PEER REVIEW

Creating and Validating Self-Efficacy Scales for Students

JONATHAN KITCHING, MSc
SIMON CASSIDY, PhD
PETER EACHUS, PhD
PETER HOGG, MPhil, DCR

Purpose *Student radiographers must possess certain abilities to progress in their training; these can be assessed in various ways. Bandura's social cognitive theory identifies self-efficacy as a key psychological construct with regard to how people adapt to environments where new skills are developed. Use of this construct is common in health care literature but little has been noted within radiographic literature. The authors sought to develop a self-efficacy scale for student radiographers.*

Method *The scale was developed following a standard format. An initial pool of 80 items was generated and psychometric analysis was used to reduce this to 68 items. Radiography students drawn from 7 universities were participants (N=198) in validating the scale.*

Results *The psychometric properties of the scale were examined using analysis of variance (ANOVA), factor analysis and item analysis. ANOVA demonstrated an acceptable level of known group validity: first-year, second-year, and third-year students all scored significantly differently (P=.035) from one another. Factor analysis identified the most significant factor as confidence in image appraisal. The scale was refined using item and factor analysis to produce the final 25-item scale.*

Conclusion *This is the first published domain-specific self-efficacy scale validated specifically for student radiographers. In its current format it may have pedagogical utility. The authors currently are extending the work to add to the scale's validity and embedding it into student training to assess its predictive value.*

The United Kingdom has a largely publicly funded health care system, which has undergone a period of unprecedented expansion and change in the past 10 years. This is evidenced by the increased number of patients treated and the extended scope of health care worker practice.[1] To support these changes, it was necessary to increase staff recruitment and, therefore, increase the number of student radiographers. Clinical training is an essential component of the radiographer educational process because approximately 50% of the UK undergraduate course is conducted within the hospital environment. Student radiographers are expected to pass various assessments to evaluate this clinical learning. These assessments are performed by radiographers who work with the students in the clinical setting. Despite such assessments, it still is possible for radiographers to complete the undergraduate course with certain abilities underdeveloped.[2] There is no definitive guide to the skills or competencies deemed essential for newly qualified radiographers in the UK. Consequently, fresh approaches of establishing whether students possess the necessary attributes should be considered. The UK National Health Service is publicly funded and subject to budgetary pressures, so any such new approaches would be subject to a cost-benefit analysis.

Bandura's self-efficacy construct[3] is well established within the field of psychology and social cognitive theory and has been widely used within health care[4] and education.[5-7] In the literature, use of the construct has emphasized how people learn new skills and overcome problems.

Literature Review

Self-efficacy is a concept grounded in social learning theory — humans have basic primary drives (eg, hunger and thirst) out of which result secondary drives. Secondary drives evolve as behaviors are rewarded or reinforced.[8] Bandura stated that each individual possesses a self-system that enables him or her to exercise

a measure of control over his or her thoughts, feelings, motivation, and actions.[1] This "can-do" cognition gives a person a sense of mastery over one's environment.[9] Self-efficacy is domain specific; it is not a generalizable trait within an individual. Self-efficacy may be related to, but distinct from, a person's self-esteem. Self-esteem is defined as confidence in one's own worth or abilities.[10] This differs from self-efficacy, which relates only to a particular subject or activity. Self-efficacy is independent of ability.

Bandura identified that 4 major sources of efficacy expectations influence an individual's level of self-efficacy.[1] Bandura realized that each of the efficacy expectations exerts different levels of influence on a person's self-efficacy. The most influential and dependable source of efficacy expectation is performance accomplishment because it is based on a person's actual experiences. Vicarious experience is another efficacy expectation. Although less efficacious than personal experience, a person's expectation levels can be raised by seeing other people perform an activity successfully. Verbal persuasion is the third efficacy expectation and is a widely used method of raising self-efficacy because it is the easiest of the sources to perform. Unfortunately, verbal persuasion is a weak method of inducing positive changes in efficacy and, in the event of failure, is reversed easily. Emotional arousal is the fourth efficacy expectation. This is a response to placing an individual in an emotionally stimulative situation (eg, placing a child in an unfamiliar surrounding or putting an adult in a threatening environment).

