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ORIGINAL ARTICLE

Development and validation of a tool to assess self-efficacy for competence in interprofessional collaborative practice

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ABSTRACT

Although interprofessional education and collaborative practice have gained increasing attention over the past five decades, development of rigorous tools to assess related competencies is still in infancy. The purpose of this study was to develop an instrument to evaluate health professions students' self-efficacy in interprofessional collaborative competency and to assess the instrument's psychometric properties. We developed a new instrument based on the Interprofessional Education Collaborative's (IPEC) *Core Competencies for Interprofessional Collaborative Practice*. In a cross-sectional study design, 660 students from 11 health programmes at an urban university in the Midwest USA completed the Interprofessional Education Collaborative Competency Self Efficacy Tool (IPECC-SET). Rasch analysis evaluated the following: (1) functioning of the instrument; (2) fit of items within each subscale to a unidimensional construct; (3) person-response validity; (4) person-separation reliability; and (5) differential item functioning in relation to gender and ethnicity. After removing seven items with suboptimal fit, each subscale demonstrated high internal validity. Two items demonstrated differential item functioning (DIF) for "Gender" and none for "Race/Ethnicity." Our findings provide early evidence of IPECC-SET as a valid measure of self-efficacy for interprofessional competence for health professions students. Additional research is warranted to establish external validity of the new instrument by conducting studies across institutions.

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Introduction

Emerging evidence regarding the value of healthcare delivered via effective interprofessional teams has created new priorities for interprofessional education (IPE; Institute of Medicine [IOM], 1972; IOM Committee on the Health Professions Education, 2003; World Health Organization [WHO], 2010). According to WHO's *Framework for Action on Interprofessional Education & Collaborative Practice*, IPE is needed to enable current and future healthcare providers to become part of a "collaborative practice-ready health workforce that is better prepared to respond to local health needs" (WHO, 2010, p. 7).

Despite recognising the value of IPE and collaborative practice, identifying methods of IPE that lead to better practice is still under exploration (Barr, 2013; Reeves et al., 2011; Reeves, Perrier, Goldman, Freeth, & Zwarenstein, 2013; Reeves et al., 2008). The Interprofessional Education Collaborative (IPEC) represents six national education associations of schools of the health professions in the United States: American Association of Colleges of Nursing, Osteopathic Medicine, Colleges of Pharmacy, American Dental Education Association, Association of American Medical Colleges, and Associated Schools of Public Health. In 2011, IPEC developed a framework for effective collaborative practice and published it as *Core Competencies for Interprofessional Collaborative Practice* (Interprofessional Education Collaborative [IPEC], 2011). The report highlighted the need for a unifying concept for clear development of core competencies for interprofessional collaborative practice. This consensus document delineated 38 competencies across four domains: Values/Ethics for Interprofessional Practice (10 competencies); Roles/Responsibilities (9 competencies); Interprofessional Communication (8 competencies); and Teams and Teamwork (11 competencies; IPEC, 2011).

Since their publication, the IPEC competencies have been widely used and cited; thus, they are a logical resource to inform development of new instruments to measure IPE-related outcomes. For example, Dow and colleagues (Dow, DiazGranados, Mazmanian, & Retchin, 2014) used a 42-item questionnaire based on the IPEC competencies to assess learning outcomes related to collaborative practice at a health science campus at a large urban university in the United States. Student responses (n = 481) defined four components, aligned in part with the four domains of the IPEC competencies. The authors concluded that a questionnaire based on IPEC competencies might provide a measure to assess programmatic outcomes related to IPE. The authors had concerns over generalizability of their findings due to a low response rate and the limited number of participating health professions students (i.e. medicine, nursing, and pharmacy).

