

Changes in Student Attitudes toward Interprofessional Education after Online and In-Person Introductory Learning Activities

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Abstract

INTRODUCTION Although introductory interprofessional education (IPE) experiences offered in a variety of formats can be beneficial to students, there is little research evaluating students' attitudes throughout a sequence of introductory IPE activities. Further, the impact of academic level, gender and race on student attitudes about IPE is not known, particularly when students from a diverse range of health profession programs participate together in introductory IPE experiences.

METHODS A sequenced, two-part introductory IPE experience comprising a 90 minute online module followed by a 2-hour face-to-face event was delivered to health science students on three campuses at a large Midwestern university. Student attitudes about IPE based on SPICE-R2 scores were compared before and after the online module and after the in-person event. Paired t-tests were used to determine differences between time points, and linear regression was used to estimate the effects of academic level, gender and race.

RESULTS The online course had a significant, positive impact on all students' attitudes about IPE with the greatest changes for the Roles subdomain. Improvements in student attitudes about IPE following the online course were retained after the in-person event. Student responses differed between academic levels and genders, but not race.

CONCLUSION The initial, online component of the sequenced introductory IPE experience was more impactful on student attitudes about IPE than the subsequent in-person component. Student responses differed between academic levels and genders, suggesting that these factors should be considered when designing introductory IPE experiences for a broad range of participants.

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Implications for Interprofessional Practice

- Previous studies have shown that student attitudes about IPE can benefit from introductory experiences offered in online or in-person formats but the separate impact of online and in-person components of an introductory IPE experience that incorporates both formats has not yet been investigated.
- Although the introductory IPE experience in this study was designed as a series with online and in-person components, student attitudes about IPE improved most following the first component (online course) compared to the second component (in-person event). Institutions that offer introductory IPE experiences with multiple components may benefit from assessing the relative impact of each component to potentially eliminate less effective instructional activities.
- The findings of this study demonstrated that academic level and gender affected student attitudes about IPE in an introductory experience, suggesting that these factors should be considered when designing or evaluating IPE experiences, particularly when administered to students in a broad range of health science disciplines with early learners at different academic levels.

Introduction

Effective interprofessional education (IPE) supports collaborative healthcare practices that may, in turn, improve patients' health outcomes (Smith et al., 2019; World Health Organization, 2010). IPE is an approach to education and practice in which students from two or more health care disciplines learn about, from and with each other to enhance effective collaboration (World Health Organization, 2010). IPE is crucial for health professional students to help them develop the competencies they need to collaborate effectively with other health professionals on healthcare teams. Such highly-functioning healthcare teams are expected to benefit healthcare by increasing positive patient experiences, improving population health, reducing healthcare costs and improving professionals' satisfaction (Sweet et al., 2019). Incorporating IPE courses and activities into health science curricula has been strongly encouraged by several organizations including the Interprofessional Education Collaborative (IPEC) (IPEC, 2020), the National Center for Interprofessional Practice and Education (NexusIPE), the American Interprofessional Health Collaborative (AIHC) (AIHC, 2021) and the Institute of Medicine (IOM) (Institute of Medicine of the National Academies, 2015).

Literature Review

Offering an introductory IPE course at an early stage of health professionals' education is recommended

(Coster et al., 2008; Inuwa, 2012; Reeves, 2016; Stull & Blue, 2016; Teodorczuk et al., 2016). The primary goal of introductory IPE offerings is for health profession students to gain foundational knowledge about IPE and an appreciation for their own and other professions by learning about, from and with students across disciplines. Early offerings can focus on raising awareness of IPE fundamentals and preparing for future professional practice (Inuwa, 2012). Moreover, offering introductory IPE courses at a formative stage may inhibit the formation of negative attitudes about other professionals and improve students' perceptions towards interprofessional learning (Coster et al., 2008; Stull & Blue, 2016; Teodorczuk et al., 2016). Thus, preparing students for collaborative-ready practice early in their education is important for shifting attitudes before embarking in interprofessional practice.