Self-Efficacy Structure

Efficacy beliefs vary in strength. Weak efficacy beliefs are easily negated by experiences in which a person fails to do well, whereas people who have strong beliefs in their capabilities persevere in their efforts even if they encounter many difficulties.[11] The process of self-efficacy can thus be seen as a positive or negative feedback mechanism. If someone believes he or she is capable of executing the behavior necessary to perform a task, he or she will persevere longer and is more likely to succeed because of this perseverance. The opposite also is true. For this (and other) reasons, higher levels of perceived self-efficacy tend to be accompanied by higher performance attainments.[12]

Self-Efficacy in Education

Self-efficacy research is well established within the educational sector and a wealth of research findings indicate that self-efficacy correlates with achievement outcomes.[13-15] Students with high levels of self-efficacy are more likely to challenge themselves and be more motivated to succeed when faced with potential failure. The opposite is true of students who have low self-efficacy: When they fail at tasks, they find it more difficult to summon the motivation to try to overcome their difficulties.[1]

Self-Efficacy in Radiology

Searches in Medline, CINAHL, and Science Direct all returned no articles when the words "self efficacy and imaging or radiology or radiography" were searched (after exclusion of irrelevant items). Because the nature of self-efficacy is, by definition, context specific, the use of a "general" self-efficacy scale is of little relevance when attempting to measure a specific set of perceived abilities or behaviors.[16] Therefore, a specific instrument to measure the self-efficacy of student radiographers regarding their clinical placement is needed. No research has been published that assesses health care students' self-efficacy regarding their attitudes toward the vocations for which they are preparing. There are, however, some published studies, notably in nursing, that measure students' self-efficacy regarding specific nursing domains.[17-19] No work has been published that purports to measure a radiography student's self-efficacy in any specific domain or to even measure a radiography student's self-efficacy in general.

Research Rationale

For creating a self-efficacy scale, the domain of student radiographer clinical practice was chosen because this area was of personal interest to the first author of this article, and because there has been no published research in this area. If a measure of the self-efficacy of student radiographers can be made at different stages and contexts of their training, it may be possible that students who have low self-efficacy scores could be afforded extra support during their learning. This may result in less attrition and a better quality learning experience. In the UK, student attrition from radiography courses was relatively high (37%) in the academic year 2007-2008.[20] "Financial reasons" was the most common reason given for the student leaving the course. This level of 37% is higher than the attrition level among other allied health professionals and nurses in the UK.

Methodology

The method comprised 2 distinct phases — creation of the initial scale and the validation of the

scale created. The creation phase began with domain identification, followed by item generation and appropriateness. The scale's face validity then was assessed; focus groups played an essential role in this phase. The validation phase involved student radiographers completing the scale; this was followed by statistical analysis. Ethical approval for this study was granted from the host university (University of Salford, UK) and 1 other university that required ethical approval before allowing its students to participate.

No previous published research on self-efficacy scale development could be found in the field of clinical imaging to use as a basis for this study. However, researchers have published several examples of self-efficacy scales in many different fields.[7,21,22] Published scales from other disciplines could be modified or updated to produce newer scales.[23,24] Because no such body of previous work exists in the combined fields of self-efficacy and radiology, it was not possible to directly build upon existing published research; the scale items would have to be developed.

Initial Scale Creation

Reviewing published and grey literature (those papers, reports, and other documents from government or academia that are produced but not distributed) established a theoretical framework from which content domains were proposed. Content domains are different areas of the construct that when united make up the whole construct. Some constructs can be covered with a single item, but others need entire subscales dedicated to them; the make-up depends on the nature of the construct.[25] Using focus groups (which combined student radiographers and their educators with experienced radiographers) and knowledge from experienced clinical radiographic staff, it was possible to identify 3 main content domains that were key to the practice of student radiographers within their clinical placements. These were named image acquisition, image critique, and communication. Scale items were generated in these domains.

After generating the scale items, the draft scale was assessed for face validity. For this study the focus group participants consisted of a radiography clinical tutor from a large teaching hospital, 2 superintendent radiographers (one of whom has a dual role split between teaching undergraduate radiography students at a university and working in a radiology department), a third-year student radiographer and a radiographer who had recently completed the undergraduate

course. The researchers felt this panel had the range of experience and knowledge that would be useful when assessing the scale items. The draft scale items were sent by e-mail to each of the participants along with a short description of the study's aims. No experience or knowledge of self-efficacy scales was presumed, so a short explanation of the concept with some information about self-efficacy also was sent to each panel member. The panel members were given 2 weeks to read the items before the focus group meeting was held. The format of the topics discussed followed the items in the e-mail correspondence to group members. The discussion also included the items and the scoring of the items.

The focus group for this study changed several items to improve their readability, deleted 12 items that the group considered redundant, and proposed adding a short section at the beginning of the scale to see if the student had undergone any teaching specifically related to image analysis. This was felt to be important because different universities have different teaching methods.

