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Assessing the Educational Environment of a Flipped Physical Therapy Course: Utilization of the Dundee Ready Education Environment Measure (DREEM)

Purpose: Using valid and reliable measures to assess curricula within health professions programs has gained significant attention in recent years. The educational environment is considered a key domain for student success. The primary aim of this study was to measure the educational environment following the addition of a flipped classroom model within a physical therapy course as measured by the Dundee Ready Education Environment Measure.

Methods: A first year doctorate of physical therapy course, “Physical Agents”, was redesigned to include a flipped classroom model, incorporating 24 videos that students reviewed independently, prior to hands-on laboratory learning. Following the conclusion of the course, students (n=57) completed the Dundee Ready Education Environment Measure, a valid and reliable survey designed to measure the educational environment within health profession programs. The Dundee Ready Education Environment Measure contains 50 items, rated from 0 to 4 (5-point Likert scale, “0” strongly disagree to “4” strongly agree), assessing five domains: students’ perceptions of learning; perceptions of teachers; academic self-perception; perceptions of atmosphere; and social self-perception. Descriptive statistics included mean global score (out of 200, 151 to 200 being an excellent environment) mean domain scores, and mean item scores. Cumulative grade point average between students in the flipped classroom model (n=58) and those who previously received a traditional teaching model (n=59) for the course were also compared. Student’s t-test was utilized with significance accepted at $p < 0.05$.

Results: The mean global score (168 ± 13.3), indicated that the flipped classroom model fostered an excellent educational environment. Additionally, all mean domain scores, including students’ perceptions of learning (41.3 ± 3.9), perceptions of teachers (39.2 ± 2.9), academic self-perception (25.1 ± 2.5) perception of atmosphere (40.1 ± 4.1) and social self-perception (22.1 ± 2.9) fell into the highest rank of each subscale. Individual item analysis demonstrated 26 items (52%) were identified as especially strong areas, five items (10%) were identified as areas that could be improved, and no individual items were identified as requiring particular concern or immediate attention. Further, no significant differences were seen in cumulative course grade point average between the flipped classroom model (3.74 ± 0.44) and the traditional teaching model (3.71 ± 0.46).

Conclusions: The flipped classroom model, utilizing an online learning environment, fostered an excellent educational environment for the physical therapy Physical Agents class. No difference in course grade point average between the flipped classroom model and previous traditional teaching model was seen. Further investigations examining performance on didactic and psychomotor activities within the flipped classroom model are recommended.

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ABSTRACT

Purpose: Using valid and reliable measures to assess curricula within health professions programs has gained significant attention in recent years. The educational environment is considered a key domain for student success. The primary aim of this study was to measure the educational environment following the addition of a flipped classroom model within a physical therapy course as measured by the Dundee Ready Education Environment Measure. **Methods:** A first-year doctorate of physical therapy course, Physical Agents, was redesigned to include a flipped classroom model, incorporating 24 videos that students reviewed independently, prior to hands-on laboratory learning. Following the conclusion of the course, students ($n = 57$) completed the Dundee Ready Education Environment Measure, a valid and reliable survey designed to measure the educational environment within health profession programs. The Dundee Ready Education Environment Measure contains 50 items, rated from 0 to 4 (five-point Likert scale, 0 = strongly disagree to 4 = strongly agree), assessing five domains: students' perceptions of learning, perceptions of teachers, academic self-perception, perceptions of atmosphere, and social self-perception. Descriptive statistics included mean global score (out of 200, 151 to 200 being an excellent environment) mean domain scores, and mean item scores. Cumulative grade point average between students in the flipped classroom model ($n = 58$) and those who previously received a traditional teaching model ($n = 59$) for the course were also compared. Student's t test was utilized with significance accepted at $p < .05$. **Results:** The mean global score (168 ± 13.3) indicated that the flipped classroom model fostered an excellent educational environment. Additionally, all mean domain scores, including students' perceptions of learning (41.3 ± 3.9), perceptions of teachers (39.2 ± 2.9), academic self-perception (25.1 ± 2.5), perception of atmosphere (40.1 ± 4.1), and social self-perception (22.1 ± 2.9), fell into the highest rank of each subscale. Individual item analysis demonstrated 26 items (52%) were identified as especially strong areas, five items (10%) were identified as areas that could be improved, and no individual items were identified as requiring particular concern or immediate attention. Further, no significant differences were seen in cumulative course grade point average between the flipped classroom model (3.74 ± 0.44) and the traditional teaching model (3.71 ± 0.46). **Conclusions:** Utilizing an online learning environment, the flipped classroom model fostered an excellent educational environment for the physical therapy Physical Agents class. No difference in course grade point average between the flipped classroom model and previous traditional teaching model was seen. Further investigations in which performance is examined for didactic and psychomotor activities within the flipped classroom model are recommended.