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Building on the discourse regarding evidence to support the usefulness of interprofessional education and collaborative practice, an Institute of Medicine (2015) report cautions that more rigorous research is needed with an explicit focus on interprofessional collaboration and its measurement to provide better evidence of the impact of practice-based interventions on professional practice and healthcare outcomes. Recognising this need, we undertook this study to develop an instrument based on IPEC competencies to evaluate health professions students' self-efficacy in interprofessional collaborative practice competence and assess the psychometric properties of the instrument. Our decision to create a self-efficacy scale was influenced by strong theoretical foundations that can be utilised to inform both operationalisation of the concept and intervention development. Bandura defined self-efficacy as belief in one's ability to succeed in specific situations or accomplish a task (Bandura, 1977). Self-efficacy is important because it determines how people feel, think, motivate themselves, and behave. Self-efficacy also influences how much effort people will expend and how long they will persist in the face of obstacles and aversive experiences (Bandura, 1977, 1994). According to Pajares (1996), researchers assess self-efficacy beliefs by asking individuals to report on the level, generality, and strength of their confidence to accomplish a task or succeed in a certain situation. In contrast to other expectancy constructs which are more global and general self-perceptions, self-efficacy is generally assessed at a more microanalytic level (Pajares, 1996). Thus, it is essential to assess self-efficacy beliefs at the optimal level of specificity that corresponds to the critical tasks being assessed and the domain of functioning being analysed (Pajares, 1996). Self-efficacy is a task-specific predictor of behaviour (Bandura, 1989; Pajares, 1996); it differs from self-confidence, which is a generalised personality trait that may not predict behaviour.

In academia, there is evidence to support association between self-efficacy and desired educational outcomes. A meta-analysis from the early 1990s indicated positive relationships between self-efficacy beliefs and academic performance and persistence; these associations remained stable across a wide variety of subjects, experimental designs, and assessment methods (Multon, Brown, & Lent, 1991). More recent evidence continues to support the correlation of self-efficacy with academic achievement, task persistence, motivation, and resilience (Ainscough et al., 2016).

Given the importance of self-efficacy as a construct influencing behaviour or performance, the overall aim of this study was to develop an instrument to assess self-efficacy based on IPEC competencies and evaluate the following: (1) functioning of the rating scale used in the instrument; (2) fit of the IPEC items to unidimensional constructs; (3) person-response validity; (4) person-separation reliability, as demonstrated by the scale's ability to separate the sample into distinct strata; (5) the presence of differential item functioning (DIF) in relation to gender and ethnicity; and (6) relationships between the subscales.

Methods

This study used a cross-sectional survey design. The study was approved by the institutional review board of the authors' university.

Instrument development

The Interprofessional Education Collaborative Competency Self-Efficacy Tool (IPECC-SET) was organised in two parts. Part 1 comprised all 38 items, verbatim, from the four IPEC competency domains (herewith referred to as subscales): Values/Ethics for Interprofessional Practice (VE), Roles and Responsibilities (RR), Interprofessional Communication (IC), and Teams and Teamwork (TT). Part 1 asked participants to rate how confident they were in their ability to demonstrate each IPEC competency (herewith referred to as *item*). A 100-point visual analogue scale was used to capture variability in responses. The IPECC-SET is presented in Table 1. Part 2 included questions about participants' prior contact with 15 different professions, their understanding of the role of each profession in the healthcare system, and demographic questions, including programme of study, gender, age, and race/ethnicity.

Participants and data collection

Study participants were 775 students from 11 health professions programmes participating in an institutional Interprofessional Immersion Day event. Before participating in this event, students completed the IPECC-SET. Students were free to choose whether to participate in the survey and were free to withdraw at any time. Data were collected with an online survey tool, Qualtrics. We used a 100-mm Visual Analogue Scale (VAS) as a VAS is simple and easy to use and facilitates capturing variability in measuring self-efficacy to range across a continuum of values. The 100-mm scale was used to ensure variability in responses; after data collection was completed scores were recoded into 10 category scores: 0–9.

Table 1. Examples of items in the SE-ICIPT from the four IPEC subdomains.*

Subscale	Item	
Interprofessional communication	IC#4	Listen actively, and encourage ideas and opinions of other team members
	IC#6	Use respectful language appropriate for a given difficult situation, crucial conversation, or interprofessional conflict
Values and ethics for interprofessional practice	VE#1	Manage ethical dilemmas specific to interprofessional patient/population-centred care situations.
	VE#4	Respect the unique cultures, values, roles/responsibilities, and expertise of other health professions
Roles and responsibilities	RR#2	Recognise one's limitations in skills, knowledge, and abilities.
	RR#9	Use unique and complementary abilities of all members of the team to optimise patient care
Teams and teamwork	TT#3	Engage other health professionals—appropriate to the specific care situation—in shared patient-centred problem-solving.
	TT#6	Engage self and others to constructively manage disagreements about values, roles, goals, and actions that arise among healthcare professionals and with patients and families

*Complete set of IPEC competencies is available at http://www.aacn.nche.edu/education-resources/ipecreport.pdf.