To achieve these goals, introductory IPE experiences have been offered with a variety of pedagogical approaches in both in-person and online formats (Beard et al., 2015; Shaw-Battista et al., 2015). Introductory IPE experiences with in-person formats have led to positive improvements in student attitudes, as well as improving information learning and sharing with teammates, and developing a greater appreciation of roles and responsibilities and the importance of communication in a collaborative setting (Eliot et al., 2018; Jernigan et al., 2018). In-person introduc-

tory IPE experiences range from a one-day event to multiple series, with components such as interactive teaching, team debriefing, small team discussion, and stereotype awareness. In-person activities are generally limited in enrollment, however, due to the challenges of accommodating a large number of students in the same space at the same time, and thus are challenging to deliver in an academic environment that includes a large number of health profession programs. In contrast, online IPE experiences can be offered to a large number of students, and can be delivered with synchronous and/or asynchronous components. IPE activities have also been successfully implemented in online formats, including case studies, journal clubs, and simulation experiences that promote learner collaboration, self-reflection, and critical thinking (Anderson et al., 2019; Cropp et al., 2018; Friedman et al., 2019). Like in-person offerings, online IPE experiences also are generally evaluated positively by learners while producing the expected results in learning outcomes (Heuberger & Clark, 2019; Singer et al., 2018; White et al., 2019). Since direct interaction among students from two or more health professions is required for IPE experiences, it would be very useful to know whether an online introductory IPE experience that mitigates the challenges of assembling students from multiple disciplines in the same space and time, can be as effective as an in-person event. To examine this issue directly, studies would need to deploy a cross-over design, adding to the challenges of offering introductory IPE experiences.

Introductory IPE experiences can be distributed over time, to accommodate a range of topics or to provide both online and in-person experiences. Longitudinal studies investigating the impact of introductory IPE experiences offered over multiple years have reported positive impact on the teamwork and collaboration and professional identity domains using the Readiness for Interprofessional Learning Scale (RIPLS) (McFadyen et al., 2010; Wong et al., 2016; Zeeni et al., 2016); other studies report no change in attitude towards interprofessional health care teams and interprofessional education across years (Curran et al., 2020). These studies, however, do not provide analyses to evaluate the incremental effect of each component of an experience, thus it is difficult to determine the relative impact of each part of a series. Similar to the longitudinal studies, many investigations of short-

er-term introductory IPE experiences demonstrate positive impact on students' attitudes about IPE, but do not provide information about the relative impact of the individual components of an experience (Bergner-Estilita et al., 2020; Curran et al., 2020; Lockeman et al., 2017; Muzk et al., 2020; Reilly et al., 2014). For example, in study by Ateah et al. (2011), health profession students reported their perspectives on health professions using the Student Stereotypes Rating Questionnaire (SSRQ) at multiple time points - at baseline, after completing an in-person, interactive educational experience and, for some students, after also completing a subsequent immersive, interprofessional practice experience. Although the investigators provided strong evidence that both components of the experience improved students' perspectives, they did not analyze the relative impact of each component on students' success in achieving the learning goal. Given the cost of providing introductory IPE experiences, it would be very useful to know if all components of an experience, whether in-person or online, contribute substantially to student learning.

Introductory IPE experiences are typically offered to early learners, usually first year students. Depending on the health science programs at a particular institution, early learners may include students at both undergraduate and graduate levels. Early learners at different academic levels are likely to have very different backgrounds and experiences, and these differences may affect students' responses to an introductory IPE experience. A few studies have reported the impact of an introductory IPE experience on students at both the undergraduate and graduate levels using the Student Perceptions of Interprofessional Clinical Education-Revised instrument, version 2 (SPICE-R2) (Lockeman et al., 2017; Matulewicz et al., 2020; McGregor et al., 2018; Muzyk et al., 2020). Although these studies demonstrated various improvements in students' attitudes about IPE at both academic levels, they did not examine the effect of academic level on students' attitudes before participating in the IPE experience or the magnitude of attitude change following the IPE experience. It would be very useful to examine the relative impact of an introductory IPE experience on undergraduate and graduate students to determine whether the needs of each type of early learner are addressed sufficiently with an introductory IPE offering.

Other characteristics of individual learners such as gender and race have also been shown to impact learning (Ashong et al., 2012; Klein et al., 1997; Ro & Loya, 2015; Zajda & Freeman, 2009). When assessed early in their professional programs, female students had more positive attitudes about IPE than male students (Coster et al., 2008; Curran et al., 2008; Wilhemsson et al., 2011; Wong et al., 2016) and Black students had higher scores on the RIPLS instrument than other students (Coster et al., 2008). It is important to assess the potential effects of gender and race, as well as academic level, on learner responses to early offerings to identify the elements of successful introductory IPE experiences that can be applied to the wide range of learners enrolled in health profession programs.

The purpose of this study was to investigate the impact of an introductory IPE experience with sequenced online and in-person components on student attitudes about IPE in early learners from a wide range of health professions at different academic levels. Student responses to survey questions were analyzed to: (1) assess differences in students' attitudes about IPE before and after completing the online and in-person components, (2) examine the relative change in student attitudes between the sequenced components, (3) investigate the effects of academic level, gender and race on student responses to the introductory activities, and (4) evaluate students' perception of value of the IPE activities.