INTRODUCTION

The use of valid and reliable outcome measures assessing pedagogy within physical therapy curricula has gained significant attention in recent years.^{1,2} Leaders in the field have called for advancements in educational scholarship through the identification of key domains and the increased use of supported instruments to assess and monitor change.^{1,2} Although researchers fluctuate about the relevance and inclusion of various educational domains, the impact and significance of the educational environment (EE) within allied health and physical therapy training programs is resounding.¹⁻⁸ Specifically, students' perceptions of the EE have been linked to motivation, self-confidence, learning, critical thinking, course satisfaction, perceived well-being, and academic

successes.⁵⁻⁸ As a result, the EE has been extensively measured in medicine, pharmacy, nursing and dental trainees, but formal assessments within physical therapy education are limited.⁶⁻¹³

The EE has been defined as “where teaching-learning process takes place.”⁴ Subsequently, the EE is multifaceted, including the physical, cultural, social, and emotional aspects surrounding the classroom.⁴ Schönrock-Adema et al. found the EE framework of allied health and medicine training is best supported by Moos’ theory.¹⁴ Moos’ theoretical framework of the EE is grounded in three broad dimensions.¹⁵ These include the personal development or goal direction dimension, the relationship dimension and the system maintenance and system change dimension. The personal development or goal direction dimension is defined as the fundamental aims of an individual as they relate to the environment, often linked to the overarching objectives of the institution.¹⁴ These dimensions regularly manifest in an individual’s personal desire to achieve growth and development necessary to obtain such results. Further, this dimension is associated in the educational setting as to how clearly instructors reinforce learning objectives, content, and constructive feedback.¹⁴ The relationship dimension includes the amount that individuals engage in supportive communication with those around them, manifested by expressing free, spontaneous and open encouragement to others. A positive relationship dimension frequently has a level of collegiality, affiliation, and sense of interpersonal support that enhances the EE.¹⁴ Finally, the system maintenance and system change dimension relate to the level of clarity, order, control, and responsiveness to change by an organization, which is often expressed as rule and policy clarity, teacher control, student innovation and influence, and overall stability of the classroom and curriculum.^{14,15}

It is important to acknowledge that although many instruments exist to evaluate the EE across the spectra of learning environments, identifying a measure suited for allied health and physical therapy curricula is warranted.^{11,14} The Dundee Ready Education Environment Measure (DREEM), a valid and reliable survey developed by Roff et al, has been used extensively to measure the EE of other allied health fields.^{5,11,14,16} Developed as a culturally non-specific instrument to assess the EE in the health professions, the DREEM has since been translated into eight languages and used in at least 20 countries.⁵ Multiple researchers, including a recent systematic review, supported the DREEM’s ability to compare the EE of different medical institutions, genders, and levels of student training within allied health curriculum, describing it as especially oriented toward introductory health care and foundational science courses.^{11,16} Furthermore, the DREEM has been identified as effectively representing the three key EE dimensions proposed by Moos.^{14,15}

