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The Role of Self-Determination Theory within a Redesigned Construction Management Technology Curriculum

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College graduates entering the workforce today are being trained to meet the future needs of their rapidly evolving industries. As such, educators are constantly adapting their curriculum to the dynamic changes to prepare well-rounded professionals. Some are leveraging classroom teaching strategies that include new and hybrid learning methods such as flipped classrooms and self-paced independent studies. The Construction Management Technology (CMT) program at Purdue University underwent a sweeping change in its curriculum four years ago, with courses redesigned to better fit the dynamic expectations of the construction industry. However, such radical changes can unintentionally create a learning environment which affects students' motivation to learn and their self-determination. This study dives into the learners' perspectives using Small Group Instructional Diagnoses (SGIDs) and connects it to self-determination theory (SDT). Ethnographic data from 334 students across five courses were collected. Data were conceptually and thematically linked to three student motivation factors based on SDT. It was found that learners were approving of the structure of the redesigned curriculum. Findings also showed that while the students' motivation was mainly built around competency and autonomy, students also identified relatedness as a supporting factor for success.

Key Words: Self-determination Theory, Student Evaluation, Small Group Instructional Diagnoses, Innovative Teaching and Learning

Introduction

In the United States (US), students have a myriad of options on which training institutes and schools to attend for the advancement of their careers. According to Henriques et al. (2018), work and career opportunities, location and proximity to job options, tuition costs, reputation, and available academic majors or research areas are some of the elements contributing to their decisions. In response, although many colleges and universities still follow orthodox learning models, some schools are gradually moving toward new teaching methods that focus on the learner to attract students (Borrego & Henderson, 2014). According to Strimel et al. (2020), if students become too focused on coursework that is centered on the instructor, they may not be well-prepared for real-world dynamic jobsites. This can be particularly true for students in science, technology, engineering, and mathematics majors (Strimel et al., 2020).

According to Huchel (2020), reputed academic centers such as Purdue University has consistently focused on transformational learning methods through grand challenges. In Spring of 2018, the CMT program took up such a challenge and introduced the transformative new curriculum. The initiative has been detailed in multiple studies (Benhart et al., 2017; Benhart & Shaurette, 2012; Santon et al., 2018). Instead of the traditional 3-credit course, the program radically shifted to 6- and 9- credit hour courses which are taught by multiple instructors instead of just one, thus introducing a realistic element of complicacy in construction education. The new courses employ jobsite-like hands-on training, while encouraging students to work independently, in small teams, and also in larger groups. Although the new curriculum is well documented, there is no data yet on how learners perceive the new curriculum. Generally, end-of-term course evaluations are distributed to students to determine their perceptions on their instructors and course material. However, course evaluations may be flawed in situations where there are multiple instructors teaching a course over fifteen weeks, as might be the case with the courses in this redesigned curriculum.

In 2003, Filak and Sheldon introduced self-determination theory (SDT) for effective course evaluation. However, it has only been used in traditional courses which are usually taught by one professor. Although students' perceptions about their knowledge and their professors are mildly related according to Clayson (2009), any constructive feedback can help in improving course material for future students. Other factors that help in the feedback process are focused discussions, faculty surveys, competency exams, etc. (Dagenais et al., 2003; Persky et al., 2019; Walkington, 2002). Thus, this study utilizes five different courses and investigates students' perceptions using small group instructional diagnoses or 'SGIDs' as an evaluation and feedback mechanism. The data was then thematically connected to self-determination theory (Filak and Sheldon, 2003). The Center for Instructional Excellence (CIE) at Purdue University assisted with the study by creating discussions through specific leading questions to the learners about their positive and negative perceptions of the course and the manner in which it was taught to them. The research questions that are being investigated by this paper are:

- What are the perceived strengths and weaknesses of transformative curriculum redesigns?
- What role does self-determination play in student perceptions of transformative curriculum redesigns?

Literature Review

The current American education system is centered around a nineteenth century concept of the weekly credit-hour system, where each learner must complete a predefined number of easily transferable credit hours to graduate (Shedd, 2003). Typically, towards the end of a term, students are asked to provide feedback on their courses and instructors. The effectiveness of classroom instructors along with their course material is usually inferred from such student evaluations of their professors. According to Berk and Theall (2006), a combination of different sources can provide a much more reliable idea of the effectiveness of instructors. These sources can be student interviews, peer evaluations, videos, and teaching awards, among others. On the other hand, assessing educators using an indirect measure such as student performances is not as accurate. Student ratings are often biased towards certain instructors or educational techniques, which provides an inaccurate description of how effective an instructor has been while teaching the material, thus rendering the feedback unreliable (Clayson, 2009; Simpson & Siguaw, 2000; Zabaleta, 2007).