Methods

Research Design

A cohort design was used to evaluate the impact of two, sequenced introductory IPE offerings. The first offering was an asynchronous online IPE activity ("Introduction to IPE"), and the second offering was an event where students participated in interprofessional face-to-face discussion groups ("IPE in Action"). These activities occurred approximately four and six weeks into the fall 2018 academic semester, with the face-to-face event occurring three days after the online course. The experiences were sequenced to build upon each other for an exposure-level IPE experience. Students could participate in both or either experience. The analyses were approved by the University's Institutional Review Board (IRB) prior to all

activities, and all participants were asked to provide electronic written consent for use of their data.

Participants

Students from 11 health science or pre-health profession programs on three campuses of a large Midwestern university participated in the IPE experiences. The programs were housed in the Schools of Dentistry, Kinesiology, Medicine, Nursing, Pharmacy, Public Health, and Social Work, and the College of Literature, Sciences and Arts, College of Health Sciences (Physical Therapy and Respiratory Therapy), and the College of Education, Health, and Human Services.

For all students, the introductory experience was their first formal exposure to interprofessional education. At the undergraduate level, the introductory experience was offered in the first year for some programs (Kinesiology and Literature, Science and Arts), and in several years for other programs (Nursing - all four years; College of Education, Health, and Human Services - second and third years; College of Health Sciences - fourth year). At the graduate level, all students were in the first year of their programs.

Typically, the students were enrolled in a course that embedded one or both of the IPE experiences as required assignments or mandatory activities. For a few programs, the IPE experiences were not required, and only some of the students participated.

Introduction to IPE Online Course

The first part of the two-part sequence was an online course that introduced students to the current health-care landscape and provided an overview of IPE and how it relates to the quadruple aim of health care. The online IPE course was offered to more than 1,500 students using the University's learning management system (Canvas). The online course was composed of seven sequential modules that could be completed in 90 minutes. After a course welcome that included a survey about IPE, the next two modules included brief videos that highlighted the benefits of IPE and interprofessional practice. Next, students posted a 6-word response to the following prompt, "As a future professional, how do you see yourself contributing to the health and well-being of people and populations?" Subsequently, they viewed and commented on responses from students in a different profession. Students were then informed

about other IPE opportunities at the University. Finally, students were asked to complete the survey about IPE again and to evaluate the course. The online course was open for 14 days and was facilitated by a lead faculty member and a graduate student instructor.

IPE in Action Face-to-Face Event

The second part of the sequence was a face-to-face event focused on roles and outcomes while giving students experience working as a team. The face-to-face IPE event was held in a large arena on campus during the 2-hour time slot that is designated each week for IPE activities across the health science schools. Participants were assigned to one of more than 100 discussion groups, each with 9-13 students and a faculty facilitator. Students were assigned to groups intentionally to maximize diversity among the disciplines.

After opening remarks about the importance of IPE and practice, each student group was guided through interactions using an ice breaker and discussion questions about a complex patient scenario. The case was intentionally selected for relevance to as many disciplines as possible. Scripted discussion questions were used by faculty to initiate dialogue between students and allow students to offer their own unique perspectives of the case. The complex patient case was presented by the actual interprofessional team who provided care for this patient, sharing their roles and interventions, and ultimately illustrating the effectiveness of interprofessional care. The purpose of the discussion was not to solve the case, but for participants to meet and engage with other health profession students, learn about the roles of other health professionals, see both the need and value of various disciplines to meet client needs, and to establish a basic understanding and appreciation of interprofessional education. After participating in IPE in Action, students were asked to complete the survey about IPE and to evaluate the event.

Questionnaire Development

The impact of the sequenced introductory IPE offerings on attitudes towards IPE was evaluated using SPICE-R2. The SPICE-R2 is a 10-item survey that can be used to evaluate a learner's experience after an interprofessional intervention (Dominguez et al., 2015). The SPICE-R2 has recently been revised for improved validity and reliability across survey items from previous versions, SPICE and SPICE-Revisions, respective-

ly (Zorek et al., 2016). The instrument specifically contains items related to the subdomains of IPE including: interprofessional teamwork and team-based practice (3 items), roles and responsibilities for collaborative practice (4 items), and patient outcomes (3 items). The language throughout the SPICE-R2 is generalizable to all health professional students, thus it has been found to be a reliable tool to measure student perceptions of IPE across these subdomains. The SPICE-R2 is often utilized as a pre- and post-evaluation to capture changes of student perceptions related to the three interprofessional subdomains from baseline to post-intervention (Fusco & Foltz-Ramos, 2018; Theodorou et al., 2018).