As technology advances and opportunities to utilize novel learning platforms grow, educators are met with the challenge of delivering fundamental learning objectives to evolving student preferences regarding online and preclass material.¹⁷ The flipped classroom model (FCM) is a pedagogical alternative with content made available to students prior to the face-to-face classroom or lab meetings with the instructor.¹⁵ Instruments, such as videos, podcasts, and/or online interactive modules, are utilized with the FCM.¹⁷⁻²⁶ This pedagogical approach has demonstrated improved learning experiences, test scores, and engagement within allied health educational settings.¹⁷⁻²² Specifically, by incorporating a FCM and in-class activities into the traditional lecture format, superior educational outcomes have been shown.¹⁸⁻²¹

Although the FCM is proposed to have multiple educational benefits, including the ability of students to participate in more active learning within lecture and lab, multiple researchers have questioned this approach.²²⁻²⁴ Particularly, the amount of online learning preferred by students has widely varied.²³⁻²⁵ Moreover, findings demonstrate that although students may appreciate some aspects of the FCM, they continue to value central elements of the traditional teaching model.²⁴⁻²⁵ Such elements include the familiarity of lecture, the face-to-face interaction with educators, and the decreased requirement to complete tasks prior to class. Due to the ongoing debate between utilization of a traditional teaching model versus a FCM, researchers examining the success of alternate pedagogical approaches on key domains within physical therapy education are suggested.^{1,2,4,5,25}

A doctorate of physical therapy foundational science course, Physical Agents, was redesigned to include a FCM in the weekly laboratory. The primary aim of this study was to measure the EE following the transition to a FCM. It was hypothesized that the FCM would produce an excellent EE as measured by the DREEM.

MATERIALS AND METHODS

A quasi-experimental posttest-only design that assessed a single-student cohort was used to examine the EE. Approval was obtained from the university’s Institutional Review Board. A convenience sample of first-year doctorate of physical therapy students (n = 57) was examined following completion of a three-credit hour, 16-week course.

To implement the FCM, a new course instructor created 24 original online videos for students to view prior to in-person laboratory sessions. To introduce each video, the investigator conducted a five- to eight-minute interview with local physical therapists who

discussed their professional background and experience with each modality. Physical therapists were selected based upon previous clinical expertise in the content area. The selection included clinicians with certification through the American Board of Physical Therapy Specialties or advanced qualifications via continuing education courses.²⁷ The interview was followed by explanation of the foundational principles, rationale for use, and a demonstration of each treatment technique, led by the instructor and co-taught by the local physical therapist. This format was utilized to ensure continuity of material between the online environment and the laboratory setting. Each video averaged 12 minutes in length. Students were required to view two to three videos per week prior to their laboratory session. Videos were accessed from the students' online education management system of their university. The FCM laboratory sessions were 60 minutes in length. Four teaching assistants were employed to assist in content delivery and lead students through stations. The in-person laboratory sessions were completed in 6, one-hour labs of 10 students each, with four teaching assistants, which resulted in a student to instructor ratio of 2.5 to 1.