A list of 87 items was generated initially. This was a relatively high number of items but the group felt that a large number of items was required for each content domain to assess the wide degree of competencies a student radiographer should display. Within each domain, a range of items also ensured differentiation between the levels of difficulty in the domain. This "gradation of challenge" is an important component of self-efficacy scales to ensure the scale reflects the full range of difficulties and to eliminate ceiling effect within the scale.[26] In addition, given that there was little UK literature available to establish essential abilities for student radiographers, a wide range of items would help capture all necessary competencies. The final scale consisted of 67 items, including the initial questions regarding the participant's year of study and the image appraisal teaching method they had undergone (see Box). In the UK, there is no standardized method to review a radiographic image. Although this review includes all the points described later in this article, methods will differ between students in the UK, the United States, and other countries.

Scale Validation

To achieve a suitable sample size, 9 universities of the 25 that offer an undergraduate diagnostic radiography course in the UK were approached to include their students in the study. Seven agreed to take part, and 2 did not reply to the contact e-mails.

Box
The Student Radiographer Self-Efficacy Scale

All answers are given using a 6-point Likert scale using one of the descriptors: strongly disagree, disagree, slightly disagree, slightly agree, agree, strongly agree.

1. I struggle to adapt my technique when performing examinations on uncooperative patients.
2. I am able to demonstrate I know which pathological conditions may need me to adjust my normal radiographic technique.
3. I lack confidence when manipulating the contrast/brightness of the image to demonstrate pathological appearances.
4. I would lack confidence if asked to change the way the imaging system has processed the image data to optimise the image.
5. I lack confidence when it comes to deciding whether supplementary projections need to be performed after viewing the standard projections for an examination.
6. When I look at an image that needs repeating due to poor patient positioning, I can struggle to work out how to correct the positioning error.
7. My confidence is lacking when it comes to trying to view a patient's previous imaging alongside their most recent examination on a web-based PACS.
8. I lack confidence when assessing images for pathology.
9. I am usually able to decide if an image is normal or abnormal.
10. I am confident I am able to name all the bones on a radiographic image.
11. I am able to describe how soft tissue signs can be used to identify subtle fractures.
12. I feel confident that I am able to distinguish between common normal variants and pathology.
13. I sometimes struggle when distinguishing between normal developmental anatomy and pathology.
14. I feel able to distinguish an old fracture from a new fracture on an image.
15. I am able to identify the different stages of fracture healing on an image.
16. Linking a mechanism of injury to a specific pathological appearance can be difficult.
17. I am able to assess spinal films for pathology.
18. I am able to identify plain film appearances that may require urgent medical intervention.
19. When I spot pathology on an image I find it difficult to know whether any more projections are required.
20. I lack confidence recognising when pathological appearances may be suspicious of Non-Accidental Injury (NAI).
21. I am able to identify the most common reasons that important pathological appearances may be "missed" on images.
22. I wouldn't feel very confident if I was asked to write a short comment to describe the appearances of images for the referring clinician.
23. I feel confident identifying if another imaging modality may be more appropriate to demonstrate a pathology than a normal x-ray examination.
24. I find it difficult to identify when it is appropriate to urgently communicate the findings of an examination to the referring clinician.
25. I sometimes feel out of my depth on clinical placement.
26. I am able to perform the correct actions when I suspect that a patient may have injuries consistent with Non-Accidental Injury (NAI).

Although no figure for the number of students contacted was obtained, a rough estimate is that 100 to 170 undergraduate students are enrolled in each university. This means that approximately 1200 students from a population of approximately 3000 were asked to participate.

One of the aims of the study was to compare known groups; these groups are radiography students in the first, second, and third years of the course. A stratified random sampling technique was used to assess the difference among these groups. This was achieved by sending out a letter to a number of course

leaders of universities and asking them to enroll students in the study.

Traditionally, self-efficacy scales have been administered using paper-based questionnaires that have been administered via mail,[27] by hand to a convenience sample,[28,29] or by a method involving an interviewer who filled them out.[23,24] With the advent of the Internet, it is now possible to administer surveys using Web-based software. Internet research also has several advantages over paper-based surveys, including potential cost savings, the ability to collect large samples as easily as small samples, and the opportunity for virtual researchers to collect data 24 hours a day.[30] Another study found that there are no major differences in the quality of data obtained between Internet data collection and more traditional methods.[31]

The sample response rate of online surveys administered to the general population with no forewarning was found to be 29.1% in a meta-analysis.[32] This number was on the same order as another study that stated that a 30% to 35% response rate from an unsolicited online survey was a good response.[33] Two published studies developed and validated self-efficacy scales using an online format.[34,35] Neither of these studies reported any significant problems with this data collection method that are relevant to the current study. Because the sample was to consist of students from all around the UK, different course timetables dictated that students were in different stages of their study, so researchers decided a Web-based survey would be the most effective method of administering the scale.

