Can research participation positively impact medical student research self-efficacy?

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Abstract

Background: Mentored research experiences during medical school can establish a scholarly foundation for residency, as well as deepen student's confidence and practical knowledge in evidence-based clinical practice. Despite these positive outcomes, many students begin medical school without prior research experience, thus creating the potential for stress, discomfort, and procrastination in pursuing research experiences during training.

Purpose: To determine the impact of a required research project on student gains in research self-efficacy, and to identify factors facilitating medical student research success.

Methods: A cross-sectional survey design was used to collect data on medical student self-reported confidence to complete 13 specific research tasks. Surveys were distributed and collected from students in four medical school classes (MSI, MSII, MSIII, and MSIV).

Results: The number of research projects completed was a significant indicator for increased confidence and self-efficacy for research participation; for writing a literature review; computing a power and sample size analysis; and summarizing and presenting project results. Significant differences were found between genders on constructing a dataset, choosing statistical analyses, describing and summarizing the meaning of results, with males showing greater confidence.

Conclusions: Research self-efficacy can develop and increase for medical students through exposure to research methods training, mentoring, and successful completion of research projects.

Keywords: Medical student research self-efficacy; medical student research; building self-efficacy; student confidence

Introduction

Mentored research experiences during medical school have potential to positively influence evidence-based medical
practice, create a scholarly foundation for residency training and medical practice, as well as enhancing student confidence in practicing medicine. Research in this context includes any student and research mentor conceived, implemented, and completed scholarly experience. Literature suggests two main goals of scheduled medical school research experience, to produce additional physician researchers and medical scholars, and to train knowledgeable physicians with the experience, skills and abilities to access and evaluate published medical research (Black, et al, 2013; Chang and Ramnanan, 2015). At minimum, research participation facilitates development of critical thinking, problem solving, and analytical skills. Ideally, students become conversant with the scientific method as well as gain some facility with research methods, including ethical principles (Liaison Committee on Medical Education, 2016). Researchers have identified a positive association between medical student research training and participation and improvement in learning approaches in the rest of the curriculum (Imafuku, et al, 2015). The benefits of engaging in mentored research may be apparent to experienced research faculty, however many students begin medical school without prior research experience. For naïve researchers, a requirement to engage in research at the medical school level can produce anxiety, possibly adding to an already tenuous confidence in their ability to master the medical curriculum. Lacking prior research experience, students may exhibit low self-efficacy for the relevant tasks. The potential benefits for medical practice are significant as trainees develop knowledge and comfort with primary research resources as well as clinical reasoning, critical thinking and problem solving skills. Some medical schools integrate research methods training and experiences into the curriculum through required or voluntary opportunities, summer programs, and electives (Chang and Ramnanan, 2015; Zier, Friedman, and Smith, 2006).

To determine to what extent completing a research requirement during medical school affects students’ self-efficacy for engaging in research, we distributed a survey to four classes of medical students enrolled in a four-year US medical education program. Survey questions asked students to gauge their confidence in successfully completing a series of research tasks. We undertook this study to inform our school's support structure for required research, to ensure that students had the resources and mentoring necessary for successful completion of a research project during medical training.

Specific Aims

Our main research question: Do measureable changes in self-efficacy for research activities occur in relation to completing a required medical school research project?

Aim 1 - Identify medical student self-reported confidence to successfully perform specific research tasks in each of four years of medical training, MSI, MSII, MSIII, and MSIV.

Aim 2 - Measure differences in responses between classes and determine if score differences are statistically significant.

Aim 3 - Identify factors that facilitate student development of research self-efficacy.

Study Context. At the study school (~419 student, four-year MD program), completion and presentation of results of a research project is a graduation requirement. Institutional assistance includes a MSI research project orientation and implementation handbook, assistance with securing a research mentor, funding for implementation and conference travel ($1250 per student), MSIV student research day (with formerly, monetary research awards). Students have the four years of medical school to complete the required research, and are encouraged to engage in additional projects as time allows. Program components are experiential with guided faculty mentoring and periodic interim deadlines.