The Standardized Higher-Education Model in the US

The credit hour system was adopted by high schools, colleges, and universities to standardize the educational model in the United States. This meant that students could, irrespective of which college

or university they studied in, graduate in a predetermined duration of time consisting of a certain number of credit hours (Heffernan, 1973). This helped to normalize graduation and admission rates, workloads, and academic records across the country. The stability of the system over the decades post World War II increased the faith that educators had in the system, and this came to be known as the full-time equivalent faculty designation (FTE). Universities began (and still continue) to traditionally offer one to three credit hour courses, while the 9-credit course as described in the study remains quite rare in educational settings.

Innovative Teaching Strategies and SDT

Four years ago, the CMT department at Purdue shifted to 9-credit hour course blocks from 3-credit courses. Topics such as cost estimating, building information modeling (BIM), land surveying and layout, mechanical, electrical, and plumbing (MEP) systems, the strength of materials and soils, etc. are now taught to students multiple times at varying levels of increasing complexity from level 150 (first–year or freshman level) to 450 (senior level). The new curriculum is more project-based like construction jobsites and involves active- and scaffolded-learning methods unlike the previous courses which taught individual subjects as an entire unit. Traditional teaching methods in science, technology, engineering, and mathematics (STEM) classrooms are gravitating towards more hybrid mechanisms such as discussions, flipped classroom lectures, self-paced 'flexible' models, independent studies, individual rotation models, enriched virtual classrooms, massive open online courses (MOOCs), and prior learning assessments, among others. Some institutions have also started to focus on competency-based learning to stress learning outcomes instead of seat time (Nodine, 2016). All these attempts are predominantly focused on improving student motivation and their self-determination.

Richard Ryan and Ed Deci built the self-determination theory in the 1970s as a tool intended to delve into learners' motivation and determination (Ryan & Deci, 2019). The theory creates an easily applicable and replicable framework from internal (e.g., emotions, needs, and drive) and external (e.g., social, cultural, and environmental) factors that may or may not contribute to an individual's motivation. SDT has three primary needs:

- Autonomy: the belief that one can control their actions
- Competency: confidence in one's own ability and knowledge, and
- Relatedness: a sense of connection between peers or between a learner and their instructor (such as respect, care, etc. (Filak & Sheldon, 2003).

Methodology

We chose ethnography as the research method for this study. An ethnographic research approach can utilize qualitative analysis to define and describe contextualized data (Harvey & Myers, 1995) Ethnography allows continuous data collection through an active presence of the ethnographer. The CIE at Purdue University facilitated this process by observing undergraduate students inside their classrooms from a neutral standpoint. CIE representatives continued to collect data through leading group discussions, engaged listening, and documentation of the responses from the learners in the classroom (Forsey, 2010).

Five redesigned courses (with 334 students in total) were selected for the study. The five chosen courses were CM-150 or 'Construction Management Fundamentals' with 46 students, CM-200 or 'Intermediate Pre-construction Management' with 108 students, CM-250 or 'Intermediate Construction Management' with 69 students, CM-300 or 'Advanced Pre-construction Management' with 70 students, and CM-350 or 'Advanced Construction Management with' 41 students. As this study focused exclusively on redesigned curricula, courses following the older curriculum were not included in the study. Some

students were counted twice as CMT students at Purdue University are allowed to take 200- and 300-level courses simultaneously, however, data shows that less than 15% of learners usually do so each semester.

The tool used for data collection was SGID. SGID can collect data on the structure, organization, course material, and instruction formats of any educational course during the semester (Diamond, 2004). This was assisted by group discussions led by CIE, a neutral third party, and often a graduate assistant or a colleague who does not teach the course. The participants discussed the pros and cons of teaching strategies of the course in small groups. CIE representatives used two leading questions to facilitate the discussions without narrowing the spectrum of student responses (Berk & Theall, 2006), which the students discussed within their small groups. Following that, the representatives summed up the outcomes before the entire class for their common opinion. The two leading questions from the CIE were:

- What about the environment, activities, and structure of this course are helping your learning?
- What specific suggestions do you have on changing the environment, activities, or structure of the course to better help your learning?

After the discussion, the CIE facilitators took notes on the following *five* areas and submitted the anonymous dataset to the CMT faculty for further investigation, namely, Course Organization and Structure, Course Content, Instructor Characteristics, Teaching Techniques, and Assessment and Grading. Researchers thematically investigated the consolidated dataset to develop any identifying descriptive patterns present in the statistics. Thematic analysis is a specific research method that can be used to show similarities and identify patterns in a data set. Such methods are flexible, applicable, and easy to use in research and educational contexts and can depict contrasting perceptions among participants (Braun & Clarke, 2006).