Data analysis

Data analysis was conducted using a Rasch rating scale model, which consists of two facets as follows: person and item. For this study, it was based on two assumptions: (1) the *more competent someone perceives he/she is*, the more likely to score higher ratings on more challenging items; and (2) the less challenging an item, the more likely *any person* is to receive higher ratings. When empirical data encounter these claims, it demonstrates that items and persons fit the measurement model, which supports internal scale and person-response validity, respectively, and also generates measures of both persons and items (Bond & Fox, 2007). Rasch models have been increasingly used for evaluating the psychometric properties of both new and existing instruments in both healthcare and education (Bode & Wright, 1999; Tesio, 2003). Rasch models are preferably used when examining whether items from a scale based on ordinal data measure a unidimensional construct (Bond & Fox, 2007). Rasch models are also preferable to use when handling data sets where all items may not be scored across all people (e.g. surveys), as no imputation of missing scores is needed for performing a Rasch analysis. The generated person measure is based upon the pattern of item responses rather than the sum of item scores as in most traditional psychometric analyses (Bond & Fox, 2007).

Following Rasch analysis, ordinal item scores were transformed into interval measures using logarithmic transformation of the odds probabilities. Transformations provided estimation along a calibrated continuum of the person's perceived confidence to engage in interprofessional collaboration and an estimate of the challenges in confidence for each interprofessional competency. Both estimates were expressed in logits ranging from low to high for perceived confidence and for perceived challenge. Statistics are presented as infit Mean-Square (MnSq), outfit MnSq, and standardised z-values (Bond & Fox, 2007) and indicate level of fit between definite and expected scores. Infit statistics were focused on because they provide valuable information when exploring fit between items and persons (Bond & Fox, 2007; Wright & Masters, 1982). The MnSq fit statistic is also preferable for item goodness of fit with polytomous data because it is less sensitive to sample size (Smith, Rush, Fallowfield, Velikova, & Sharpe, 2008). Analyses were conducted using a systematic stepwise approach similar to that used in previous studies (Lerdal & Kottorp, 2011). We decided to evaluate each of the four subscales separately. For analyses, WINSTEPS software program version 3.91.0 was used.

Step 1 aimed to evaluate the psychometric properties of the instrument following the essential rating scale criteria of Linacre (2004): (a) average calibration for each step category on each item should advance monotonically; (b) should be at least 10 observations of each category in the rating scale; and (c) outfit MnSq values for each step category calibration should be less than 2.0. If the instrument did not function according to the criteria, we followed Linacre's recommendation of collapsing scale steps (Linacre, 2004).

Step 1 aimed to evaluate internal scale validity by analysing the fit of the item responses to the above stated Rasch model assertions (Bond & Fox, 2007). Any item that did not show acceptable goodness of fit to the model (according to the listed criteria) was removed, and the psychometric properties of the remaining items were reanalysed. The item fit procedure was systematically repeated iteratively until all items in each subscale demonstrated acceptable goodness of fit, which was defined via a sample-size adjusted criterion (Smith et al., 2008) set for infit MnSq values 0.7–1.3 logits.

Step 3 served to evaluate unidimensionality in the generated measures by a principal component analysis (PCA) of the residuals, with the criterion that the first latent dimension should explain at least 50% of total variance (Linacre, 2016).

Step 4 addressed the evaluation of person-response validity. As others (Nilsson & Fisher, 2006), our evaluation of person goodness of fit was defined to accept infit MnSq values less than 1.4 logits and/or an associated z value less than 2. Commonly, 5% of the sample may by chance fail to demonstrate acceptable goodness of fit without being a threat to person-response validity (Kottorp, Bernspang, & Fisher, 2003).

Step 5 targeted estimation of the subscales' ability to separate participants into distinct groups reliably. Based on clinical experience, it was decided to allocate participants into three groups of perceived interprofessional competence, each with a person-separation index of 2.0, high, moderate, and low. The Rasch-equivalent person reliability coefficient, as well as the raw score Cronbach's alpha reliability coefficient, was also reported for each subscale.

Step 6 aimed to evaluate a uniform differential item functioning (DIF) analysis to explore stability of response patterns in relation to IPECC-SET subscale items for gender, age, and race/ethnicity. The magnitude of DIF was evaluated using the Mantel-Haenzel statistic for polytomous scales, using log-odds estimators (Mantel, 1963; Mantel & Haenzel, 1959) in WINSTEPS ($p < 0.01$).

