Adv Physiol Educ 42: 354–359, 2018;
doi:10.1152/advan.00183.2017.

HOW WE TEACH | *Generalizable Education Research*

The potential of interprofessional education to translate physiology curricula effectively into future team-based healthcare

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Submitted 11 December 2017; accepted in final form 17 April 2018

Edwards S, Molina PE, McDonough KH, Mercante DE, Gunaldo TP. The potential of interprofessional education to translate physiology curricula effectively into future team-based healthcare. *Adv Physiol Educ* 42: 354–359, 2018; doi:10.1152/advan.00183.2017.—Incorporating active interprofessional education (IPE) opportunities into the classroom setting is a potentially effective mechanism to enhance student learning both in the basic sciences and for future interprofessional collaboration. We integrated an IPE exercise into a graduate-level human physiology course at our health sciences center that enrolled physician assistant (PA), physical therapy (PT), and graduate studies students. Our activity adopted and targeted the four Interprofessional Education Collaborative (IPEC) competency domains of values/ethics (VE), roles/responsibilities, interprofessional communication, and teams and teamwork (TT). Effectiveness of the training exercise was determined via pre- and postsurveys, which assessed student self-perceptions of IPEC competency domains, as well as student reflections and evaluations of the exercise itself. We noted a significant improvement in each of the targeted IPEC subcompetencies among all of the students, and within both PT and PA groups when analyzed separately. Moreover, a positive correlation was found between the number of previous IPE experiences and presurvey IPEC VE and TT subcompetency ratings. Our discoveries provide an example of broad acquisition of IPE learning within the context of a physiology curriculum. Perhaps more importantly, our findings indicate that a history of IPE training sets the stage for future IPE learning, reflecting a potential for IPE to transform basic physiological principles into team-based practice and improvement in patient outcomes.

graduate studies; interprofessional education; physical therapy; physician assistant; physiology

INTRODUCTION

Interprofessional education (IPE) is a growing, international movement in health education. IPE is defined as, "when students from two or more professions learn about, from, and with each other" (5). Many health professional programs are now required by their respective accreditation organizations to incorporate IPE into their curricula. As a consequence, academic programs are developing IPE experiences through case-based studies, high-fidelity simulation, community engagement, and clinical rotations. However, there are many challenges associated with implementing IPE. A frequently mentioned barrier is scheduling a common time where multiple programs can participate in an IPE experience (3, 9). Basic medical science departments that offer courses that enroll multiple disciplines together can offer a solution to the scheduling challenge, while providing a valuable opportunity for interprofessional engagement among students (18). Kirch and Ast (7) advocated for the inclusion of IPE experiences within the anatomical sciences, and the literature in this area has recently grown (2, 12). We are yet to see the same growth in the physiological sciences, even as physiology may best represent a foundational discipline that could uniquely benefit from IPE training objectives.

In association with the American Physiological Society, members of the Physiology Educational Research Consortium recently published *The Core Concepts of Physiology: A New Paradigm for Teaching Physiology* (13). The authors argue that the exponential growth of knowledge in physiology has produced textbooks with more scientific facts than students can hope to learn, necessitating a renewed emphasis on (and assessment of) core concepts that underlie and interconnect physiological processes (14). A related challenge is addressing the educational needs of a wide spectrum of student groups whose future professional careers will rely heavily on a solid understanding of physiological principles to solve complicated and often unanticipated medical and scientific problems. At most health science centers, students not only come from diverse professional groups, but may also have varying scientific backgrounds and motivations/expectations for learning. These factors represent significant teaching confounds when groups are brought together in a single classroom or health simulation environment. However, such diversity may also represent a significant strength if students are encouraged to learn and communicate core concepts in an interprofessional manner. Interprofessional activities require dedicated time for effective student interaction, which can be limited in most physiology courses where lectures remain the predominant teaching style. However, more active styles of learning, such as case-based learning (8), high-fidelity mannequin simulation (10), and team-based learning (17) within physiology courses, have all been associated with improved student knowledge of

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physiological principles, as well as improved student attitudes toward physiology course work.