The DREEM is a 50-statement closed item questionnaire on a five-point Likert scale from 0 to 4.^{5,16,28,29} Answer options included strongly disagree, disagree, uncertain, agree, and strongly agree.^{5,16,28,29} Five domains were assessed, including students' perceptions of learning (12 items), students' perception of teachers (11 items), students' academic self-perception (8 items), students' perception of atmosphere (12 items), and students' social self-perception (7 items).^{5,16} Nine negative items were placed within the instrument with scoring accomplished by reversal secondary to question construct (questions 4,8,9,17,25,35,39,48, and 50).^{5,16,28,29} Normative values for course and curricular performance have been established with higher scores indicating the presence of a superior educational environment.^{5,16} A maximum score on the DREEM is 200 points with global score interpretation as 0-50 being very poor, 51-100 being many problems, 101-150 being more positive than negative, 151-200 being excellent.^{5,16,28,29} Further score descriptions of the five domains subscales are found in Table 1 as proposed by McAleer and Roff.²⁹ Individual item means scores of greater than or equal to 3.5 are interpreted as especially strong areas, items scoring between a 2 to 3 are areas that could be improved, and those less than or equal to 2.0 require particular attention from educators.^{5,16,28,29} DREEM surveys were administered with all participants remaining anonymous at the end of the 16-week semester. The course coordinator was blinded to those participating and did not recruit or administer the survey. Notably, written permission from Roff et al was obtained prior to utilization of the tool. Furthermore, to specifically consider the EE of the Physical Agents course in isolation, students were instructed to consider the educational experience of this single course instead of the describing the training program as a whole. Descriptive statistics were analyzed using the Statistical Package for Social Science (IBM Corp, Version 23; Armonk, New York). Mean global scores, mean domain scores, and mean individual item scores were examined. Additionally, cumulative grade point average between students in the flipped classroom model (n = 58) and those previously receiving a traditional teaching model (n = 59) for the course were compared. De-identified course grades were obtained from a departmental staff member. A student's t test was utilized with significance accepted at $p < .05$.

Table 1. An Approximate Guide to Interpret the DREEM Subscales^{28,29}

Subscales	
Subscale I: Student's perception of learning: 12 items/max score of 48	
0-12	Very Poor
13-24	Teaching is viewed negatively
25-36	A more positive perception
37-48	Teaching highly thought of
Subscale II: Student's perceptions of teachers: 11 items/max score 44	
0-11	Abysmal
12-22	In need of some retraining
23-33	Moving in the right direction
34-44	Model Teachers
Subscale III: Student's academic self-perceptions: 8 items/max score of 32	
0-8	Feelings of total failure
9-16	Many negative aspects
17-24	Feeling more on the positive side
25-32	Confident
Subscale IV: Student's perceptions of atmosphere: 12 items/max score of 48	
0-12	A terrible environment
13-24	There are many issues which need changing
25-36	A more positive atmosphere
37-48	A good feeling overall
Subscale V: Student's social self-perceptions: 7 items/max score of 28	
0-7	Miserable
8-14	Not a nice place
15-21	Not too bad
22-28	Very good socially

RESULTS

The FCM demonstrated a mean global score of 168.2 ± 13.3 , demonstrating an excellent EE. Mean DREEM domain scores for students' perception of learning (41.3 ± 3.9), perception of teachers (39.6 ± 2.9), academic self-perception (25.1 ± 2.5), perception of atmosphere (40.1 ± 4.1), and social self-perception (22.1 ± 2.9) all fell into the highest rated subscale category. Twenty-six items (52%) were identified as particularly strong areas (means scores of ≥ 3.5) and 5 items (10%) were identified as areas that could be improved (mean scores between 2 and 3) while no individual items required particular attention or concern (mean score ≤ 2.0). Mean item scores are depicted in Table 2.^{5,16,28,29} Furthermore, no significant differences were seen in cumulative course GPA between the flipped classroom model (3.74 ± 0.44) and the previous traditional teaching model (3.71 ± 0.46).