Step 7 explored relationships among the subscales by correlating the Rasch-generated individual findings using Pearson's product moment correlations.

Data about participants' prior contact with different professions and their understanding of the role of each profession in the healthcare system were not used for analysis in this study. These data will be used in a future study examining predictors of self-efficacy in interprofessional collaborations.

Results

Sample demographics are presented in Table 2. A summary of the findings by analysis steps is presented in Table 3 for each subscale: VE, RR, IC, and TT.

Step 1: Rating scale functioning

Linacre's two first rating scale criteria (a and b) were met for the IC, RR, and TT subscales. On the VE subscale, however, the lower scale step categories were disordered (0312), so we collapsed these four scale steps into one before proceeding to further analyses. Linacre's criterion (c) was met for all step category calibrations across all subscales, except the lower categories (0 and 1), which demonstrated higher than expected outfit MnSq calibrations associated with a limited number of responses.

Table 2. Sample demographics (n = 658).

Demographic		
Gender		
	Male	208 (31.7%)
	Female	442 (67.4%)
	Choose not to answer	6 (0.9%)
	Missing	2
Race/ethnicity		
	Hispanic or Latino	82 (12.5%)
	American Indian or Alaskan Native	7 (1.1%)
	Asian or Pacific Islander	160 (24.3%)
	Black or African American	50 (7.6%)
	White	360 (54.7%)
	Choose not to answer	38 (5.8%)
	More than one ethnic group	39 (5.9%)
Age group (years)		
	18–21	36 (5.5%)
	22–25	272 (41.9%)
	26–29	199 (30.7%)
	30–35	83 (12.8%)
	36–40	28 (4.3%)
	41–45	10 (1.5%)
	46–50	9 (1.4%)
	51 years or older	12 (1.8%)
	Missing	9 (1.4%)
Programme		
	Dentistry	44 (6.7%)
	Medicine	146 (22.2%)
	Pharmacy	132 (20.1%)
	Physical therapy	50 (7.6%)
	Nursing	101 (15.3%)
	Health administration	24 (3.6%)
	Social work	35 (5.3%)
	Occupational Therapy	38 (5.8%)
	Nutrition	33 (5.0%)
	Other	55 (8.4%)

Steps 2 and 3: Item fit to the Rasch model and unidimensionality (Table 3 item misfit)

Some items across IPECC-SET subscales did not demonstrate acceptable goodness of fit to the Rasch model (see Table 4). One to three items were excluded in each of the four subscales to meet the criteria of item fit. After one or two additional iterations, all items met the criteria for item fit. The principal component analysis revealed that the subscales explained 62.7% (for VE) to 65.3% (for IC) of total variance, which exceeded our criterion. We therefore concluded that the IPECC-SET subscales measure generated from the Rasch analysis demonstrated acceptable levels of unidimensionality and could be used for further statistical analysis.

Step 4: Person-response validity

Of the 658 participants answering Part 1 of the IPECC-SET, 3.6% to 8.1% of the pattern of responses did not demonstrate acceptable goodness of fit to the Rasch model across the subscales, which was near our set criterion. When comparing misfit group to others, systematic differences were found. On the TT subscale, a significantly higher proportion of White/Caucasian students demonstrated misfit ($p < 0.05$). On the IC subscale, a significantly higher proportion of female students demonstrated misfit ($p < 0.01$). Otherwise, no significant differences were found. The proportions of participants scoring maximum scores on all subscale items were between 8.1% (TT) and 27.5% (VE; Table 3).

Step 5: Separation and reliability

Person-separation indices in the IPECC-SET subscales ranged from 1.87 to 2.82; most subscales exceeded the set criterion of acceptable separation reliability (Table 3). Only the VE subscale demonstrated somewhat lower separation than the set criterion, still indicating that this subscale could separate the sample in at least two distinct strata of perceived interprofessional competence. The raw score Cronbach's alpha reliability coefficients ranged 0.92–0.94 for all subscales, whereas the Rasch-equivalent person reliability coefficients ranged 0.78–0.89.

Step 6: Differential item functioning (DIF)

None of the IPECC-SET subscales demonstrated item DIF by race/ethnicity. Two subscales (IC and RR) demonstrated item DIF by gender (Table 4). On the IC subscale, items #CC7 and #CC2 were likelier to receive higher scores from male students. On the RR subscale, item #RR7 was more likely to receive higher scores from female students.