Medical Students and research self-efficacy

Self-efficacy is defined by Social Cognitive Theory as confidence in one’s ability to successfully complete a specific task (Bandura, 1993); therefore a student may feel highly efficacious in mastery of course content but less so in
conceptualizing and completing a research project. While interest in medical research may be conceptual, self-efficacy for doing research is affective, practical, and based in personal experience. Confidence in one's ability for successful completion of a behavior, task, or action arises from developed skill and belief in the success of implementing that skill (Artino, 2012; Bandura, 1993). Efficacy beliefs are strengthened through: mastery experience (performance accomplishment), based on domain specific personal achievement; vicarious experience, based on watching someone else perform a task which creates belief of success in one's own ability; social interaction (verbal persuasion), verbal, experiential and encouraging engagement with others; or emotional arousal (psychological or physiological change states (Bandura, 1993; Shunk, 2001). Competency beliefs influence how "people feel, think, motivate themselves, and behave" (Bandura, 1993, pg. 118). Low self-efficacy is a major reason behind procrastination and avoiding tasks, whereas high self-efficacy can generate motivation and task focus (Artino, 2012; Bandura, 1993; Shoemaker, 2010). Self-efficacy beliefs are situational, intertwined with the environment, along with the personal aspects of learning motivation (Shunk, 2001). To build efficacy for research some medical schools have provided summer research training programs including didactic, experiential, and mentoring components, with results indicating a significant increase in self-efficacy for research (Black, et al, 2013; Halpain, et al, 2005). A negative relationship between research anxiety and research self-efficacy was identified (Rezaei and Zamani-Miandashti, 2013). Increasing student research self-efficacy could strengthen student engagement and confidence with the medical curriculum generally. Since efficacy beliefs generally strengthen with successful experiences, we considered the possibility that self-efficacy for research might strengthen during medical school as a byproduct of conceptualizing, implementing and presenting results of a mentored research project.

Methods

Using a cross-sectional study design, a self-created "Attitudes toward Research" survey (Appendix) was sent to four (4) classes of medical students: MSI- (Google doc survey); MSII- (Google doc survey); MSIII- (paper survey during an OSCE); and MSIV- (Google doc survey) during fall semester 2016. Students were recruited by email (MS I, MS II, MS IV) and recruited during a regularly scheduled Objective Structured Clinical Exam (OSCE) [MS III].

The University of New Mexico, School of Medicine Human Research Protections Office (HRPO) approved the study (HRRC # 00-071), September 6, 2016. Students indicated consent by completing and submitting the survey.

Data collection and analysis. The "Attitudes toward Research" survey contained 13 items describing tasks related to completing a research project, with one open-ended "general comments" section (Appendix). We also collected demographic information for grouping variables (class year, gender, and number of research projects participated in over time). Students indicated their level of confidence in performing each research task by choosing a number corresponding to their response on a scale from 1 (I cannot do this at all) to 100 (I am highly certain I can do this). Project researchers generated survey questions based on literature and experience with medical student research.