Louisiana State University Health Sciences Center-New Orleans (LSUHSC-NO) recently established a Center for Interprofessional Education and Collaborative Practice to support faculty in the development and implementation of IPE experiences. In 2016, the LSUHSC-NO Department of Physiology implemented its first IPE experience within the endocrine block of a physiology course for graduate studies (GS), physical therapy (PT), and physician assistant (PA) programs (1). A new learning experience in 2017 was identical to that of 2016, except for a modification of the IPE student learning objectives. The clinical focus remained the female athlete triad, a multifaceted endocrine disorder highly relevant to all three of our student groups. The IPE student learning objectives included all four Interprofessional Education Collaborative (IPEC) competency domains: values/ethics (VE), roles/responsibilities (RR), interprofessional communication (CC), and teams and teamwork (TT). IPEC represents a panel of health education associations in the United States focused on the promotion of collaborative behaviors among health professionals (6). IPEC has identified four major interprofessional competency domains for collaborative practice, as well as respective subcompetencies to guide interprofessional learning (6).

For our the 2016 exercise, the IPEC student learning objectives included the following:

1. RR1: Students should be able to communicate their roles and responsibilities clearly to other health care professional students.
2. TT4: Integrate the knowledge of other professions to inform care decisions, while respecting patient values and priorities/preferences for care.

The 2016 study noted a significant positive change in student perceptions of IPEC subcompetencies across all student groups following the IPE experience, and a significant increase in PA student perceptions when groups were analyzed separately (1). For the 2017 exercise, we decided to expand and change one of the targeted IPEC subcompetencies for the learning activity. This change was based on our analysis of student-identified learning from a previous open-ended questionnaire, as well as classroom discussion. The four IPE student learning objectives for the 2017 case-based activity included the following:

1. VE1: Students should be able to place interests of patients and populations at the center of interprofessional health care delivery and population health programs and policies, with the goal of promoting health and health equity across the life span.
2. RR1: Students should be able to communicate their roles and responsibilities clearly to other health care professional students.
3. CC4: Students should be able to listen actively and encourage ideas and opinions of other team members.
4. TT3: Students should be able to engage health and other professionals in shared patient-centered and population-focused problem-solving.

The purpose of the current research study was to re-evaluate student perceptions of their interprofessional competence based upon new IPEC subcompetencies, as well as strengthen study results through the use of paired data sets.

METHODS

Materials and Training Exercise Protocol

To first supply background reading from each discipline's perspective (PA, PT, and preclinical science), three comprehensive review articles covering the female athlete triad were provided on the course website for the students to read. Additional documents containing information regarding the IPE session, including learning objectives and stimulus questions, was also provided to the students on the website and made available on the day of the exercise.

The IPE experience was 60 min in length. Students were provided time in class to complete pre- and postsurveys conducted before and after the session, on either their cell phones or laptop computers. The remaining time was dedicated to the IPE learning experience. Students were organized into interprofessional groups of eight to nine members, with an attempt to include all three professions in each group. The students discussed answers to the IPE stimulus questions within their respective groups for 30 min. After that time, each group was asked to participate in a large-group discussion, providing insight to a stimulus question from their group's perspective. The large-group discussion was allocated 20 min. Experienced faculty members were available in the classroom throughout the entire IPE session to facilitate the discussion and answer questions about the exercise.

Study Design and Approval

Students completed the pre- and postsurvey using a personal electronic device. The presurvey included a total of nine questions: five demographic questions and four questions related to four IPEC student learning objectives (VE1, RR1, CC4, and TT3). The postsurvey included a total of 11 questions: 2 demographic questions, 4 questions related to the IPEC student learning objectives, and 6 activity evaluation questions. Students were also asked to participate in the research portion of this study, with implied consent being given by completing the pre- and postsurvey. The research portion of this study was anonymous and was approved by our Institutional Review Board (LSUHNO no. 9260).

Data Analysis and Statistics

A Likert-type scale that ranged from strongly disagree (1) to strongly agree (5) was used to measure the responses related to the four IPEC subcompetencies and four activity evaluation questions. Two open-ended questions were also included in the postsurvey: "Based on your exposure to IPE opportunities, describe how your views on health and/or delivering healthcare have changed," and "Do you have any suggestions for improving this interprofessional experience?" All analyses were performed using the Statistical Analysis System (version 9.4). Post- vs. presurvey paired comparisons were carried out using the Wilcoxon signed-rank test. A point biserial correlation was used to measure the relationship between the number of previous IPE activities and IPEC subcompetency mean scores.