Step 7: Relationships between IPE subscales

Correlations between subscales were overall high ($r > .73$), indicating the subscales measured a similar phenomenon (Table 5). The VE subscale demonstrated lower correlations overall compared with other subscales (Table 5).

Discussion

We designed the IPECC-SET to explore health professions students' self-efficacy in interprofessional collaborative practice competence. The tool is intended to support evaluation efforts associated with IPE initiatives targeting students from diverse health professions. This study contributes empirical evidence about the psychometric properties of the IPECC-SET.

Most items in IPECC-SET subscales worked well together to define unidimensional constructs. The IPECC-SET also demonstrated the ability to differentiate students in at least three different groups of interprofessional competence confidence levels for three subscales (TT, IC, and RR) and two groups for VE. The proportion of students not demonstrating goodness of fit to the model ranged 3.6%–8.1% across all subscales, and the tool did not demonstrate DIF in relation to ethnicity. Further, the instrument demonstrated a range of difficulty levels across the items and an ability to distinguish students across different levels of confidence in interprofessional competence.

Some items in each subscale did not demonstrate acceptable goodness of fit and were excluded from subsequent analyses. At least five of seven misfitting items (71%) may have demonstrated misfit because they did not represent skills specific to interprofessional practice (Table 4). For example, the IC item *Listen actively, and encourage ideas and opinions of other team members*, is an important skill for practitioners whether they act as individual practitioners or members of an interprofessional team. Students may have provided responses

Table 3. Overview of the statistical approach, criteria, and results of the Rasch analysis of the IPECC-SET subscales.

Aspect of validity measured	Statistical approach and criteria	*N* = 658			
		TT (11 items)	CC (8 items)	VE (10 items)	RR (9 items)
Step 1. Rating scale functioning	≥10 observations per category Average measures for each item step category on each item should advance monotonically Outfit mean square *(MnSq)* values < 2.0 for step category calibrations	Criteria a and b met. The lowest category (0) demonstrated a higher outfit mean square measure than expected (3.98)	Criteria a and b met. The lowest categories (0) and (1) demonstrated higher outfit mean square measures than expected (2.39; 2.28)	Criterion a met. The lower scale step categories were ordered illogically (0312) so the categories 0 to 3 were therefore collapsed. After collapsing scale step categories, the lowest categories (0) and (4) demonstrated higher outfit mean square measures than expected (3.45; 2.12)	Criteria a and b met. The lowest category (0) and (1) demonstrated higher outfit MnSq measures than expected (3.55; 3.28)
Step 2. Internal scale validity	Item goodness of fit statistics A sample-size adjusted criterion for item goodness of fit requiring infit *MnSq* values between 0.7 and 1.3 logits	After removing one item, the remaining ten items all demonstrated acceptable fit	After removing two items, the remaining six items all demonstrated acceptable fit	After removing three items, the remaining seven items all demonstrated acceptable fit	After removing one item, the remaining eight items all demonstrated acceptable fit
Step 3. Internal scale validity	Principal component analysis of the residuals The criterion was set for at least 50% of the total variance to be explained by the first latent variable. The criterion was set for at least 50% of the total variance to be explained by the first latent variable	Item range: 45.0–57.94 10 items: 64.8%	Item range: 47.2–53.6 6 items: 65.3%	Item range: 42.6–55.3 7 items: 62.7%	Item range: 44.1–53.6 8 items: 63.3%
Step 4. Person response validity	Person goodness of fit statistics The criterion was to accept infit *MnSq* values ≤ 1.4 logits and/or a *z* value < 2.0 Up to 5% of the sample may fail to demonstrate acceptable goodness of fit by chance.	47 out of 658 respondents (7.1%) did not demonstrate acceptable goodness of fit.	41 out of 658 respondents (6.2%) did not demonstrate acceptable goodness of fit.	24 out of 658 respondents (3.6%) did not demonstrate acceptable goodness of fit.	53 out of 658 respondents (8.1%) did not demonstrate acceptable goodness of fit.
Step 5. Person-separation reliability	Person-separation index > 2.0 was required to ensure that the scale could differentiate students with at least three different levels of interprofessional competence. Person reliability and Cronbach's *α* coefficients	10 items (separation index = 2.82) Raw score to measure correlation = .86 Person reliability (Rasch) = 0.89 Person raw score reliability (*α*) = 0.94	6 items (separation index = 2.21) Raw score to measure correlation = .88 Person reliability (Rasch) = 0.83 Person raw score reliability (*α*) = 0.92	7 items (separation index = 1.87) Raw score to measure correlation = .82 Person reliability (Rasch) = 0.78 Person raw score reliability (*α*) = 0.94	8 items (separation index = 2.39) Raw score to measure correlation = .85 Person reliability (Rasch) = 0.85 Person raw score reliability (*α*) = 0.94
	Person measure range (M, SD) Maximum scores *n* (%)	20.4–113.2 (69.8, 17.9) *n* = 53 (8.1%)	17.7–111.9 (74. 0,19.4) *n* = 83 (12.6%)	32.5–111.6 (84.7, 20.6) *n* = 181 (27.5%)	29.7–114.4 (75.5, 20.2) *n* = 87 (13.2%)

