Research Article https://doi.org/10.12973/eu-jer.10.3.1317

European Journal of Educational Research
Volume 10, Issue 3, 1317 - 1327.
ISSN: 2165-8714
https://www.eu-jer.com/

Influencing Variables and Implications in the Teacher-Student Relationships

Yung-Hsiang Hu*
National Yunlin University of Science and Technology, TAIWAN

Randolf L. Asistido
STI-West Negros University, PHILIPPINES

Mary Jonie O. Villanueva
STI-West Negros University, PHILIPPINES

Received: January 4, 2021 ▪ Revised: March 27, 2021 ▪ Accepted: June 13, 2021

Abstract: The purpose of the study was to examine correlations between perceived teacher innovation (PTI) and self-regulated learning (SRL), where learning motivation, self-efficacy, and learning transfer help illustrate the interplay between and among influencing variables in the teacher-student relationship. This study gathered 213 valid questionnaires out of 355 participants in the Design Thinking for Data Scientists, which is one of the courses taught from a university in Taiwan. This study has analyzed the possible linkage in the Structural Equation Modeling (SEM) through the path coefficient. The ensuing data analysis study has shown that learning motivation, self-efficacy, and learning transfer not only served as the mediator effects in the PTI and SRL but also played small moderating effects. It appears that when learning motivation, self-efficacy, and learning transfer decrease, the interplay between PTI and SRL becomes stronger. It is necessary to increase the level of intrinsic motivation by the perception of greater innovation in teaching materials. By so doing, students would be more receptive and affective of course contents in the classroom and regulate themselves to achieve educational goals. The implications of teachers' perceptions of pedagogical innovation for learning motivation and learning experience are likewise discussed.

Keywords: *Learning motivation, learning transfer, perceived teacher innovation, self-efficacy, self-regulated learning.*

To cite this article: Hu, Y. H., Asistido, R. L., & Villanueva, M. J. (2021). Influencing variables and implications in the teacher-student relationships. *European Journal of Educational Research, 10*(3), 1317-1327. https://doi.org/10.12973/eu-jer.10.3.1317

Introduction

In cognitive psychology, scholarly debates echoed differences between a teacher-centered approach and a student-based approach. However, there has been a paradigm shift from the former to the latter over the last three decades. The student-based approach underlines self-directed initiatives and thereby constructs problem-solving skills throughout their lives (Sungur & Tekkaya, 2010). The increasing trend has produced different layers of analysis such as classroom management and potential influences on student learning and motivation; this has underlined the rationale for this study to research how students could benefit from the student-based curriculum design and take their initiatives learning. To strengthen the justification, we used Design Thinking for Data Scientists, which aims to present challenges upfront, streamline the problem-solving process and propose feasible solutions in the context of challenges.

Scholars continue to discuss the debate over which approaches are genuinely practical for learning outcomes. Colliver (2000) compared the problem-based curricula to the traditional curricula, concluding that the problem-based curricula did not present convincing evidence for their predominance. His review's weakness was that it lacked standard specification for both curricula, resulting in an issue with the methodological design. Norman and Schmidt (2000) responded to Colliver's work by emphasizing the effects of multiple cognitive psychology variables that require more systematic exploration of research. However, Capon and Kuhn (2004) researched the context of the problem-based context where teachers are described as critical variables; that is to say, they are "either controlled or systematically varied in an unconfounded design" (Norman & Schmidt, 2000, p. 62).

We extend the previous research in the student-based approach by examining psychological variables. This study's central question is whether the teacher-student relationship could be understood as the interactive process of students' learning journey. In response to this question, we review contemporary literature on critical factors influencing effective learning and propose eight hypotheses to investigate the relationship above. In the sections that follow, we

* **Corresponding author:**
Yung-Hsiang Hu, National Yunlin University of Science and Technology, General Education Center, Taiwan. ✉ hsiang@yuntech.edu.tw

explain the methodology adopted in this study and how it was analyzed. At the same time, we present our findings and recommendations in the final section.