RESULTS

Seventy-one students were enrolled in the physiology course from GS ($n = 6$), PT ($n = 35$), and PA ($n = 30$) programs. Sixty-eight students (96%) participated in the presurvey, and 59 students (83%) participated in the postsurvey. After the data were adjusted for missing responses, 21 PA, 33 PT, and 3 GS student paired data sets were analyzed. Table 1 provides a summary of the IPEC subcompetency data analysis.

Table 2 provides qualitative student evaluations of the 2017 IPE experience. There were five evaluative questions asked about the IPE activity in both 2016 and 2017. Three of the evaluation questions remained the same across both years: *1*) everyone on the team contributed to the discussion; *2*) conver-

Table 1. *Improvements in IPEC subcompetency assessments across student groups*

IPEC Subcompetency	Student Group	Presurvey	Postsurvey	Postsurvey-Presurvey	*P* Value
VE1	All students	4.421 (0.565)	4.736 (0.444)	0.315 (0.505)	<0.0001*
	Graduate studies	4.000 (1.000)	4.333 (0.577)	0.333 (0.577)	1.000
	Physical therapy	4.545 (0.505)	4.818 (0.391)	0.242 (0.501)	0.0215*
	Physician assistant	4.190 (0.601)	4.619 (0.497)	0.428 (0.507)	0.0039*
RR1	All students	3.929 (0.798)	4.578 (0.498)	0.649 (0.719)	<0.0001*
	Graduate studies	3.666 (1.527)	4.333 (0.577)	0.666 (1.154)	1.000
	Physical therapy	3.909 (0.842)	4.606 (0.496)	0.696 (0.769)	<0.0001*
	Physician assistant	4.000 (0.632)	4.571 (0.507)	0.571 (0.597)	0.0010*
CC4	All students	4.350 (0.517)	4.666 (0.475)	0.315 (0.539)	<0.0001*
	Graduate studies	4.666 (0.577)	4.666 (0.577)	0.000 (0.000)	N/A
	Physical therapy	4.484 (0.507)	4.727 (0.452)	0.272 (0.452)	0.0039*
	Physician assistant	4.190 (0.402)	4.619 (0.497)	0.428 (0.676)	0.0195*
TT3	All students	4.245 (0.509)	4.684 (0.468)	0.438 (0.535)	<0.0001*
	Graduate studies	4.000 (1.000)	4.333 (0.577)	0.333 (0.577)	1.000
	Physical therapy	4.363 (0.488)	4.757 (0.435)	0.393 (0.496)	0.0002*
	Physician assistant	4.095 (0.436)	4.619 (0.497)	0.523 (0.601)	0.0020*

Values are means (SD). CC, interprofessional communication; IPEC, Interprofessional Education Collaborative; N/A, not applicable; RR, roles/responsibilities; TT, teams and teamwork; VE, values/ethics. *Statistical significance.

sations on my team were respectful; and *3*) because of my interprofessional education experiences, my appreciation for a team-based approach to healthcare has improved. Table 3 provides a comparison of results between 2016 and 2017. With regard to team contributions to the discussion and respectful conversations, responses between the 2 yr are quite similar. However, there was a substantial increase in the number of students that strongly agreed with the question, "Because of my interprofessional education experiences, my appreciation for a team-based approach to healthcare has improved," when comparing 2016 (48.39%) and 2017 (69.49%).

This led us to next examine the relationship between number of previous IPE experiences and the presurvey means for each of the IPEC subcompetencies (Table 4), a measure that may reflect how historical IPE training carries over into current competency. While a positive correlation was found for all four subcompetencies, statistical significance was noted specifically for two subcompetencies: VE1 and TT3.

Finally, some important themes emerged from students when answering the open-ended question, "Based on your exposure to interprofessional education (IPE) opportunities, describe how your views on health and/or delivering healthcare have changed." Thirty-four students provided comments, and the themes (see below) were largely reflective of three IPEC competencies and regarded an overall aim of improving future patient outcomes.

Roles and responsibilities. Student remarks included an increased awareness of various health professions and increased knowledge of providers' roles and responsibilities. Specifically, five students commented on the importance of referring to other providers as appropriate for patient care.

Interprofessional communication. Students commented on the importance of communication within a team. Having an understanding of the various treatment plans offered by different healthcare providers was an important component to improving patient outcomes.