Table 4. Items from the IPEC subscales demonstrating misfit and differential item functioning (DIF; n = 658).

Item demonstrating misfit in IPECC set	
TT subscale	TT#10: Use available evidence to inform effective teamwork and team-based practices.
CC subscale	CC#6: Use respectful language appropriate for a given difficult situation, crucial conversation, or interprofessional conflict.
	CC#4: Listen actively, and encourage ideas and opinions of other team members.
VE subscale	VE#8: Manage ethical dilemmas specific to interprofessional patient- /population-centred care situations.
	VE#5: Work in cooperation with those who receive care, those who provide care, and others who contribute to or support the delivery of prevention and health services.
	VE#1: Place the interests of patients and populations at the centre of interprofessional healthcare delivery.
RR subscale	RR#2: Recognise one's limitations in skills, knowledge, and abilities.
Items demonstrating DIF in IPECC set	
CC subscale	CC#7: Recognise how one's own uniqueness, including experience level, expertise, culture, power, and hierarchy within the healthcare team, contributes to effective communication, conflict resolution, and positive interprofessional working relationships.[a]
	CC#2: Organise and communicate information with patients, families, and healthcare team members in a form that is understandable, avoiding discipline-specific terminology when possible.[a]
RR subscale	RR#7: Forge interdependent relationships with other professions to improve care and advance learning.[b]

[a]Relatively easier to score high on for male participants in comparison with female participants.
[b]Relatively easier to score high on for female participants in comparison with male participants.

Table 5. Relationships between IPECC-SET subscale measures (n = 658).

	RR subscale	TT subscale	VE subscale	CC subscale
RR subscale	1.00	0.91**	0.79**	0.90**
TT subscale	–	1.00	0.73**	0.91**
VE subscale	–	–	1.00	0.75**
cc subscale	–	–	–	1.00

**$p < 0.01$.

based on their confidence in these skills as individual practitioners and/or members of an interprofessional team. The challenge associated with these misfitting items is to determine when the team-based competencies described in the item are different from the competencies related to being an individual practitioner. There might be significant overlap in the competencies health professionals need to attain as individual practitioner versus team member.

Another potential explanation for the misfitting items may be that multiple skills are represented within the same item. For example, two items in the VE subscale demonstrated misfit: *Manage ethical dilemmas specific to interprofessional patient-/population-centred care situations* and *place the interests of patients and populations at the centre of interprofessional healthcare delivery*. Both referred to competencies related to both patient- and population-based work. The items may be misfitting because students' views may differ regarding their competence in individual patient-related work versus population-based work.

Finally, at least one item in the VE subscale did not reflect competencies associated with values and ethics: *Work in cooperation with those who receive care, those who provide care, and others who contribute to or support the delivery of prevention and health services*. This item may fit better with another subscale such as Teams and Teamwork (TT).

No item in the IPECC-SET demonstrated DIF in relation to race/ethnicity. This is an important feature of fairness in testing for any evaluation tool used in healthcare practice and education, but often overlooked (Paradis et al., 2013). Some items did, however, demonstrate DIF in relation to gender (Table 4). Further studies are needed to better understand the reasons. Larger data sets may also be needed to explore whether these findings are truly gender-driven or more closely associated with other variables (e.g. professional programme).