Results/Analysis

Using Stata 14.2, summary statistics for survey data (55.25% response rate) were calculated on each survey item and the grouping variables (Tables 1-3). Student's t-tests and ANOVA were conducted on class response scores on the 13 items. There were no statistical differences between classes, gender and experience (number of projects).
| Class                                                                 | N  | Mean | S.D. | S.E. | 95% C.I  |
|---------------------------------------------------------------------|----|------|------|------|----------|
| Research/scholarly study conceptualization (concept)                |    |      |      |      |          |
| MS 2017                                                             | 38 | 6.8  | 2.2  | 0.35 | 6.1-7.5  |
| MS 2018                                                             | 85 | 7.4  | 1.8  | 0.19 | 7.0-7.8  |
| MS 2019                                                             | 61 | 7.0  | 2.1  | 0.27 | 6.5-7.5  |
| MS 2020                                                             | 55 | 6.6  | 2.7  | 0.37 | 6.3-7.3  |
| Identifying and working with a research mentor (mentor)            |    |      |      |      |          |
| MS 2017                                                             | 38 | 7.1  | 2.5  | 0.40 | 6.3-8.0  |
| MS 2018                                                             | 75 | 7.5  | 2.1  | 0.23 | 7.1-8.0  |
| MS 2019                                                             | 70 | 7.0  | 2.8  | 0.36 | 6.3-7.7  |
| MS 2020                                                             | 69 | 6.9  | 2.6  | 0.35 | 6.2-7.6  |
| Constructing research questions/hypotheses (quest_hyp)             |    |      |      |      |          |
| MS 2017                                                             | 70 | 7.0  | 2.2  | 0.36 | 6.3-7.7  |
| MS 2018                                                             | 73 | 7.3  | 1.7  | 0.19 | 6.9-7.7  |
| MS 2019                                                             | 66 | 6.6  | 2.1  | 0.27 | 6.1-7.2  |
| MS 2020                                                             | 65 | 6.5  | 2.4  | 0.32 | 5.9-7.1  |
| Completing a literature review that summarizes current research in topic area (litreview) |    |      |      |      |          |
| MS 2017                                                             | 78 | 7.8  | 2.1  | 0.34 | 7.2-8.5  |
| MS 2018                                                             | 77 | 7.7  | 1.9  | 0.21 | 7.3-8.1  |
| MS 2019                                                             | 62 | 6.2  | 2.7  | 0.34 | 5.6-6.9  |
| MS 2020                                                             | 65 | 6.5  | 2.7  | 0.36 | 5.8-7.2  |
| Creating an appropriate study design (studydesign)                  |    |      |      |      |          |
| MS 2017                                                             | 60 | 6.0  | 2.5  | 0.40 | 5.2-6.8  |
| MS 2018                                                             | 66 | 6.6  | 2.3  | 0.25 | 6.1-7.1  |
| MS 2019                                                             | 57 | 5.7  | 2.4  | 0.30 | 5.1-6.3  |
| MS 2020                                                             | 57 | 5.7  | 2.2  | 0.30 | 5.1-6.3  |
| Completing a power analysis (poweranalysis)                        |    |      |      |      |          |
| MS 2017                                                             | 33 | 3.3  | 2.7  | 0.44 | 2.4-4.2  |
| MS 2018                                                             | 46 | 4.6  | 3.0  | 0.32 | 3.9-5.2  |
| MS 2019                                                             | 29 | 2.9  | 2.6  | 0.33 | 2.2-3.5  |
| MS 2020                                                             | 44 | 4.4  | 2.9  | 0.40 | 3.6-5.2  |
| Designing methods of data collection (datacollect)                  |    |      |      |      |          |
| MS 2017                                                             | 52 | 5.2  | 2.4  | 0.40 | 4.4-6.0  |
| MS 2018                                                             | 61 | 6.1  | 2.5  | 0.27 | 5.6-6.7  |
| MS 2019                                                             | 51 | 5.1  | 2.6  | 0.34 | 4.4-5.8  |
| MS 2020                                                             | 58 | 5.8  | 2.3  | 0.31 | 5.2-6.5  |
| Constructing a data set (dataset)                                   |    |      |      |      |          |
| MS 2017                                                             | 57 | 5.7  | 2.7  | 0.44 | 4.8-6.6  |
| MS 2018                                                             | 58 | 5.8  | 2.8  | 0.30 | 5.2-6.4  |
| MS 2019                                                             | 54 | 5.4  | 3.0  | 0.38 | 4.6-6.1  |
| MS 2020                                                             | 59 | 5.9  | 2.9  | 0.38 | 5.2-6.7  |
| Choosing statistical analyses that will answer research questions (statanalysis) |    |      |      |      |          |
| MS 2017                                                             | 38 | 3.8  | 2.7  | 0.44 | 2.9-4.7  |
| MS 2018                                                             | 50 | 5.0  | 2.8  | 0.31 | 4.4-5.6  |
| MS 2019                                                             | 41 | 4.1  | 3.0  | 0.38 | 3.4-4.9  |
| MS 2020                                                             | 49 | 4.9  | 3.0  | 0.41 | 4.1-5.7  |
| Describing and summarizing the meaning of obtained results (results) |    |      |      |      |          |
| MS 2017                                                             | 67 | 6.7  | 2.1  | 0.34 | 6.0-7.4  |
| MS 2018                                                             | 69 | 6.9  | 2.2  | 0.23 | 6.4-7.4  |
| MS 2019                                                             | 58 | 5.8  | 2.7  | 0.35 | 5.1-6.5  |
| MS 2020                                                             | 68 | 6.8  | 2.4  | 0.32 | 6.2-7.5  |
| Requesting study approval from the Human Research Protections Office (HRPO) |    |      |      |      |          |
| MS 2017                                                             | 53 | 5.3  | 3.4  | 0.55 | 4.2-6.4  |
| MS 2018                                                             | 61 | 6.1  | 2.7  | 0.29 | 5.5-6.7  |
| MS 2019                                                             | 45 | 4.5  | 3.1  | 0.40 | 3.7-5.3  |
| MS 2020                                                             | 48 | 4.8  | 3.0  | 0.40 | 3.9-5.6  |
| Presenting research results, oral or poster format (presentposter)  |    |      |      |      |          |
| MS 2017                                                             | 76 | 7.6  | 2.5  | 0.41 | 6.8-8.4  |
| MS 2018                                                             | 78 | 7.8  | 2.3  | 0.25 | 7.3-8.3  |
| MS 2019                                                             | 68 | 6.8  | 2.6  | 0.33 | 6.1-7.5  |
| MS 2020                                                             | 71 | 7.1  | 2.7  | 0.37 | 6.3-7.8  |
Presenting research results in a written format (presentpaper)