Table 2: The DREEM – Item and Domain Scores.^{28,29}

Subscales	Item Mean ± SD
Subscale I: Student's perception of learning: 12 items/max score of 48	
Q. 1 I am encouraged to participate in class	3.8 ± 0.4
Q. 7 The teaching is often stimulating	3.5 ± 0.7
Q. 13 The teaching is student centered	3.6 ± 0.5
Q. 16 The teaching helps to develop my competence	3.6 ± 0.6
Q. 20 The teaching is well focused	3.6 ± 0.5
Q. 22 The teaching helps to develop my confidence	3.3 ± 0.7
Q. 24 The teaching time is put to good use	3.6 ± 0.5
Q. 25 <i>The teaching over-emphasizes factual learning</i>	2.5 ± 0.8
Q. 38 I am clear about the learning objectives of the course	3.5 ± 0.5
Q. 44 The teaching encourages me to be an active learner	3.6 ± 0.5
Q. 47 Long-term learning is emphasized over short-term learning	3.4 ± 0.8
Q. 48 The teaching is too teacher-centered	3.4 ± 0.6
Subscale: Total	41.3 ± 3.9
Subscale II: Student's perceptions of teachers: 11 items/max score 44	
Q.2 The teachers are knowledgeable	3.9 ± 0.3
Q.6 The teachers are patient with patients	3.7 ± 0.6
Q.8 <i>The teachers ridicule the students</i>	3.8 ± 0.4
Q.9 <i>The teachers are authoritarian</i>	3.0 ± 1.1
Q.18 The teachers have good communication skills	3.8 ± 0.4
Q.29 The teachers are good at providing feedback to students	3.6 ± 0.5
Q.32 The teachers provide constructive criticism here	3.5 ± 0.5
Q.37 The teachers give clear examples	3.4 ± 0.5
Q.39 <i>The teachers get angry in class</i>	3.8 ± 0.5
Q.40 The teachers are well prepared for their classes	3.8 ± 0.4
Q.50 <i>The students irritate the teachers</i>	3.4 ± 0.7
Subscale Total:	39.6 ± 2.9
Subscale III: Student's academic self-perceptions: 8 items/max score of 32	
Q.5 Learning strategies that worked for me before, continue to work for me now	3.1 ± 0.6
Q.10 I am confident about passing this year	3.7 ± 0.5
Q.21 I feel I am being well prepared for my profession	3.6 ± 0.6
Q.26 Last year's work has been a good preparation for this year's work	2.1 ± 0.7
Q.31 I have learned a lot about empathy in my profession	3.3 ± 0.6
Q.41 My problem-solving skills are being well developed here	3.4 ± 0.6
Q.45 Much of what I have to learn seems relevant to a career in health care	3.7 ± 0.5
Subscale Total:	25.1 ± 2.5
Subscale IV: Student's perceptions of atmosphere: 12 items/max score of 48	
Q.11 The atmosphere is relaxed during the ward teaching	3.2 ± 0.8
Q.12 This school is well timetabled	3.1 ± 0.9
Q.17 <i>Cheating is a problem in this school</i>	3.3 ± 1.0
Q.23 The atmosphere is relaxed during lectures	3.5 ± 0.5
Q.30 There are opportunities for me to develop interpersonal skills	3.5 ± 0.5
Q.33 I feel comfortable in class socially	3.6 ± 0.5
Q.34 The atmosphere is relaxed during seminar/tutorials	3.4 ± 0.6
Q.35 <i>I find the experience disappointing</i>	3.6 ± 0.5
Q.36 I am able to concentrate well	2.9 ± 0.9

Q.42 The enjoyment outweighs the stress of studying medicine	3.1 ± 0.7
Q.43 The atmosphere motivates me as a learner	3.4 ± 0.5
Q.49 I feel able to ask the questions I want	3.5 ± 0.7
Subscale Total:	40.1 ± 4.1
<u>V. Student's social self-perceptions: 7 items/max score of 28</u>	
Q.3 There is a good support system for students who get stressed	3.8 ± 0.5
Q.4 <i>I am too tired to enjoy this course</i>	2.6 ± 0.9
Q.14 I am rarely bored in this course	2.8 ± 1.0
Q.15 I have good friends in this school	3.7 ± 0.5
Q.19 My social life is good	3.0 ± 0.9
Q.28 I seldom feel lonely	3.1 ± 0.7
Q.46 My accommodation is pleasant	3.2 ± 0.6
Subscale Total:	22.1 ± 2.9

Note: Negative items requiring score reversal in *italics*.