The overall high correlation coefficients among the four subscales (0.73 to 0.91; Table 5) indicate they may reflect the same underlying construct, rather than being four separate but related constructs of confidence in interprofessional practice competence. We decided to analyse the subscales separately in this study and did not combine them because the IPEC competencies are presented within four distinct competency domains derived through a consensus-driven process (IPEC, 2011). However, our findings indicating strong interrelationships among the subscales suggest that IPEC competencies may represent a unitary concept. Future studies should also explore additional dimensions of interprofessional competence not captured in the IPEC competencies, possibly because these competencies are based on the consensus of a limited range of perspectives and professions.

Another argument that supports maintaining the subscales as separate entities is that if there were a clear hierarchy in the four constructs (e.g. if items reflecting TT were more challenging overall than items reflecting VE), it could make sense to maintain four separate subscales. Our findings, however, revealed large overlaps among subscales (Table 3), supporting the idea that the subscales and items are more intertwined than separate, though the VE subscale seems to be less related to the others (Table 4).

Our empirical findings in relation to the IPEC competencies reflecting more of a unitary concept are also supported by the recent update to the original core competencies proposed by the Interprofessional Education Collaborative (IPEC, 2016). The 2016 IPEC update reaffirms the original competencies and makes refinements to individual competencies to broaden the context to better integrate population health approaches across the health domains and professions to enhance collaboration for improving both individual care and population health. Most relevant to our findings, "Interprofessional Collaboration is pushed forward as the *central domain* under which the original four core general competencies and related subcompetencies are arrayed". This grounding of the interprofessional competency model under a singular domain of Interprofessional Collaboration is a key conceptual framework that will shape future efforts for both training and assessment of learners.

Our study has certain limitations. First, healthcare professions were not equally represented in the student sample in our study; students had varying levels of experience with other healthcare students or professionals; and the students included in the sample were at different stages of their healthcare education. Second, from a survey research perspective, it is crucial to note that many IPECC-SET items reflect more than one competency. In other words, many items are double- or triple-barrelled questions. We, however, decided to use the original wording of the IPEC competencies to assess the functioning of the instrument based on the IPEC competencies written in their original form (IPEC, 2011). Third, we recognise that this self-efficacy assessment would not replace competency-based assessments, such as TOSCE (Gordon et al., 2013). It will be important to look at the relationship between confidence in interprofessional practice competence and *demonstrated* competence using other workplace-based assessment methods in future studies involving diverse cohorts of students. Fourth, our study sample was limited to students from one university in an urban area of the United States, which may limit generalizability of our findings. Finally, since the revised IPEC core competencies were released after we had completed our study, we were not able to use the updated set of IPEC core competencies.

It is noteworthy that, overall, our sample rated their self-efficacy in interprofessional practice competence high, as reflected in their overall high mean abilities and proportion of maximum scores in relation to the item difficulty distribution (Table 3). We recognise that this self-efficacy assessment would not replace competency-based assessments, such as TOSCE (Gordon et al., 2013). By using evaluation tools targeting both perceived and observed competence in interprofessional collaboration, we have better opportunities to target and customise educational interventions to various target groups, rather than providing "one size fits all" solutions. It will therefore be important to further examine the relationship between confidence in interprofessional practice competence and demonstrated competence using other workplace-based assessment methods in future studies involving diverse cohorts of students to detect differences across target groups.

Concluding comments

In summary, this study provided initial evidence of validity and reliability of a new instrument, IPECC-SET, for assessment of self-efficacy in interprofessional collaborative practice competence. Self-efficacy has been used previously for learner self-assessment in many areas of health professions education, but has not been applied to interprofessional collaborative competencies. This study is a step forward in the field of developing rigorous assessment tools to measure competency in interprofessional collaborative practice. Further systematic efforts are needed to support wider testing of this new instrument across different settings. Based on the findings from this study, future studies with the IPECC-SET should therefore further evaluate the following: a) validity evidence of the tool and included items based on a unidimensional concept rather than four distinct aspects of interprofessional competence, b) differential item functioning in relation to health professions educational background in order to make valid comparisons between educational groups, c) predictive validity of the tool by studying the relationship between self-efficacy and competence based on actual performance, d) sensitivity to measure change in relation to educational interventions to facilitate interprofessional education, and e) association of variables such as demographic factors, prior experience with other health professions and the level of understanding of other health professions, with self-efficacy in interprofessional collaboration. Our study provides an important step in establishing valid measures for self-efficacy in interprofessional collaborative competence; the next steps in this line of inquiry can further explore how different variables may influence self-efficacy in this competency domain.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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