Table 2: Summary Statistics by Gender

| Gender | N   | Mean | S.D. | S.E. | 95% C.I |
|--------|-----|------|------|------|---------|
| Research/scholarly study conceptualization (concept) | Female | 126 | 7.1 | 2.3 | 6.6 | 7.5 |
| | Male | 112 | 6.9 | 2.0 | 6.6 | 7.3 |
| Identifying and working with a research mentor (mentor) | Female | 7.1 | 2.7 | 0.21 | 6.6 | 7.6 |
| | Male | 7.3 | 2.7 | 0.19 | 6.8 | 7.7 |
| Constructing research questions/hypotheses (quest_hyp) | Female | 6.7 | 2.3 | 0.20 | 6.3 | 7.1 |
| | Male | 7.1 | 1.8 | 0.17 | 6.7 | 7.4 |
| Completing a literature review that summarizes current research in topic area (litreview) | Female | 6.8 | 2.5 | 0.22 | 6.4 | 7.3 |
| | Male | 7.4 | 2.3 | 0.22 | 6.9 | 7.8 |

Table 3: Summary Statistics by Number of Projects

| No. of Projects | N   | Mean | S.D. | S.E. | 95% C.I |
|-----------------|-----|------|------|------|---------|
| Research/scholarly study conceptualization (concept) | None | 29 | 5.5 | 2.5 | 4.6 | 6.5 |
| | 1-3 | 153 | 6.8 | 2.0 | 6.5 | 7.3 |
| | 4 + | 49  | 8.1 | 1.8 | 7.6 | 8.6 |
| Identifying and working with a research mentor (mentor) | None | 6.1 | 2.5 | 0.47 | 5.1 | 7.0 |
| | 1-3 | 70  | 2.5 | 0.20 | 6.6 | 7.4 |
| | 4 + | 80  | 2.2 | 0.31 | 7.1 | 7.7 |
| Constructing research questions/hypotheses (quest_hyp) | None | 5.8 | 2.3 | 0.42 | 4.9 | 6.6 |
| | 1-3 | 6.7 | 2.0 | 0.27 | 6.4 | 7.1 |
| | 4 + | 7.7 | 1.9 | 0.27 | 7.2 | 8.3 |
| Completing a literature review that summarizes current research in topic area (litreview) | None | 5.5 | 2.6 | 0.48 | 4.5 | 6.5 |
| | 1-3 | 6.9 | 2.4 | 0.19 | 6.5 | 7.5 |
| | 4 + | 8.3 | 1.7 | 0.24 | 7.9 | 8.8 |
| Creating an appropriate study design (studydesign) | None | 5.0 | 2.1 | 0.39 | 4.2 | 5.8 |
| | 1-3 | 5.8 | 2.3 | 0.18 | 5.5 | 6.2 |
| | 4 + | 6.9 | 2.3 | 0.33 | 6.3 | 7.6 |
| Completing a power analysis (poweranalysis) | None | 3.4 | 2.1 | 0.40 | 2.6 | 4.2 |
| | 1-3 | 3.7 | 2.9 | 0.23 | 3.2 | 4.1 |
| | 4 + | 4.5 | 3.2 | 0.46 | 3.6 | 5.4 |
| Designing methods of data collection (datacollect) | None | 4.9 | 2.3 | 0.43 | 4.0 | 5.8 |
| | 1-3 | 5.3 | 2.4 | 0.19 | 5.0 | 6.2 |
| | 4 + | 6.8 | 2.6 | 0.37 | 6.0 | 7.5 |
| Constructing a data set (dataset) | None | 4.8 | 2.7 | 0.50 | 3.8 | 5.9 |
| | 1-3 | 5.4 | 2.7 | 0.22 | 5.0 | 5.8 |
| | 4 + | 6.8 | 2.9 | 0.42 | 6.0 | 7.6 |
| Choosing statistical analyses that will answer research questions (statanalysis) | None | 4.0 | 2.6 | 0.48 | 3.1 | 5.0 |
| | 1-3 | 4.4 | 2.9 | 0.24 | 3.9 | 4.8 |
| | 4 + | 5.2 | 3.0 | 0.43 | 4.3 | 6.1 |
| Describing and summarizing the meaning of obtained results (results) | None | 5.8 | 2.6 | 0.47 | 4.8 | 6.8 |
| | 1-3 | 6.3 | 2.4 | 0.19 | 5.9 | 6.7 |
| | 4 + | 7.6 | 1.9 | 0.27 | 7.1 | 8.2 |
Requesting study approval from the Human Research Protections Office (HRPO)  | None | 1-3 | 4 + | 1-3 | 4 + |
|----------------|------|-----|-----|-----|-----|
| 4.0 | 4.9 | 7.1 | 6.2 | 7.1 | 8.4 | 6.0 | 6.9 | 8.3 |
| 2.8 | 3.0 | 2.7 | 2.7 | 2.5 | 2.1 | 2.4 | 2.5 | 1.8 |
| 0.52 | 0.24 | 0.38 | 0.50 | 0.21 | 0.29 | 0.04 | 0.20 | 0.26 |
| 2.9 | 4.4 | 6.3 | 5.2 | 6.7 | 7.8 | 5.1 | 6.5 | 7.7 |
| 5.1 | 5.4 | 7.8 | 7.2 | 7.5 | 9.0 | 6.9 | 7.3 | 8.8 |