Table 1

Steps followed in the thematic analysis

Steps	Description
1. Getting familiar with the data	Transcribing data, iteratively reading data, noting down initial ideas.
2. Generating initial codes	Systematically coding interesting features of the data, collating those relevant to each code.
3. Searching for themes	Collating data and codes into potential themes.
4. Reviewing themes	Checking if the themes work with the coded extracts and entire data set, generating a thematic map of the analysis.
5. Defining and naming themes	Ongoing analysis to refine the specifics of each theme, the overall story from the analysis, generating clear definitions/names for each theme.
6. Producing the report	Final analysis, select vivid and compelling extract examples, relating it back to research question and literature, and producing a scholarly report.

The responses were first sorted and coded into the previously mentioned five categories by the CIE representatives. We then utilized two independent raters who independently analyzed the provided data using SDT dimensions (one being the principal investigator of the study, along with a graduate researcher experienced in SDT). Both separately decided how the responses were affiliated to a dimension of SDT, whether it could be described as autonomy, competency, or relatedness. From

McHugh (2012), the concept of Cohen's Kappa (κ) statistic was used to interrelate the results of the two researchers. The values varied as:

- ≤ 0 indicated no agreement at all,
- 0.01–0.20 as none to slight agreement,
- 0.21–0.40 as fair agreement,
- 0.41–0.60 as moderate agreement,
- 0.61–0.80 as substantial agreement, and
- 0.81– 1.00 as near perfect agreement

The data in this study found that the reliability statistic across all three SDT dimensions between the two raters were $\kappa = 0.73$ for autonomy, $\kappa = 0.69$ for competency, and $\kappa = 0.62$ for relatedness. The results showed that 'substantial agreement' existed between the two raters for each of the three SDT dimensions. This provided a concrete idea of how the learners perceived the changed curriculum being offered to them

Findings

A total of 116 responses were provided by each participant in the study, of which 33 were about helpful attributes of the course that contributed to their experience, and the remaining 83 were comments and suggestions on further improvement of the curriculum. For example, students stated that they preferred to include "*more field trips/site visits*" in their courses, which can be related to 'competency' under SDT. Site visits are always an intrinsic part of construction management education, and it helps students understand and relate to classroom material better when they were able to *see* them on jobsites. Additionally, students also stated that "*better organization of Brightspace content*" (Brightspace being their primary online learning/course management system) helped greatly, and this can be attributed to 'autonomy'. This improvement in online material structuring helped the students find course material pertaining to each week more efficiently and made the course load easier for them. "*Good collaboration between Professors or Instructors and content*" was found to be an example of 'relatedness' for the students. According to Diamond (2004), contextual feedback like this can help instructors improve courses in the future by incorporating features that can motivate students and help them learn effectively

Student Perceptions from SGID Data

The SGID data showed that the learners had various suggestions about the structure and presentation of the course material (approximately 30% of their suggestions). Their next concern was course content which was the topic of about 28% of their comments, which included '*hands on lab sessions*', '*more in-class activities*' and having definite '*areas of concentration such as Mechanical, Electrical and Plumbing (MEP), Healthcare, Residential, etc.)*'. It is essential that the learners' perception of their courses is factored into its design as it can have a significant impact on student success and their motivation towards learning (Sherry et al., 1998). Table 2 below shows all the findings based on the five SGID factors from all five undergraduate CMT courses.

Table 2

Student perceptions of overall courses based on number of responses/comments

	Course Organization / Structure	Course Content	Instructor Characteristic	Teaching Techniques	Assessment and Grading
Course 1	0	5	0	6	2
Course 2	10	7	6	3	4
Course 3	11	7	1	2	5
Course 4	3	7	2	5	4
Course 5	11	6	3	3	3
	35 (30%)	32 (28%)	12 (10%)	19 (16%)	18 (16%)

Students of Course 1 were CMT freshmen, and they were found to be mainly concerned with teaching techniques and practices. They also thought that scaffolding issues were not taught for long enough during laboratory classes. The concerns of students from Courses 2, 3, and 4 were equally distributed between the importance of both course structures and course content. In Course 5, it was found that the students' apprehensions focused greatly on team collaboration, learning together in groups, and hands-on activities as they felt that those contributed to their knowledge levels and competency.

The Role of SDT in Education

Self-determination theory can help course instructors and researchers understand which specific factors can motivate a learner toward their education and make them successful. This study only focuses on how SDT can assist instructors in recognizing how students perceive a completely redesigned course curriculum. The motivations for each of the three SDT factors were found to be 54% for competency, 30% for autonomy, and 16% for relatedness. According to (Filak & Sheldon, 2003), satisfying all three factors will ensure that the students are pushed to their full potential. If a learning environment can fulfill all three SDT factors, then students' motivations towards their education have been found to also increase (Jungert et al., 2019). Figure 1 below depicts the three thematic SDT factors distributed over the five corresponding CMT courses.