Each item assessed a different skill that is required of an undergraduate student radiographer in clinical placement. The response format for each of these items was a 6-point Likert scale. The lower end of the score was "strongly disagree" and the upper point was "strongly agree," with 4 gradations between the 2 extremes.

Results and Analysis

Data were collected over a 3-month period. At the end of this time, 198 student radiographers had completed the scale. The sample consisted of students from the 3 different years of undergraduate study (see Figure 1).

The scale consisted of 6 initial questions that asked about previous "red dot" teaching at the student's university and clinical placement. The so-called "red dot" system is a way that radiographers identify abnormal images to referring clinicians; it was first suggested by Berman.[36] The system initially involved placing a small red sticker on the image that demonstrated the abnormality, hence the name. In 2006, the Society of Radiographers recommended that all radiographers in the UK be trained to make informed clinical comments on the images they produce.[37] Image interpretation is now included as a key part of the undergraduate radiography course in the UK. Image interpretation specifically refers to the practice of assessing images for pathology. (Image appraisal may include image interpretation.)

The main part of the scale consisted of 61 items relating to self-efficacy. The responses were converted into numerical scores by equating the responses with corresponding scores. Questions that had negative wording (eg, "I lack confidence," "I don't think I can," "I'm not sure") were reversed for scoring purposes so that all responses were unidirectional (ie, a score of 6 reflected a high level of self-efficacy).

Aggregate scores for each of the respondent's scores on the 61 scale items then were calculated. This revealed that there were 8 incomplete scales (ie, less than half of the items had responses). These scales were removed from the data set. One outlier was identified — the
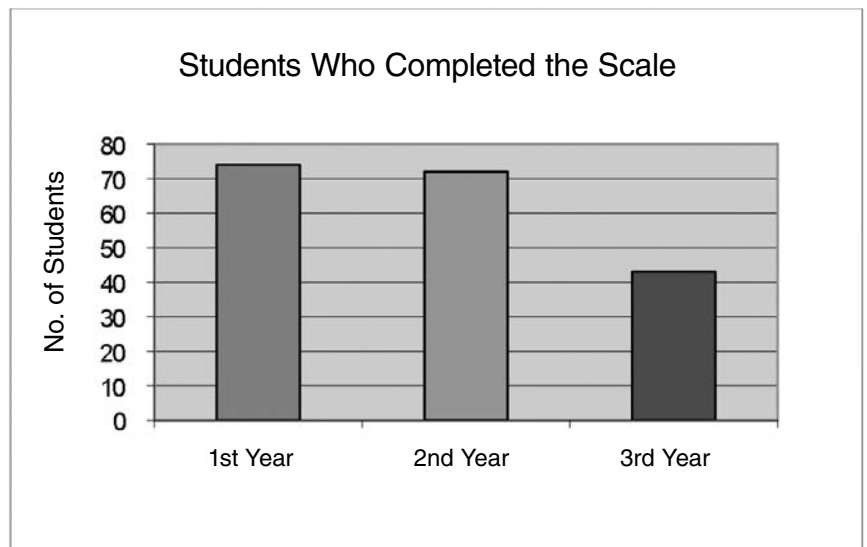
Figure 1. *Distribution of sample between year groups.*

score was very low (116) compared with the mean score on the scale (261). When the responses were studied for this participant, it was evident that throughout the scale, the participant had used only the extremes of the scale (1 or 6 on the Likert scale). This participant's score was removed from the data set because this data was likely to be erroneous. This left 189 responses that formed the data set for the remainder of the analysis. The data set was compared with that of a normal distribution and conformed closely to a normal distribution.

Cronbach Alpha

Internal reliability is an amalgamation of how well the items correlate to one another and how well each item correlates with the total scale score.[16] Cronbach alpha was calculated to assess the internal reliability of this scale. Cronbach alpha was found to be 0.92 (for the 61-item scale), indicating a high level of internal reliability, and 0.93 (for the 68-item scale). Therefore, substantially reducing the item pool did not result in a substantial lowering of the internal reliability of the scale.

Item Analysis

Item analysis allows for observation of the characteristics of items. A method of item analysis that uses descriptive statistics has been described.[38] This method identifies that apparently redundant items can be eliminated. Item analysis identified 17 items that did not add meaningful data to the overall scale. These items were deleted from the scale and the interitem correlations were calculated for the remaining items. Interitem correlations describe how well individual items correlate with other item scores on the scale. Items were deleted if more than half of their responses had an interitem correlation of < 0.25. Four items met this criterion. After item analysis was completed, all the items shown to either have a high level of error within them or to add no meaningful data to the results were eliminated. It was possible to move onto the next stage of the data analysis. At the end of item analysis, the remaining scale consisted of 40 items.