One-way ANOVAs of the 13 items by class year revealed some differences between groups on four of the 13 items. A significant difference between groups was found on efficacy in putting together a literature review (p=0.0001) and Tukey-Kramer pairwise comparisons allowed us to distinguish which groups drove the significant differences. First- and second-year students in the classes of 2020 and 2019 felt significantly less confident in putting together a literature review than third- and fourth-year students in the classes of 2018 and 2017 (Figure 1).

Figure 1: Confidence putting together a Literature Review. By class year, newest to oldest

In computing a power and sample size analysis, ANOVA showed a significant difference in feeling of efficacy between the groups (p=0.0016) but the direction of the difference was interesting. While there were no significant differences between most of the groups, there was a significant dip in confidence from the first year class (2020) to the second year class (2019). That dip in confidence then righted itself with the third year class of 2018 (Figure 2).
A significant difference between classes was also detected on summarizing the meaning of results ($p=0.03$), with the second-year class of 2019 feeling significantly less confident than the third-year class of 2018 (Figure 3). Finally, students in different class years also showed a significant difference in confidence in requesting study approval from the Human Research Protections Office ($p=0.0082$), with the third-year class feeling significantly more confident than the other classes (Figure 4).

Figure 2: Performing power and sample size analysis. By class year, newest to oldest

Figure 3: Summarizing and presenting results. By class year, newest to oldest
Figure 4: Requesting approval from HRPO. By class year, newest to oldest
Because gender is a two-category variable (we removed one observation where gender was not indicated), Student’s t-tests were performed on each of the 13 items to test for differences in means. We found significant differences on four items: constructing a dataset \((p=0.0192)\); choosing statistical analyses \((p=0.0476)\); describing and summarizing the meaning of results \((p=0.0151)\); and oral or poster presentation \((p=0.0495)\). Because the data is left-skewed, Wilcoxon rank-sum tests were performed on each of the significant variables, and all remained significant save for oral or poster presentation. On each of the significant items, male students felt more confident than female students (Figures 5-8).

Figure 5: Constructing a dataset. By gender
Figure 6: Choosing statistical analyses. By gender
Figure 7: Describing and summarizing results. By gender
Figure 8: Oral or poster presentation. By gender
We also looked at differences across groups defined by the number of research projects previously completed (Table 4). The nature of the three-category independent variable, which consisted of categories of 0 projects (N=29), 1-3 projects (N=153) and 4 or greater projects (N=49), called for analysis by one-way ANOVA to determine if there were differences between groups. The unbalanced nature of the data in some cases led to uneven variances between groups, but the variances were not large enough to disqualify ANOVA. Upon analysis, 11 of the 13 items showed significant differences between groups. The only items that showed no significance between groups were computing a power and sample size analysis and choosing statistical analyses, which makes sense given that most students, despite exposure to bio statistical training, have not yet developed expertise and need to consult with a statistical expert to complete these tasks. It is clear from the table that greater exposure to research by participation in more research projects makes students more confident in almost all aspects of research.