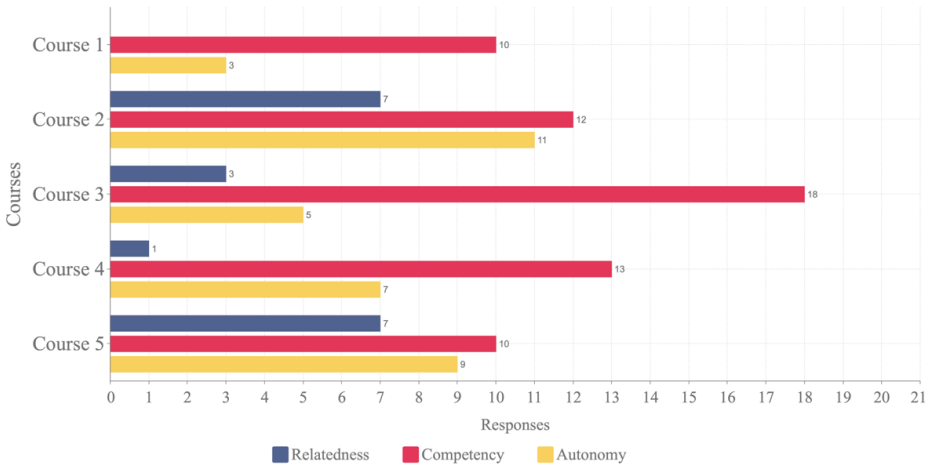

Figure 1: Thematic SDT factors for each course

It was important for the researchers to understand whether students believed that they had volitional control over how they learn and what they learn. Competency, autonomy, and relatedness must all be encouraged and carefully enforced in a learning environment for students to feel involved in and motivated towards their education and 'heard' by their instructors. This also helps build a good rapport and a level of trust between students and their mentors or instructors (in this case, professors). Competency and autonomy help in building necessary skills of learners, and relatedness makes learners feel connected to their peers and the course material, and thus this can greatly contribute to how much they learn from it. This assists in interpersonal development as well as professional improvement in students and can make the course work more solid and quantifiable in the learners' eyes. Additionally, these quantified perceptions can help course instructors think of ways to improve the course material for future semesters.

Conclusions

In an educational context, self-determination theory is extremely useful for educators and course instructors (Reeve, 2002). In this study, SDT was successfully utilized to understand students' perceptions in an educational setting involving a redesigned curriculum. Additionally, SDT can help educators thematically understand their students' perceptions beyond their course evaluations which can often be undependable (Clayson, 2009). The Center for Instructional Excellence, a neutral third party from Purdue University, facilitated an ethnographic data collection by using SGIDs in accordance with the specific research questions of this study. Following that, researchers at Purdue analyzed the data thematically as described earlier in the paper.

The collected data was aggregated for thematic analysis by the two raters. The findings showed that students were highly intuitive about their courses and how they were affected by teaching strategies. Concerns ranged from structural issues with the course, to communication methods, and course content. They were focused on various aspects of the CMT courses, starting from incorporation of field visits in their curriculum to collaboration between peers. It was found that students in different years of their degree also had stark differences in their concerns. The study found that self-determination theory is well-connected to educational coursework and how students react to changes in their course material. The 'relatedness' factor successfully determined areas which made students feel connected and relatable to others. The other two factors, i.e., 'autonomy' and 'competency' helped the researchers identify certain aspects of their construction management courses at Purdue which encouraged student learning. The factors can interfere with the students' motivation toward their education and help them learn the material on their own. Keeping the findings in mind, one can ensure that their teaching environments are interesting, encouraging, and help the students grow both professionally and personally.

Limitations

There are limitations in the scope of this study that future studies can investigate further. Students with stronger personalities may unintentionally 'push' their opinions on their peers during group discussions. This can subdue opinions from introverted or quieter participants, thus causing the collected data to be biased toward a certain demographic. However, SGIDs have the capacity to extract data from such settings by changing the power dynamics that may exist between peers, and thus can assist instructors in schools and colleges. Additionally, as this study was specific to construction management technology students at Purdue University, the results of this paper may not be strictly applicable to other majors and may not be easily generalized for other schools. However, the study can still be modified and can be scaled-up to fit the needs of other non-related scientific

fields. The research questions included in this study can be customized depending on the educational settings of other majors. Comparative studies can also be conducted in the future to establish relationships between past courses and newer redesigned courses. Long term longitudinal studies can also show how such curriculum changes impact student motivations over time, and whether students' attitudes towards such courses and their effectiveness change or evolve over time.

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