Factor Analysis

Factor analysis is a way of exploring whether there are correlations between items that can be linked together to form an underlying theme for the scale items.[38] Before factor analysis can be undertaken, it is important to confirm that the patterns of correlations between the items are relatively compact.[38] The Kaiser-Meyer-Olkin

Table 1
Factor Analysis for an Unrotated Solution

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	10.422	27.427	27.427
2	2.129	5.602	33.029
3	1.783	4.691	37.720
4	1.624	4.273	41.993
5	1.558	4.099	46.092
6	1.432	3.769	49.861
7	1.340	3.525	53.386
8	1.195	3.146	56.532
9	1.161	3.054	59.586
10	1.035	2.724	62.310

score for this set of scale items was 0.79; this indicates that the data set correlations are compact.

Redundant items were eliminated in the item analysis stage. Factor analysis (principal component analysis) was undertaken on the remaining items, and it was found that there was one dominant factor that accounted for 27% of the variance within the scale (see Table 1). Ten factors were found with an eigenvalue > 1. The second largest accounted for < 6% of the variance within the scale. This low level of variance was not high enough to be included as a significant factor. This is also the case for the other factors with even lower eigenvalues.

To assess whether a different factor structure existed, factor analysis was performed again on the same group of items, but with a varimax rotation. Performing the factor analysis with a rotation sometimes can produce a result that reveals underlying factors that are not apparent in an unrotated solution. Once again, a single strong factor was identified that accounted for slightly > 25% of the variance within the scale. When the items that loaded onto this factor were analyzed, almost all the same items were produced as in the unrotated solution. Although 19 factors had an eigenvalue > 1, the second largest factor in the varimax rotation results accounted for < 5% of the variance within the scale. Once again, this is too slight to be significant. The single factor that loaded highly on both solutions was then explored to see which of the items

loaded onto the factor (ie, which items correlated well with this factor). The literature suggests items that correlate poorly with such a factor as this be eliminated.[38] The items that correlated the least with this factor were then eliminated. For this study, items with a factor loading of < 0.4 were eliminated, which resulted in the elimination of 13 factors.
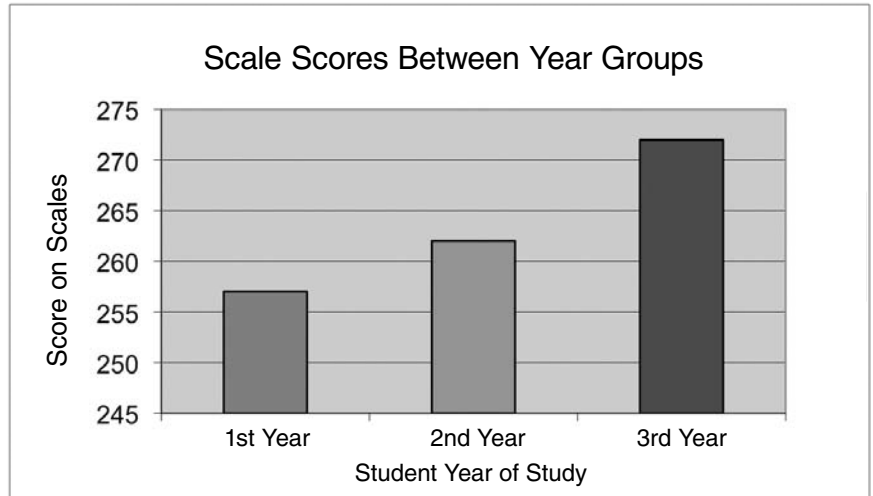
Other Correlations

To assess the criterion validity of the scale, the difference between the known groups was analyzed. In this study, the known groups are first-year, second-year, and third-year students.

Figure 2 demonstrates the 3 groups achieved differing scores on the scales with third-year students scoring, on average, higher than the second-year students and the second-year students scoring, on average, higher than the first-year students.

A 1-way analysis of variance (ANOVA) was performed to test whether there was a significant difference between these groups (see Table 2).