**Table 4: One-way ANOVA by Number of Projects**

| Item            | N  | No. of Projects | Mean | F    | p     | Group vs. Group differences | Tukey-Kramer pairwise |
|-----------------|----|-----------------|------|------|-------|----------------------------|------------------------|
| Conceptualization |    | None            | 5.5  |      | 14.76 | 0.0000                     | None v. 1-3            |
|                 | 29 | 1-3             | 6.8  |      |       |                            | None v. 4+             |
|                 | 153| 4+              | 8.1  |      |       |                            | 1-3 v. 4+              |
|                 | 49 |                 |      |      |       |                            |                        |
Finally, we used a multivariate ANOVA to determine if any of the grouping variables were consistent over our thirteen items (Table 5). The number of research projects that a student was involved in was most consistent, being highly significant on 12 of our 13 items. The lone exception was computing a power and sample size analysis. Class year was significant on 7 of the 13 items, while gender was only significant on two items.

Table 5: Multifactor ANOVA

| Item                              | Grouping Variable          | F     | p    |
|-----------------------------------|----------------------------|-------|------|
| Conceptualization                 | Class year                 | 1.52  | 0.2103 |
|                                   | Gender                     | 1.00  | 0.3193 |
|                                   | Number of Projects         | 15.99 | 0.0000 |
| Identifying a mentor              | Class year                 | 0.49  | 0.6876 |
|                                   | Gender                     | 0.01  | 0.9408 |
|                                   | Number of Projects         | 6.28  | 0.0022 |
| Constructing research questions/hypotheses | Class year             | 0.53  | 0.6609 |
|                                   | Gender                     | 0.47  | 0.4931 |
|                                   | Number of Projects         | 7.77  | 0.0005 |
| Completing a literature review    | Class year                 | 2.89  | 0.0367 |
|                                   | Gender                     | 0.68  | 0.4114 |
|                                   | Number of Projects         | 9.16  | 0.0002 |
Creating a study design

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 1.03       | 0.06   | 6.59               |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Completing a power analysis

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 5.09       | 0.44   | 2.84               |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Designing methods of data collection

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 3.03       | 0.00   | 9.79               |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Constructing a dataset

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 1.33       | 4.80   | 6.66               |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Choosing statistical analyses

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 2.95       | 3.10   | 3.15               |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Describing and summarizing results

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 2.84       | 3.97   | 7.40               |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Obtaining approval from Human Protection Resource Office

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 3.24       | 0.06   | 12.28              |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Oral or poster presentation

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 0.77       | 1.91   | 6.57               |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Presenting research results in paper

|                  | Class year | Gender | Number of Projects |
|------------------|------------|--------|--------------------|
| DeVoe P, Hess M  | 2.97       | 0.00   | 12.95              |
| MedEdPublish     |            |        |                    |
| https://doi.org/10.15694/mep.2018.0000251.1 | | |

Discussion

Research self-efficacy beliefs play a role in medical student research interest, participation, persistence, and ability to negotiate for needed resources. Student motivation and self-efficacy for research evolve in institutional environments that foster research skill building, experiential opportunities and project support. Clearly, students gain confidence by engaging in research. Training programs might begin with identifying, summarizing and reviewing literature with first and second year students, and explicitly linking biostatistics instruction to research methodology. As students gain experience with statistical analyses, skill in summarizing their own study results, skills in synthesizing and reviewing methods and analyses from published literature will likely also improve. Familiarity with Human Research Protections/Institutional Review Board protocols could also develop through practical exercises designed to build student process knowledge and confidence. Mentoring by experienced researchers as well as observational and practical participation on research teams is facilitative for developing self-efficacy in research implementation.

There are recognized barriers to medical student research. As shown, the best way to develop self-efficacy for research is for medical students to participate in research experiences. This participation can be difficult to manage if the school has not established a supportive infrastructure. Personal barriers to research participation include student interest, motivation and knowledge base, as well as confidence. Institutional barriers include adequate training in research methodology for students and mentors, facilities and funding to support the desired research. Institutional support also includes access to active mentoring for the research tutors, dedicated curricular time for research activities, and acknowledgement of student research productivity as well as faculty mentoring efforts (Abushouk, et al, 2016; Ashrafi-Rizi, et al, 2015; Mohd, Bazli, and O’Flynn, 2014; Stockfelt, Karlsson, and Finizia, 2014).
2016; Unnikrishnan, et al, 2014). Even in relatively well resourced medical schools there are often limitations to what the school can provide to build and maintain a student research program. Students with low self-efficacy for research may be less persistent in seeking out relevant help from school personnel, faculty mentors and other resources.