Three self-administered, electronic questionnaires using Qualtrics© software were used before the online course (Time 1), after completing the online course (Time 2), and after participating in the face-to-face event (Time 3). The purpose of these questionnaires was to assess students' attitudes toward IPE. All questionnaires included the SPICE-R2, and Time 1 and 3 also included a written consent. In addition to the SPICE-R2 survey, course evaluation items were included in the post-course (Time 2) and post-event (Time 3) questionnaires. We also asked students to indicate their level of agreement with the statement "I am likely to recommend this course/event to another student in my program" on a 5-point Likert Scale (1=strongly disagree, 5=strongly agree). We also obtained demographic information from student records with IRB-approved permissions.

Statistical Analyses

At each time, the SPICE-R2 scores were averaged to create three outcome variables corresponding to the three subdomain scores noted as Roles, Teamwork, and Outcomes. Race, gender, and academic level were determined for each respondent using student record data obtained from the Registrar for each campus. Race was coded as White/Asian or other (this categorization was used to focus particularly on the most underrepresented minority students), gender was coded as male or female, and academic level was coded as undergraduate or graduate. Whether the course and event were required versus optional was also coded. We used SPSS version 24 (SPSS Inc., Chicago, Illinois), RStudio version 1.1.463 (RStudio Inc., Boston, MA) and GPower v3.1.9.7 to run the analyses.

Independent t-tests were used to determine the effects of race, gender and academic level on scores before students completed the online course (Time 1). Paired t-tests were used to detect differences in scores before (Time 1) and after (Time 2) completing the online course. Paired t-tests were used to detect differences in scores after completing the online course (Time 2) and after participating in the event (Time 3). Cohen's d was used to calculate effect sizes for differences between means (Lakens, 2013). Linear regression models were used to determine the separate effects of race, gender and academic level on differences in SPICE-R2 scores as a function of the online course and the event. The significance level for all statistical analyses was set at $p < .05$.

Finally, an independent t-test was used to examine the effects of race, gender, and academic level on student perceptions about the value of the online course and the event. We also tested whether the course and event as a program requirement had an impact on recommending it to peers.

Results

Student Demographics

Over 1,500 students were enrolled in the online course and over 1,000 students participated in the in-person event. The majority of students participating in the online course were enrolled in first-year courses in their programs at both the undergraduate ($n=689$, 53.6%) and graduate ($n=880$; 100%) levels. However, not all participating students completed the learning activities or consented to have their responses included in the analysis. Therefore, respondents comprised 68.1% ($n=993$) of the students who completed the online course ($n=1,458$) and 41.8% ($n=453$) of the students who completed the event ($n=1,085$). The majority of respondents were White/Asian in both the online course and the event (73.3 and 78.4%, respectively). On average, most respondents were graduate students for both the online course and the event (59.9 and 68.2%, respectively), and about three-quarters of the students were female for both activities (75.8 and 76.6%, respectively). The percentages of female graduate, female undergraduate, male graduate and male undergraduate students who completed the online course were 44.3, 31.7, 15.7 and 8.4%, respectively. The percentages of female graduate, female

undergraduate, male graduate and male undergraduate students who participated in the event were 50.8, 25.8, 17.4 and 6.0%, respectively.

The majority of students participated as part of a course or program requirement for the online course (98.5%) and for the in-person event (87.8%).

Student Attitudes About IPE Before Completing the Online Course

Students generally had positive attitudes about IPE before completing the online course, with the highest scores for Teamwork (4.42 ± 0.48) and Outcomes (4.02 ± 0.58) and the lowest scores for Roles (3.37 ± 0.67) for all students (Figure 1). Scores at Time 1 for Teamwork and Outcomes were significantly higher (more positive) for females compared to male students (0.15 and 0.21; Cohen's $d = 0.31$ and 0.37, respectively; both $p < .05$). Teamwork and Outcomes were slightly but significantly higher for graduate students compared to undergraduate students (0.07 and 0.11; Cohen's $d = 0.15$ and 0.19, respectively; $p < .05$). Roles scores were similar among all student groups. When predicting Teamwork and Outcomes scores with linear regression models, the impact of gender was greater than academic level since marginal means for both Teamwork and Outcomes scores were higher for gender (0.15 and 0.22, respectively) than for academic level (0.09 and 0.12, respectively) (Table 1).