In total, there were 61 items on the scale to measure self-efficacy. (There also was 1 item related to participants' consent to take part in the study and 6 items that addressed recent teaching the students may have had; these items were not graded using a Likert scale.) This represented a minimum score of 61 and a maximum score of 366 on the scale for a given participant. The difference between the 3 groups is significant ($P < .05$). Because this is a test of multiple groups, it was appropriate to use a Bonferroni post hoc analysis to assess whether to reject the null hypothesis (that the scores between the groups would not differ). Because there are 3 groups and $P < .05$, the desired critical level of significance with Bonferroni post hoc correction level becomes $P < 0.0167$ (.05/3). The significance level is greater than this for all 3 groups. Table 3 demonstrates the difference between the groups compared with one another.

The critical level of significance between each set of 2 groups is now $P < 0.025$ (0.05/2) because only 2 groups are being compared to one another in each set. The difference between the first and third years is lower than this level of significance and the difference

Figure 2: *The difference in mean scores of the sample when split into their different years of study.*

between the second and third years is slightly higher than the significance level.

Effect of Red Dot Teaching

No significant correlation was found between the group of participants who reported having had red dot teaching and those who had not. Similarly, no difference in scores was found between the group who had received instruction regarding image interpretation on their clinical placement and those who had not. Although neither group demonstrated a significant difference in their scores, the decision was made to analyze whether the timing of any such instruction the students received made a difference in their scores. Students were asked if this teaching had occurred < 3 months ago, < 6 months ago, ≤ 12 months ago or > 1 year ago. Once again, no significant difference was found between members of the groups who had received teaching relatively recently at either their university or their clinical placement and those who had had teaching longer ago.

Discussion

Factor Analysis

Factor analysis is a method used to examine how underlying constructs influence the responses on a number of measured variables.[39] Factor analysis was used in this study to examine the factor structure within the scale and demonstrated that there was a single dominant factor. This factor loaded highly

Table 2
Results of 1-way ANOVA on Scale Scores for Each Year Group

Group	Mean	SD	Significance Level
1st year	257	29.98	*P* = .035
2nd year	262	28.43	
3rd year	272	31.81	

Table 3
Significance Level of Scores of Each Year Group

Groups Compared	Significance Level
First year and third year	*P* < .001
Second year and third year	*P* < .031
First year and second year	*P* < .175

(factor loadings above 0.4) on all of the scale items that were identified to make up this factor. The presence of a single factor within the scale (as opposed to several coexisting factors) indicates that the scale is unidimensional. By definition, a unidimensional scale measures a single factor and therefore it is unnecessary to split the scale into subscales.

Examining the items that loaded into this factor revealed that 18 of the 25 items on the final scale could be classified as "image appraisal" items. These items all relate to skills that student radiographers use when assessing the images obtained for a given examination. These items relate to how the image is viewed, assessed for pathology, and used to establish whether the examination can be concluded or to determine whether some further action needs to take place.

This indicates that image appraisal is the most significant factor regarding the self-efficacy of student radiographers in their clinical placements. The other 7 items that load onto this factor could have been discarded because although they loaded well onto the factor, they do not fit with the dominant factor of image interpretation. Of the remaining 7 items, 4 relate to communication, 2 relate to skills required to perform the examination, and 1 is related to the student's general confidence about his or her clinical placement competence. However, to give the scale balance and to try to get a broader assessment of the

student's self-efficacy beliefs, researchers decided to retain the items on the scale.

Scale Validity
The devised scale demonstrates a high level of internal reliability (Cronbach alpha 0.92). This figure is above the generally accepted range of acceptability (0.7 to 0.8) and indicates that the scale has a high level of internal reliability.[25] The high levels of interitem correlation (all > 0.4) also indicate an internally reliable scale. A high level of internal reliability indicates that the scale measures a single underlying construct but gives little insight into what that construct is, or whether the scale measures what the researcher claims it does. To further validate the scale, the scale normally would need to correlate with another known measure of student radiographer self-efficacy. No other measurement of this construct is known to exist; therefore, there is no way to correlate the score on this scale with a validated measure. In this situation, it is normal to prove validity by gathering evidence to support the scale's validity.[25] For this study's scale, it could be hypothesized what other factors correlate with either a high or low score on the scale. Further research would need to be conducted to establish whether this is the case.

Comparing known groups has proved that the scale has some validity. Self-efficacy theory indicates that student radiographers' self-efficacy should increase as they progress through the undergraduate course. This is because students have more opportunities to learn new skills and overcome new challenges as they progress with their studies. This theory gives rise to the hypothesis that if the scale measures student radiographer self-efficacy, third-year students' mean scores would be higher than second-year students' scores and second-year students' mean scores would be higher than first-year students' mean scores, which was shown to be the case with the mean scores between the study's groups. Furthermore, the difference in the mean scores between the groups was found to be significantly different at the *P* < .05 level (*P* = .035).