Whether targeting the development of physician-investigators, or informed and skilled practitioners in the practice of Evidence Based Medicine, the benefits of involving medical students in the operational aspects of medical research are significant (Abushouk, et al, 2016; Memarpour, Fard and Ghasemi, 2015; Park, McGhee and Sherwin, 2010; Siemens, et al, 2010). The literature indicates that although many medical students have an interest in research participation, they may lack the self-efficacy to negotiate the various component steps without significant mentoring and a supportive school infrastructure. Self-efficacy theory predicts that task related efficacy develops from one’s experience of task success, observing others successfully perform the task, working with others who advise, critique, and encourage the work, and the feeling of being engaged through psychological and physiological evidence (Bandura, 1993). Several environmental factors facilitate medical student engagement in research. Making research a requirement of the medical curriculum engages scarce resources, including curricular time and funding. Schools can most readily assist the alignment of student and faculty researchers by providing appropriate facilities when possible, and importantly, coordinating formal guidance and instruction in research methods for both students and mentors. (Abushou, et al, 2016; Ashrafi-Rizi, et al, 2015; Mohd, Bazli and O'Flynn, 2014; Unnikrishnan, et al, 2014). Medical student interest facilitates research skill development when adequate training and infrastructure are present, persistence is reinforced and projects completed. With incremental personal research experience, self-efficacy for research can develop.

**Study limitations**

Research is a curricular requirement at the study school, so students who elected to complete the survey may have been predisposed to the idea of doing research during medical school, or already had successful experiences with research. Because we used a cross-sectional survey design to capture changes in self-efficacy over time using different classes as proxy for developmental change, it is possible that longitudinal data would show different results. The focus of this study does assume a certain level of resource availability, and may not match school resources found elsewhere. Nevertheless, there are relative and recognizable resource constraints and balancing of priorities experienced by most medical schools, including the study school, creating an ongoing challenge for curricular and resource management.

**Conclusion**

Research self-efficacy can develop and increase for medical students through exposure to research methods training, mentoring, and successful completion of research projects.

**Take Home Messages**

- Research self-efficacy plays a functional role in medical student research participation.
- Many medical students are eager to develop research skills given appropriate school infrastructure and support.
- Low research self-efficacy, as well as the potential stress associated with research requirements, eases through exposure to research methods training, mentoring, and experiential practice.
Notes On Contributors

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### Appendices

OARS Attitudes about Research Survey

Student ID code _______ (last 4 digits of social security number)

Medical school year, class of _________

Gender _______________

Age ______________

How many research/scholarly projects have you worked on over time?  Please choose the approximate number below.

0-_____
[The attached form lists different activities.] In the column "Confidence," rate how confident you are that you can successfully perform each of these activities as of now. Rate your degree of confidence by recording a number from 0 to 100 using the scale given below:

| Confidence: Cannot do at all | Moderately can do | Highly certain can do |
|-----------------------------|-------------------|----------------------|
| 0                           | 10                | 20                   |
| 30                           | 40                | 50                   |
| 60                           | 70                | 80                   |
| 90                           | 100               |                      |

| Confidence (0-100) |
|--------------------|
| 1. Research/scholarly study conceptualization     |
| 2. Identifying and working with a research mentor |
| 3. Constructing research questions/hypotheses      |
| 4. Completing a literature review that summarizes current research in topic area |
| 5. Creating an appropriate study design            |
| 6. Completing a power analysis                     |
| 7. Designing methods of data collection            |
| 8. Constructing a data set                         |
| 9. Choosing statistical analyses that will answer research questions |
| 10. Describing and summarizing the meaning of obtained results |
| 11. Requesting study approval from the Human Research Protections Office |
| 12. Presenting research results, oral or poster format |
| 13. Presenting research results in a written format |

General comments about the Mentored Scholarly Project in medical school:

**Declarations**

The author has declared that there are no conflicts of interest.

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Ethics Statement

The University of New Mexico, School of Medicine Human Research Protections Office (HRPO) approved the study (HRRC # 00-071), September 6, 2016.

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