Changes in Student Attitudes About IPE After Completing the Online Course

SPICE-R2 scores after completing the online course (Time 2) scores were significantly higher (more positive) than scores before the course (Time 1) for Roles (0.51 ± 0.68 ; Cohen's $d = 0.75$), Teams (0.26 ± 0.42 ; Cohen's $d = 0.62$) and Outcomes (0.49 ± 0.50 ; Cohen's $d = 0.98$) for all students (all $p < .05$) (Figure 1). When separating the effects of academic level, gender and race on score differences with linear regression models, only academic level had a significant impact, with marginal means significantly higher for undergraduate than for graduate students for Roles, Teamwork and Outcomes ($p < .05$) (Table 2).

Model		Estimate	Std. Error	t	Sig.
Roles n = 946 ¹	(Intercept)	3.47	0.06	62.84	0.00
	Race	-0.03	0.05	-0.67	0.50
	Gender	-0.06	0.05	-1.21	0.23
	Academic Level	-0.08	0.05	-1.72	0.09
	R ² = .005				
Teamwork n = 946 ¹	(Intercept)	4.25	0.04	108.84	0.00
	Race	0.02	0.04	0.44	0.66
	Gender	0.15	0.04	4.20	0.00
	Academic Level	0.09	0.03	2.69	0.01
	R ² = .025				
Outcomes n = 945 ¹	(Intercept)	3.78	0.05	80.96	0.00
	Race	0.04	0.04	0.91	0.36
	Gender	0.22	0.04	5.14	0.00
	Academic Level	0.12	0.04	3.07	0.00
	R ² = .036				

Table 1. Regression models predicting student attitudes about IPE based on SPICE-R2 scores before completing the online course (Time1)

¹ The number is < 993 because some students did not complete all SPICE-R2 items.

Model		Estimate	Std. Error	t	Sig.
Roles n = 919 ¹	(Intercept)	0.54	0.06	9.47	0.00
	Race	0.04	0.05	0.79	0.43
	Gender	0.06	0.05	1.18	0.24
	Academic Level	-0.14	0.05	-3.05	0.00
	R ² = .013				
Teamwork n = 920 ¹	(Intercept)	0.31	0.04	8.94	0.00
	Race	-0.03	0.03	-1.03	0.30
	Gender	0.02	0.03	0.62	0.54
	Academic Level	-0.10	0.03	-3.51	0.00
	R ² = .015				
Outcomes n = 918 ¹	(Intercept)	0.54	0.04	13.01	0.00
	Race	-0.06	0.04	-1.63	0.10
	Gender	0.02	0.04	0.53	0.60
	Academic Level	-0.08	0.03	-2.42	0.02
	R ² = .009				

Table 2. Regression models predicting the differences in student attitudes about IPE after completing the online course (Time2) based on differences in SPICE-R2 scores

¹ The number is < 993 because some students did not complete all SPICE-R2 items.

