = 9.79)] and was predicted by the MCAT science score [R^2 change = 0.155, $F(1, 110) = 20.205$, $P < 0.000$]. The score on WE4 was not predicted by the self-efficacy rating at that time point [R^2 change = 0.009, $F(1, 109) = 1.189$, $P = 0.278$, $\beta = 0.097$], when MCAT science score was controlled.

DISCUSSION

Hierarchical linear regressions were used to investigate the predictive nature of anatomical self-efficacy for academic performance of students in medical gross anatomy, while controlling for academic ability. The results indicated that for all four laboratory practical (i.e., LP1, LP2, LP3, and LP4), scores were predicted by the corresponding self-efficacy ratings while corresponding self-efficacy ratings predicted the score for two (i.e., WE2 and WE3) of the four written examinations. The written examinations whose scores were predicted by anatomical self-efficacy were the second examination, covering the thoracic and abdominal regions of the body, and the third examination, covering the pelvic and lower limb regions of the body. The written examinations whose scores were not predicted by the anatomical self-efficacy were the first examination, covering the back and upper limb regions of the body, and the fourth examination, covering the head and neck regions of the body.

Connection to Earlier Studies

The finding that medical student anatomical self-efficacy predicted the academic outcomes, defined as the laboratory practical and/or written examination scores in the medical anatomy course, is similar to previous research findings at other educational levels. For example, a meta-analysis of self-efficacy studies from the 1980s indicated that self-efficacy beliefs accounted for approximately 14% of the variance in academic performances of students in different curriculums from elementary school to college (Multon et al., 1991).

A closer look at self-efficacy research in the undergraduate student setting reveals that researchers have found that self-efficacy predicts academic performance at the university level (Andrew, 1998; Klomegah, 2007). However, most (if not all) research has focused on the prediction of final course grades (Andrew, 1998; Klomegah, 2007) instead of individual assessment scores. For example, Andrew (1998) demonstrated that the science self-efficacy of undergraduate nursing students predicted the final score the students obtained in two first-year science courses.

Influence of Self-Efficacy

Self-efficacy influences academic performance by acting as one determinate of behavioral and psychological activities (Schunk, 1984; Bandura, 1986; Schunk, 1991; Pajares, 1996; Bandura, 1997; Zimmerman, 2000; Britner and Pajares, 2006). These includes choice of activities (Bandura, 1986; Bandura, 1994; Zimmerman, 2000), effort expenditure (Bandura, 1986; Zimmerman, 2000), persistence (Lent et al., 1984; Bandura, 1986; Zimmerman, 2000), use of cognitive strategies (Pintrich and De Groot, 1990), use of self-regulatory strategies (Pintrich and De Groot, 1990), and the setting of personal goals (Zimmerman et al., 1992). In terms of choice in behaviors, individuals will select tasks for which they have higher self-efficacy, while those with lower self-efficacy tend to avoid tasks believed to be beyond the scope of their capabilities (Bandura, 1986). Although all medical students at this institution (as well as others) must complete the medical anatomy course, there are still various levels of student participation available within the course, especially in the dissection laboratory. As students are divided into dissection groups and with only so many members of a group being able to dissect at any given time, those students with higher anatomical self-efficacy may possibly choose to take possession of the dissection tools and complete the dissection for their group. Those students that choose to carry out the dissection more often thus receive more mastery experiences then their less active group members, as well as possibly learn additional information as it pertains to the relationships of anatomical structures in the body. Therefore, this difference in participation could lead to higher assessment scores, especially when it comes to the laboratory practical portions of the assessments. This may be one reason all four laboratory practical scores were predicted by the corresponding anatomical self-efficacy rating in contrast to only two of the four written examination scores.

There are a number of other hypotheses as to why the first written examination component on the back and upper limb regions and the fourth written examination component on the head and neck regions were not predicted by the respective self-efficacy ratings. The first hypothesis is based on the self-efficacy instrument itself. The 16 items on the anatomical self-efficacy instrument can be split into four categories: (1) laboratory activities including dissection and laboratory practicals (eight items); (2) general anatomical learning and activities (four items); (3) clinical activities related to anatomy (three items); and (4) written anatomy examinations (one item). It is possible that many of the students were unable to make the connection between the laboratory activities (e.g., dissection) and the material assessed on the written examinations. Therefore, for example, although they may have had low beliefs in their abilities to successfully complete laboratory activities, a fundamental component of the anatomy curriculum, those beliefs may not have impacted their written examination performance.

The second hypothesis for why the first and third written components were not predicted by the self-efficacy ratings is that students received extensive preparation for the first and fourth written examinations outside of the laboratory, unlike the second and third written examinations. Specifically, there was a practice written examination available for the students to complete only prior to the first written examination and the fourth written examination contained a lot of neuroanatomical material that could not be visualized in the laboratory.

Role of the Anatomy Instructor

As mentioned above, there are various levels of student participation within a medical anatomy course, especially in the dissection laboratory. Within a few weeks, it is often observed that the students in a dissection group fall into permanent roles within the group. For example, in a dissection group of four students, two students often become the "dissectors," while the other two students often become the "readers" of dissection instructions. With this permanent division of labor, two students receive more mastery experiences in terms of dissection, while the readers only receive vicarious information by watching the dissectors. Therefore, the role of the instructor is to find ways to rotate the division of labor in the dissection group so that one person is not always the dissector or the reader, and thus ensure that all students get the opportunity for mastery experiences in anatomy. This is vital, since an individual's own authentic accomplishments, successes, and mastery experiences provide the most reliable and influential information for accessing self-efficacy (Bandura, 1977, 1986; Schunk, 1991; Bandura, 1994, 1995, 1997; Schunk, 2004) and are more dependable than vicarious or observational experiences (Bandura, 1977, 1986). There are also clinical implications to this rotation of labor, since dissecting provides the students the opportunity to begin learning the manual dexterity required to use medical instruments such as the scalpel, scissors, and forceps (Ellis, 2001) and "an appreciation of the strength or fragility of tendons, ligaments, and nerves" (Jones, 1997) that cannot be learned or appreciated through observation.

FUTURE DIRECTIONS

Although this is an initial investigation into the role of anatomical self-efficacy in the medical anatomy curriculum, it is apparent from these findings that further investigation is warranted. Of particular interest is the possible role prior experiences in anatomy play into self-efficacy ratings of students as they enter medical school. A better understanding of the relationship of coursework completed prior to medical school with medical school academic achievement and subsequent medical practice would be valuable when considering medical school admission prerequisites. In addition, research has found gender differences in self-efficacy beliefs, specifically that males report higher self-efficacy than females in science (Tippins, 1991; Anderman and Young, 1994; Meece et al., 2006). Although gender differences in self-efficacy have been studied principally at the primary and secondary level, the same gender discrepancies in science self-efficacy have also been demonstrated at the collegiate level (Cavallo et al., 2004). It is therefore of particular interest to us whether these gender differences in science self-efficacy are observed with medical students in relation to the anatomy curriculum. A subsequent research paper will address these areas.

CONCLUSIONS

The results of this study indicate the predictive nature of anatomical self-efficacy for the academic performance of students in the medical gross anatomy curriculum. Our findings suggest that educators should consider the role motivation (which includes self-efficacy) plays on academic achievement at all educational levels, including within professional schools, and ways to enhance that motivation to further the success of their students.

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