Teams and teamwork. Students noted the benefits and challenges of team-based care. Several students commented on the importance of care coordination within the team of healthcare providers, but also assisting the family with prioritizing and

Table 2. *Student evaluations of the 2017 IPE activity*

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Everyone on the team contributed to the discussion.					
%	0	1.69	0	37.29	61.02
n		1		22	32
Conversations on my team were respectful.					
%	0	0	1.69	25.42	72.88
n			1	15	43
I had sufficient time to learn from, about, and with other students during this IPE experience.					
%	0	3.39	5.08	33.90	57.63
n		2	3	20	34
Because of this IPE experience, I will be more likely to collaborate with one of the other professions represented today.					
%	0	0	5.08	28.8	66.10
n			3	17	39
Because of my interprofessional education experiences, my appreciation for a team-based approach to healthcare has improved.					
%	0	0	1.69	28.81	69.49
n			1	17	41

Values are percent response and no. (*n*) of respondents. A Likert-type scale that ranged from strongly disagree (1) to strongly agree (5) was used to measure the responses.

Table 3. *Student evaluations of the 2017 vs. 2016 IPE activities*

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
2017: Everyone on the team contributed to the discussion.					
%	0	1.69	0	37.29	61.02
n		1		22	32
2016: Everyone on the team contributed to the discussion.					
%	0	0	3.23	37.10	59.68
n			2	23	37
2017: Conversations on my team were respectful.					
%	0	0	1.69	25.42	72.88
n			1	15	43
2016: Conversations on my team were respectful.					
%	0	0	1.61	22.58	75.81
n			1	14	47
2017: Because of my interprofessional education experiences, my appreciation for a team-based approach to healthcare has improved.					
%	0	0	1.69	28.81	69.49
n			1	17	41
2016: Because of my interprofessional education experiences, my appreciation for a team-based approach to healthcare has improved.					
%	3.23	0	1.61	46.77	48.39
n	2		1	29	30

Values are percent response and no. (*n*) of respondents. A Likert-type scale that ranged from strongly disagree (1) to strongly agree (5) was used to measure the responses.

scheduling visits. One student mentioned potential financial issues that might arise with multiple provider visits.

DISCUSSION

IPE is a lifelong learning process that formally begins in professional educational programs (15). Within longitudinal academic curricula, repeated exposure to IPEC subcompetencies may increase a health profession student's awareness and confidence in developing and executing team-based behaviors. Our IPE experience was designed to assess specific IPEC subcompetencies as student learning objectives. However, students also appeared to demonstrate learning beyond the four targeted subcompetencies, as noted through their responses to an open-ended question on future healthcare delivery. Students were able to share their respective roles as related to the female athlete triad case during small group discussions (RR1). Along with sharing, students in the IPE groups actively listened (CC4), which increased student knowledge in the roles and responsibilities of other professions. Students commented on the importance of appropriately referring to other healthcare providers (TT3) to ultimately improve patient outcomes (VE1). Communication and coordination of care were also highly recognized by students. The student-guided interactive experience inherent in IPE is a particularly important occurrence that expands the potential of learning beyond targeted goals (16) and likely foreshadows future healthcare collaborative efforts.

The IPE experience offered between 2016 and 2017 was not altered, except for the selection of new IPEC subcompetencies as student learning objectives. We noted a significant improvement in each of the targeted IPEC subcompetencies among all students and within both PT and PA groups when analyzed separately. In 2016, a statistical significance was also noted in IPEC subcompetencies across all students and within the PA group, with a trend for positive improvements in the PT student group. A limitation of the previous and current study is the relatively low number of GS students enrolled in the course in both years, possibly precluding demonstration of significant improvements in this population. We should also point out that, while we did not specifically collect data on or investigate sex as a factor, the majority of our students were women. A more rigorous examination of sex differences in IPE learning is warranted in future studies.

In the assessment of IPEC competencies, it is worth considering whether relative inexperience or, in contrast, a history of IPE training sets the stage for the acquisition of new IPE learning. The IPE literature is void of information comparing repeated exposures to IPE experiences and student perceptions of IPEC subcompetencies, although a primary goal of IPE is the carry over and functional transformation of such training

Table 4. *Correlation of previous IPE experiences and IPEC subcompetency scores*

IPEC Subcompetency	Correlation Coefficient	*P* Value
VE1	0.354	0.0068*
RR1	0.031	0.8171
CC4	0.217	0.1041
TT3	0.300	0.0231*

CC, interprofessional communication; IPEC, Interprofessional Education Collaborative; RR, roles/responsibilities; TT, teams and teamwork; VE, values/ethics. *Statistical significance.