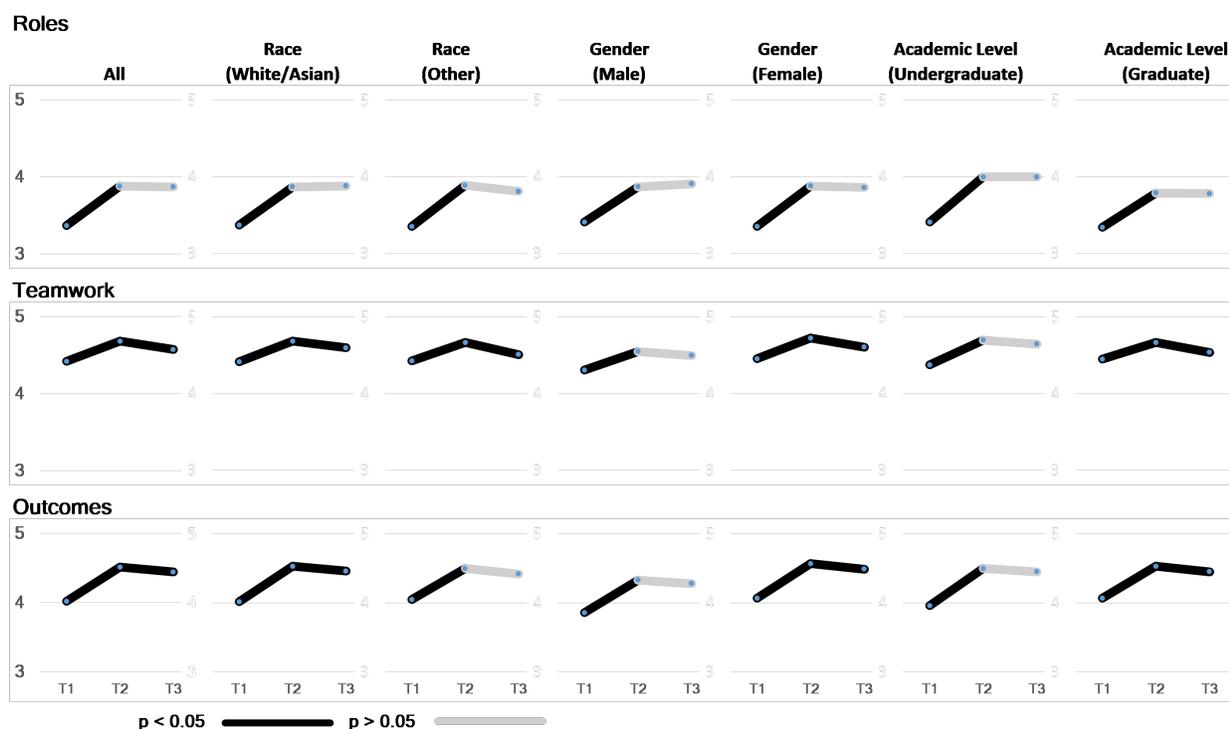


Figure 1. Mean scores across all SPICE-R2 items for each subdomain (Roles, Teamwork, Outcomes) before students completed the online course (Time1; T1), after students completed the online course (Time2; T2) and after students participated in the event (Time3; T3). The scales 3, 4 and 5 correspond to Neutral, Agree and Strongly Agree, respectively. A dark line between T1 and T2 or between T2 and T3 represent statistically significant differences.

Changes in Student Attitudes About IPE After Participating in the Event

Compared to scores after completing the online course (Time 2), the scores after completing the in-person event (Time 3) were slightly but significantly lower (less positive) for Teamwork and Outcomes across all students (0.10 and 0.07, Cohen's $d = 0.20$ and 0.15, respectively; $p < .05$) (Figure 1). Roles scores were similar before and after the in-person event. Among student groups, Teamwork and Outcomes scores were similar between Time 2 and Time 3 for male students and undergraduate students (both $p > .05$). Linear regression models were used to predict the separate effects of race, gender and academic level on the differences in SPICE-R2 scores (Time 3 - Time 2), and no statistically significant predictors were identified (all $p > .05$).

Despite overall lower scores after participating in the in-person event for Teamwork and Outcomes, post-event (Time3) scores were higher than pre-on-

line course scores (Time 1) (Figure 1). Scores across student groups after the in-person event were still significantly higher than baseline (before the online course) for Roles (0.49 ± 0.76 , Cohen's $d = 0.64$), Teamwork (0.13 ± 0.54 , Cohen's $d = 0.24$) and Outcomes (0.40 ± 0.60 , Cohen's $d = 0.69$) (all $p < .05$).

Student Perceptions of the Online Course and Event

Students were asked if they would recommend the course and event to their peers. The mean score (3.70 ± 0.91) indicated that students were somewhat positive about recommending the online course. The mean score was significantly greater for undergraduates than for graduate students (3.78 ± 0.91 and 3.64 ± 0.90 , respectively; Cohen's $d = 0.16$; $p < .05$). The mean scores were not statistically significantly different for race or gender. The mean scores were not statistically significantly different for students who were required to take the course (3.70 ± 0.91) than for those who elected to take the course (3.71 ± 0.47).

In considering the event, the mean score (3.63 ± 1.09) indicated that students were somewhat positive about recommending the event. The mean score for undergraduate students (3.89 ± 0.97) was greater than for graduate students (3.51 ± 1.11 ; Cohen's $d = 0.37$; $p < .001$). The mean scores were not significantly different between students for whom the event was required (3.61 ± 1.08) versus optional (3.86 ± 0.92). No differences by race or gender were found.

Discussion

An introductory IPE experience with sequenced online and in-person components was delivered to students in 11 different health science disciplines across three campuses. The online course had a significant, positive impact on all students' attitudes about IPE. Although student attitudes about IPE improved in all subdomains, the greatest changes occurred for Roles. The subsequent face-to-face event did not improve student attitudes about IPE beyond the gains made by the online course, yet improvements from baseline were retained. Student responses differed between academic levels and genders, suggesting that these factors should be considered when designing introductory IPE experiences for a broad range of participants.