DISCUSSION

Results of our study were used to support the acceptance of the hypothesis that the FCM provided an overall excellent EE as measured by the DREEM for this doctorate of physical therapy foundational science course. Additionally, this occurred without a significant reduction in overall cumulative course GPA as compared with the traditional teaching model. Further, the FCM had the highest score description within each EE subscale. Indeed, the main findings of this study are encouraging for the practice of a FCM, especially for courses with hands-on laboratory content. With this investigation, we also highlighted the usage of reliable and valid standardized instruments assessing this key educational domain, which is especially relevant as there is a current paucity of evidence examining the EE following the establishment of a FCM in physical therapy curricula.^{1,2,11}

Additionally, in this investigation, the authors were provided with selected areas or individual items that could be improved as well as numerous areas that were especially strong. Specific items, scoring between a 2 to 3, which could be improved included "The teaching over-emphasizes factual learning," "I am rarely bored in this course," "I am able to concentrate well," "I am too tired to enjoy this course," and "Last year's work has been a good preparation for this year's work." This information is particularly valuable by informing educators about future areas to target, hoping to further enhance student engagement in the classroom. Areas that were especially strong and demonstrated the highest individual item scores included "The teachers are knowledgeable," "I am encouraged to participate in class," "The teachers are well prepared for their classes," and "The teachers have good communication skills." Such outcomes provide useful insights into the potential strengths of the course.

Although the DREEM has been heavily employed within a variety of medicine and allied health fields, its prevalence in the physical therapy literature is limited.^{8,10,11,30-35} We examined the EE by administering the DREEM following the implementation of a FCM into a foundational physical therapy course.¹¹ Descriptive statistics assessing the EE offer helpful information regarding overall, subscale, and item performance within the FCM. Additionally, with the implementation of the FCM, the instructor was able to employ a favorable student to teacher laboratory ratio of 2.5 to 1, which was believed to have contributed to the positive outcome.

It is important to note that several limitations of this study exist. Although the investigators instructed students to measure the EE of this individual course, potential influence from the program as a whole must be acknowledged when interpreting the results. Secondly, this study utilized a small sample size, and future researchers who examine a larger sample are warranted. Subsequent investigations would also benefit from pretest-posttest assessments of the EE following a course redesign, providing appropriate control data. Additionally, comparison of cumulative course GPA between teaching models needs to be considered in light of several factors. The course instructor and the cognitive and psychomotor learning assessments were different between the FCM and traditional teaching model. As a result, we recommend that future analyses of learning outcomes stem from a more controlled setting, utilizing the same learning assessment tools and instructor to better inform the effectiveness of such pedagogical shifts. Also, future researchers could report section-specific performance on the national physical therapy exam as an alternate learning outcome.

The limitations of a FCM also need to be discussed. Khanova et al examined student perceptions of large scale implementation of multiple (10) flipped courses within a single curriculum.³ Several negative themes emerged, including concerns about execution, the quality and quantity of preclass learning materials, the ability of the instructor to be engaging and interactive in the flipped environment, and the potential lack of assessments targeting application of knowledge and critical thinking skills.³ Likewise, researchers of the FCM within other allied health fields have highlighted the ongoing challenge of balancing time requirements of

preclass and in-class responsibilities as well as the level of student preparedness for hands-on activities.^{3,21,23,26} These previously identified concerns need to be considered prior to proceeding with such significant pedagogical changes.

In summary, we examined the EE of a FCM for laboratory learning within a foundational physical therapy science course. The FCM demonstrated an excellent overall EE and superior scores within each subscale of the DREEM. Individual item analysis demonstrated that 52% of items were identified as particularly strong areas, 10% of items were identified as areas that could be improved, and no item areas required particular attention or concern by the instructor. Moreover, by using the FCM, a student to teacher ratio of 2.5 to 1 was applied, which provided an efficient and individualistic approach to laboratory learning. With these findings, we were able to support the potential utility of a FCM for physical therapy foundational science courses. The EE has been shown to have a significant impact on students' motivation, self-confidence, learning, critical thinking, course satisfaction, perceived well-being, and academic success.⁵⁻⁸ By systematically using valid outcome measures, which are aimed at key educational domains, educators may gain insight into the effectiveness of subtle or significant curricular change.

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