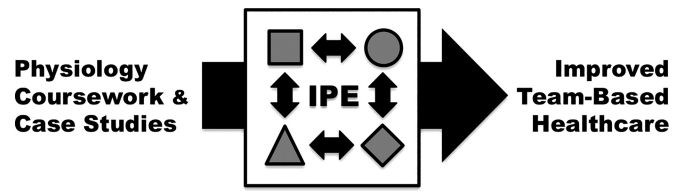

Fig. 1. Interprofessional education (IPE) embedded within the physiology curricula at comprehensive health sciences centers can foster the long-term development of communication and teamwork concepts linking multiple health professions, representing an ideal opportunity to transform core physiology principles into future team-based healthcare.

experiences into future interprofessional practice. In our 2016 cohort (1), we hypothesized that the more robust IPE experience-related improvements noted in the PA group could be associated with their relative inexperience coming into the exercise, as the PA students were only in the first 3 mo of their academic program. However, regarding the more robust improvements seen in the 2017 PT student cohort, we noted their exposure to four previous IPE experiences compared with three in the 2016 cohort. In fact, the additional IPE exposure occurred 1 mo before the female athlete triad case and was also embedded within the physiology course (4).

In this regard, it is important to discuss further the positive correlation found between the number of previous IPE experiences and presurvey IPEC subcompetency ratings (Table 4). Significance was specifically observed in VE1 and TT3 across all student groups. In 2016, this analysis was not conducted due to the lack of paired student data sets and lack of knowledge regarding previous IPE exposure. The 2017 cohort of students was actually exposed to all four subcompetencies once (within other exercises) in the 2 mo preceding the endocrine IPE learning session. Further research comparing pre-and post-scores for each IPEC subcompetency within each IPE session is needed to make more definitive conclusions regarding repeated exposure and strength of student perceptions. Incorporation of additional cohorts and a future review could also provide more insight into the correlations found in this study. For example, the question could be raised whether repeated exposure to the same subcompetency or repeated exposure to IPE experiences in general would more likely impact student perceptions. We did note an increase in frequency to strongly agree from 2016 to 2017 to the question, "Because of my interprofessional education experiences, my appreciation for a team-based approach to healthcare has improved." In 2017, students engaged in three IPE sessions over a period of 3 mo (January, February, and March) compared with two in 2016 (January and March), and the additional February IPE experience may have critically impacted student perceptions.

Importantly, students are able to appreciate the benefits of collaboration and communication early in their respective health careers (11). As IPE evolves, it is important to continue expanding team-based learning opportunities in basic medical science curricula. Physiology courses represent a special area of opportunity to engage students in IPE, as suggested treatments and viewpoints based on physiological processes will likely come from multiple healthcare professions to improve patient outcomes. As translational science relies on the ability of the preclinical researcher to effectively communicate with healthcare providers, graduate students in the basic sciences are also strongly encouraged to participate in IPE exercises. The sharing of multiple perspectives is a prime opportunity for students and practitioners to learn from, about, and with each other. As health care teams increasingly interact in the interpretation of physiological data and management of a variety of health conditions, we believe that IPE could represent a valuable core conceptual platform for translating physiology principles into more integrative healthcare practices in the future (Fig. 1).

ACKNOWLEDGMENTS

Bobby Moore assisted in the development and coordination of the IPE activity.

GRANTS

This study was supported in part by Grant 1 U54 GM-104940 from the National Institute of General Medical Science of the National Institutes of Health, which funds the Louisiana Clinical and Translational Science Center.

DISCLAIMERS

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

S.E., P.E.M., K.H.M., and T.P.G. conceived and designed research; SE and T.P.G. performed experiments; S.E., D.E.M., and T.P.G. interpreted results of experiments; SE and T.P.G. prepared figures; SE and T.P.G. drafted manuscript; S.E., P.E.M., K.H.M., and T.P.G. edited and revised manuscript; S.E., P.E.M., K.H.M., D.E.M., and T.P.G. approved final version of manuscript; D.E.M. and T.P.G. analyzed data.

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