Scale Utility
Caution in interpreting and using these findings is necessary until they are replicated and can be generalized to the student radiographer population. The scale requires further testing to determine whether the scale indeed represents student radiographer self-efficacy. If this is proved, further work can commence to establish

whether student radiographer self-efficacy correlates with any measurable outcomes. These could be related to student attrition in the undergraduate course, predicting the students that are more likely to pass or fail their clinical assessments or identifying students who are in need of more support. Once this work is done, it would be possible to see where the scale could be used.

The authors currently are gathering further validation data and assessing its predictive value against known measures of student performance for the scale domains.

Conclusion

The purpose of this research was to create and validate a scale that measured the self-efficacy of student radiographers on clinical placement. A review of the literature was performed, which demonstrated that although self-efficacy is ubiquitous in health care research, very little research has been performed within the field of radiology. During the review of relevant literature, many published articles were found that described differing methods for developing self-efficacy scales. Using these articles, a method was established that could be used to develop a self-efficacy scale for student radiographers.

A scale was created and validated to measure the self-efficacy of student radiographers in their clinical placements. The scale was reduced using factor and item analysis, and a dominant factor was found that explained a large proportion of variance in student radiographers' self-efficacy beliefs. This factor was related to image interpretation.

Very little research was found in reviews for this study that used self-efficacy theory in relation to radiology. Self-efficacy theory should be explored further in the radiologic sciences to assess whether this construct has further relevance in the specialty.

This scale needs further testing to improve its validity. The scale's utility is uncertain and further research should be undertaken to demonstrate its potential predictive value regarding whether students complete or thrive in the radiography course.

References

1. Department of Health. The NHS Improvement Plan. London: The Stationery Office; 2004.

2. Mackay S, Anderson A, Hogg P. Preparedness for clinical practice: perceptions of graduates and their work supervisors. *Radiography.* 2008;14:226-232.

3. Bandura A. *Social Foundations of Thought and Action: a Social Cognitive Theory.* Upper Saddle River, NJ: Prentice Hall; 1986.

4. Edwards R, Telfair R, Ceci H, Lenoci J. Reliability and validity of a self-efficacy instrument specific to sickle cell disease. *Behav Res Ther.* 2000;38(9):951-963.

5. Cassidy S. Assessing "inexperienced" students' ability to self-assess: exploring links with learning style and academic personal control. A*ssessment & Evaluation in Higher Education.* 2007;32(3):1-18.

6. Eachus P, Cassidy S. Development of the Web user self-efficacy (WUSE) scale. Issues Sci Technol. 2006;3:199-211. www.informingscience.org/proceedings/InSITE2006 /IISITEach219.pdf. Accessed August 15, 2011.

7. Betz G, Hackett G. The relationship of mathematics self-efficacy scale to the selection of science-based college majors. *J Vocat Behav.* 1983;23(3):329-345.

8. Eysenck D. *Psychology – A Student's Handbook.* Hove, England: Psychology Press Ltd; 2000.

9. Luszczynska A, Schwarzer R. Social cognitive theory. In: Conner M, Norman P, eds. *Predicting Health Behaviour.* 2nd ed. Buckingham, England: Open University Press; 2005.

10. Pajares F. Information on self-efficacy – a community of scholars. http://des.emory.edu/mfp/self-efficacy .html#search. Accessed July 25, 2008.

11. Bandura A. S*elf-efficacy: Toward a Unifying Theory of Behavioral Change.* Upper Saddle River, NJ: Prentice Hall; 1977.

12. Bandura A. Exercise of personal agency through the self-efficacy mechanism. In: Scharzer R, ed. *Self-efficacy: Thought Control and Action.* Washington, DC: Hemisphere Publishing Company; 1992.

13. Bandura A. *Self-efficacy: the Exercise of Control.* New York, NY: Freeman; 1997.

14. Pajares F, Kranzler J. Self-efficacy beliefs and general mental ability in mathematical problem-solving. *Contemp Educ Psychol.* 1995;20(4):426-443

15. Schunk DH. Self-efficacy and education and instruction. In: Maddux JE, ed. *Self-efficacy, Adaptation, and Adjustment: Theory, Research, and Application.* New York, NY: Plenum Press; 1995: 281-303

16. Streiner D, Norman GR. H*ealth Measurement Scales: a Practical Guide to Their Development and Use.* 3rd ed. Oxford, England: Oxford University Press; 2003.

17. Lim J, Downie J, Nathan P. Nursing students' self-efficacy in measuring transcultural care. *Nurse Educ Today.* 2004;24(6):428-434.