Social identity theory advocates for students to consider their own professional identity, and that introductory IPE activities provide these opportunities for consideration of their roles and responsibilities (Roberts & Kumar, 2015). Provision for this type of identity reflection was provided with multiple activities in the online course in which students generated six words to describe their discipline as well as read other disciplines' descriptions, and at the in-person event participation in an interdisciplinary discussion of a case study which highlighted unique discipline specific perspectives and contributions. In line with the theory, the Roles domain of SPICE-R2 showed the most change for all students, and students' attitudes towards Roles after completing the online course had the most improvement. This finding is consistent with previous studies that showed health profession students gained a better understanding of the roles of other healthcare professions and had a greater appreciation for the roles of various professionals after attending an IPE course or event (Singer et al., 2018; Soubra et al., 2018). After completing the event, however, students' attitudes towards Roles were not significantly different, i.e., did not increase or de-

crease. This is also not an uncommon finding with the IPE literature showing that professional identity can decline over time as one sees the reality of the profession which may not have matched with their perceptions (Coster et al., 2008).

We found that an asynchronous online course was an effective design for introductory IPE for early learners in health science programs. Even though students' attitudes about IPE were relatively positive before participating in the online course, which is similar to earlier studies (Al-Qahtani, 2016; Gunaldo et al., 2020; Townsend et al., 2017), our online course improved students' attitudes significantly across all three IPE subdomains. This result is consistent with other published studies, where students show increased positive attitudes towards IPE after participating in an online course (Anderson et al., 2019; Heuberger & Clark, 2019; Smith et al., 2019; White et al., 2019). In considering the specific subdomains of SPICE-R2, improvement of students' attitudes toward Teamwork was less than Roles and Outcomes after the online course. This finding is likely because the content of the online module was focused on the why and what of IPE and interprofessional care as well as on the 6-word activity, which aligns with the Outcome and Role subdomains of SPICE-R2. There were no activities or content specifically focused on building teamwork knowledge or skill. Additionally, students' attitudes about teamwork at baseline were the most positive among all of the subdomains.

During the 2-hour face-to-face event, health science students across disciplines came to the same physical location and were intentionally assigned to small groups with representation from diverse disciplines. Students' scores for all subdomains except Roles were lower after participating in the event compared to their scores after completing the online course. McFadyen et al. (2010) notes this trend in decreasing initial positive attitudes toward IPE as resulting from a "reality check" of one's expectations. Thus, the in-person component of the sequenced introductory IPE experience in this study did not further improve students' attitudes about IPE, suggesting that the costly, large-scale event could be eliminated without negative effects on student learning. It may be useful for other institutions that offer sequenced, in-person and online components to consider the relative merit of individual elements comprising an introductory IPE experience.

Students' attitudes towards Roles were not different after completing the event compared to their scores after completing the online course. The Teamwork scores were significantly lower for all students compared to their post-online course scores, although the size of the effect was small. This finding was similar to Lockeman et al. (2017) who found that a large group event did not improve students' attitudes in Teamwork. Further, the small group discussion focusing on teamwork may have been perceived by some students as 'artificial' (Rosenfield et al., 2011). Although the event did not help to improve students' overall attitudes towards IPE, the post-event scores across all students were significantly higher than the baseline scores. Possible reasons that the event did not further improve students' attitudes about IPE could be the characteristics of the event, such as it was too large, too short (Rosenfield et al., 2011) and/or the complex case for discussion might have been overwhelming or frustrating to group members who were at the beginning stage of their education (Singer et al., 2018).

In considering student evaluations, they were somewhat positive about recommending the online course. This was likely because the online course was easily accessible and flexible in the timeline for its completion (Smith et al., 2019). Additionally, students' recommendations were similar regardless of whether the online course was required or elected. Regarding student perceptions about the face-to-face event, students were somewhat positive in recommending this event to their peers. Because students' recommendations were more positive if they participated by choice rather than by mandate, it may be that the logistics of attending the event were more frustrating for those students who were required to attend.

A significant finding in this study was differences in attitudes about IPE between academic levels, particularly for the online course. Graduate students had more positive attitudes about IPE than undergraduates at baseline, however the amount of change in attitudes toward IPE was greater among undergraduates after the online course. This is consistent with other studies that focused on readiness for IPE showing that students with less experience have lower positive attitudes about IPE as they may be less aware of the benefits of working interprofessionally (Coster et al., 2008). Additionally, graduate students' attitudes toward most subdomains significantly decreased after completing

the event whereas undergraduate students showed no change. Students' recommendations on both the online course and event were significantly more positive for undergraduates compared to graduate students. These findings can be explained as young (undergraduate) learners seem more willing to change and accept new things compared to older (graduate) learners (Anderson & Thorpe, 2008). Although this introductory IPE experience resulted in improved attitudes about IPE in students at both academic levels, the response of undergraduate students suggests that introducing IPE in pre-health profession programs is particularly effective and may enable more rapid development of interprofessional skills when these students arrive in graduate health profession programs.