18. McConville S, Lane A. Using on-line video clips to enhance self-efficacy toward dealing with difficult situations among nursing students. *Nurse Educ Today.* 2006;26(3):200-208.

19. Shellman J. The effects of a reminiscence education program on baccalaureate nursing students' cultural self-efficacy in caring for elders. *Nurse Educ Today.* 2007;27(1): 43-51.

20. Society and College of Radiographers. Improving Student Retention: Guidelines and Good Practice. http://doc-lib.sor.org/improving-student-retention-guidelines-and-good-practice. Published 2007. Accessed June 1, 2009.

21. Jerusalem M, Schwarzer R. Self-efficacy as a resource factor in stress appraisal processes. In: Schwarzer R, ed. Self-efficacy: Thought Control of Action. Washington, DC: Hemisphere. 1992: 195-213.

22. Burke L, Dunbar-Jacob J, Sereika S, Ewart C. Development and testing of the cholesterol-lowering diet self-efficacy scale. *Eur J Cardiovasc Nurs.* 2003;2(4):265-273.

23. Wolf M, Chang C, Davis T, Makoul M. Development and validation of the communication and attitudinal self-efficacy scale for cancer (CASE-cancer). *Patient Educ Couns.* 2005;57(3):333-341.

24. Sullivan M, Andrea Z, Russo J, Katon W. Self-efficacy and self-reported functional status in coronary heart disease: a six-month prospective study. *Psychosom Med.* 1998;60(4):473-478.

25. Spector P. *Summated Rating Scale Construction – an Introduction.* Thousand Oaks, CA: Sage Publications; 1992.

26. Bandura A. Guide for constructing self-efficacy scales. In: Urdan T, Pajares F. *Self-efficacy Beliefs of Adolescents.* New York, NY: Information Age Publishing; 1997.

27. Brenowitz N, Tuttle C. Development and testing of a nutrition-teaching self-efficacy scale for elementary school teachers. *J Nutr Educ Behav.* 2003;35(6):308-311.

28. Siwatu K. Preservice teachers' culturally responsive teaching self-efficacy and outcome expectancy beliefs. *Teach Teach Educ.* 2007(7);23:1086-1101.

29. Perraud S. Development of the depression coping self-efficacy scale (DCSES). *Arch Psychiat Nurs.* 2000;14(6):276-284.

30. Joinson A, Reips U. Personalized salutation, power of sender and response rates to Web-based surveys. *Comput Hum Behav.* 2007;23(3):1372-1383.

31. Krantz J, Dalal R. Validity of Web-based psychological research. In: Birnbaum MH, ed. *Psychological Experiments on the Internet.* San Diego, CA: Academic Press; 2000:35-60.

32. Parrish M. *Meta-analysis of Questionnaire Response Rates in Military Samples* [master's thesis]. Wright-Patterson Air Force Base, Ohio: Department of the Air Force Air University Air Force Institute of Technology; 2001.

33. Barnes S. Survey Design, Bristol Online Survey Support Blog. University of Bristol. www.survey.bris.ac.uk/support/survey-design. Published 2001. Accessed May 25, 2009.

34. Cousineau T, Green T, Corsini E, Barnard T, Seibring A, Domar A. Development and validation of the infertility self-efficacy scale. *Fertil Steril.* 2006;85(6):1684-1696.

35. Cassidy S, Eachus P. Developing the computer use self-efficacy scale (CUSE): investigating the relationship between self-efficacy, gender and experience with computers. *J Educ Comput Res.* 2002;26(2):133-153.

36. Berman L, de Lacey G, Twomy E, Twomey B, Welch T, Eban R. Reducing errors in the accident department: a simple method using radiographers. *Br Med J (Clin Res Ed).* 1985;290(6466):421-422.

37. Society of Radiographers. *Medical Image Interpretation and Clinical Reporting by Non-Radiologists: The Role of the Radiographer.* 2nd ed. London, UK; 2006.

38. Field A. Discovering Statistics Using SPSS. 3rd ed. Los Angeles, CA: Sage Publishing; 2009.

39. DeCoster J. Overview of factor analysis. Stat-Help.com website. www.stat-help.com/notes.html. Accessed on December 16, 2009.

Jonathan Kitching, MSc, is the priniciple radiographer for the emergency and outpatient departments at Manchester Royal Infirmary, Main X-ray Department, United Kingdom. Simon Cassidy, PhD, is senior lecturer at the University of Salford, UK. Peter Eachus, PhD, is head of psychology and counselling, and Peter Hogg, MPhil, DCR, is professor of radiography at the University of Salford.