The difference in student responses to the introductory IPE experience suggest that academic level should be considered when designing or evaluating IPE offerings. Based on the context of this study, undergraduate students may benefit more from an in-person component offered subsequent to an online module than more experienced graduate students. Alternatively, introductory IPE experiences could be offered to health profession students at the same level of training to allow for standardization of training (Reilly et al., 2014). Further, academic level should be considered when evaluating introductory IPE experiences offered to students at different academic levels. For example, several studies have reported differences in student attitudes between health science disciplines when students are at different academic levels within each discipline (Lockeman et al., 2017; Matulewicz et al., 2020; McGregor et al., 2018; Muzyk et al., 2020). Potentially, differences in academic level may confound reported differences between health professions.

Regarding gender differences, female students had more positive attitudes about IPE than males at baseline and showed greater improvements than males after completing the online course. Several studies have noted that women have more positive attitudes toward IPE (Coster et al., 2008; Groessl & Vandenhouten, 2019). Coster (2008) also noted that women have stronger professional identification and prefer "connected" learning which involves listening to views and perspectives of others. After participating in the in-person event, both males and females' attitudes about IPE significantly decreased, but the decrease for females was greater than for males. This may indicate that the large scale format

may not have met IPE-related expectations and/or may not have provided the “connected learning” preferred. Tsai et al. (2015) reported similar results among students in an information management program, suggesting that female students seem to adapt themselves in asynchronous learning situations better than males, whereas male students perceived themselves as having better strategies in face-to-face discussions. These results suggest that gender differences in response to online and in-person formats should be considered when designing introductory IPE experiences so that these differences can be intentionally addressed.

To our knowledge, this study is the first to investigate the potential impact of race on student responses to an introductory IPE experience. We found that race did not impact student attitudes about IPE following participation in either the online or in-person components of the introductory IPE experience. Because our large-scale study included many students across a broad range of disciplines, the relatively large number of under-represented minority students participating in the IPE offering enabled a meaningful assessment that might not have been available in other studies with a smaller number of students.

This study had some limitations. A measure of professional identity was not included, but we used the Roles subdomain from SPICE-R2 to provide insights about this concept. We used a cohort design to make comparisons among students who provided consent, and control groups were not included. Some students were required to attend the event and others were not and we controlled for this in our analysis of their willingness to recommend the IPE activities. Further exploration and measurement of professional identity and readiness to engage in IPE may further inform development of effective IPE educational programming with use of tools such as the Professional Identity Scale (Parsell and Bligh, 1999) and the Readiness for Interprofessional Learning Scale (Brown, et al, 1986).

We used a traditional pretest-posttest (TPP) design rather than a retrospective pretest-posttest (RPP) design so that student attitudes about IPE could be directly compared among student groups prior to their participation in the first IPE activity. Other studies have used the TPP design with SPICE-R2 for a similar purpose (Brennan et al, 2021). The TPP design is limited by the potential for response shift bias due to

lack of self-awareness or understanding of constructs at pretest, socially desired responding, and retest effects (Little et al., 2020). Because the SPICE-R2 items do not require particular disciplinary knowledge, we estimate that any response shift bias that might have occurred would not affect our interpretation of changes in students’ attitudes following the IPE activities. Further, we administered the SPICE-R2 test three times which might have led to a retest effect, in which scores would tend to increase as students were more familiar with the test items at posttest and may have responded more positively, in the direction of socially desired responses. However, students’ scores on the second posttest (T3) were generally lower than on the first posttest (T2), suggesting that the T3 scores were not dominated by a retest effect. Finally, the independent effects of course format cannot be assessed directly with the current study because each of the sequenced components was delivered in only one type of format, that is, the first component was offered only as an online course, and the second component was offered only as an in-person event.

Conclusion

An introductory IPE experience comprising sequenced online and in-person activities was delivered to students in 11 health science disciplines across three campuses, and student attitudes about IPE based on SPICE-R2 scores were compared at three different times. SPICE-R2 scores improved after the online module and slightly declined after the face-to-face event except for the Roles subdomain. Student scores after the face-to-face event were improved compared to pretest, before the online module. Student responses differed between academic levels and genders, suggesting that these factors should be considered when designing introductory IPE experiences for a broad range of participants. Overall, we were successful in impacting health profession students’ foundational knowledge about IPE by providing students the opportunity to learn together with other students across disciplines in both online and in-person formats.

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