Literature Review

Contemporary literature indicated that effective learning is composed of proper study skills, a positive learning attitude, a considerable amount of motivation, and self-regulation (Credé & Kuncel, 2008; Reason et al., 2006; Roeser & Peck, 2009). These four factors contributing to effective learning constitute what we might call student attitude, which, in the words of Jufrida et al. (2019), is an integral aspect in learning situations. It could refer to their personal view of the whole educational setting that, in all, affect students' willingness to learn. McMahon (2006) summarized two distinct student approaches to learning that refer to 'surface' and 'deep learning approaches. Pintrich (2004) believed that the two approaches were too simplified to offer comprehensive insights into motivational, cognitive, affective, and social contextual factors. In an earlier article that saw print on pp. 451-502 of the Handbook of Self-Regulation, Pintrich (2000) proposed that SRL is goal-orientated, functioning as proper study strategies. The most striking part of his model is that self-efficacy, motivation, and goal orientation are viewed as the perceivable aspects of SRL.

In discussing motivation, there are two different kinds of orientation. One is intrinsic motivation, and the other is extrinsic motivation. The former refers to learning something out of inner interest or enjoyment, while the latter refers to learning something because of external incentives or (Ryan & Deci, 2000). Goal theorists (Elliot, 1997; Harackiewicz et al., 1997; Molden & Dweck, 2000) argued that students are either mastery-oriented or achievement-oriented.

Self-determination theorists, on the one hand, underlined the extension of intrinsic motivation through the variables of autonomy, competence, and relatedness (Muller et al., 2006). Zimmerman (2002), on the other hand, argued that students could utilize SRL to regulate their behaviors, motivation, cognition, and learning environment. To go further on this, this study explains how motivation, self-efficacy, and learning transfer influence one another in the association between PTI and SRL.

PTI, SRL, and Motivation

PTI explores how students' perceptions of their teachers' teaching innovation, especially the extent to which teachers are perceived to develop SRL skills and motivate students' autonomy, with the latter contributing to the former as a learning skill to achieve goals. There have been few studies examining teachers' perceptions of course design. In the words of Cooney (1994), most researches emphasized: "what teachers did, not what they thought." The shifting paradigm occurred in the early 1980s to highlight the link between teachers' perception, learning, and classroom instruction (Clark & Peterson, 1986; Peterson et al., 1989). The shifting paradigm strengthened the conceptualization of teachers' cognitive influence on classroom instruction and the importance of teaching efficacy to motivate students. Based on this, we propose the first hypothesis;

H_1: PTI has a significant effect on learning motivation.

SRL is often described as a learning strategy in achieving academic goals; responsiveness represents one of the distinct aspects of SRL. The SRL process involves not only students' beliefs to make progress but also the interaction between teachers and students (Zimmerman, 2002). This has profound implications for teachers' pedagogies and learning motivation. Zimmerman (2002) described SRL as different phases, claiming that self-efficacy is the fundamental belief of self-motivation in the forethought phase. Therefore, self-efficacy could be understood as a belief in confidence to sustain self-motivation. Moving on, Gaskill and Hoy's (2002) textbook entitled Self-Efficacy and Self-Regulated Learning: A Dynamic Duo in School Performance implies some kind of interaction between these twin variables. Another point worth highlighting is Schuitema et al.'s (2012) contention about the apparent influence of the learning environment vis-à-vis self-regulated learning. With the teacher at the center of learning the said environment, we propose the following hypotheses:

H_2: PTI has a significant effect on self-regulated learning.

H_3: PTI has a significant effect on self-efficacy.

Self-efficacy, Learning Transfer and Motivation

Self-efficacy, says Bandura (1997), can be construed as the belief that people have in their capabilities to carry out a given task. Efficacy beliefs serve as a potent influence to develop human competencies (Bandura, 1997; Pintrich, 1999). In discussing motivation orientation, Bandura (2001) indicated that efficacy beliefs are the fundamental components of human agency. The same author asserts that people have little incentive to get through the difficulties if they do not conceive of relevancies between desired outcomes and present actions.

Self-efficacy plays a central role in constructing thought patterns, academic performance, emotional actions, and skill development. As a result, it indeed serves as a vital element in the motivational orientation. Meanwhile, its reverence to SRL has also been confirmed by a substantial review of studies. Self-efficacy can influence goal and commitment, which

largely performs similar functions of SRL (Gist & Mitchell, 1992). To further explore this line of thought, we hereby submit two hypotheses;

H_4: Learning motivation affects self-efficacy.

H_5: Learning motivation affects SRL.

In examining motivation and actions, Bandura (2001) indicated that people might anticipate the future consequences of specific actions. In the forethought phase, the learning behavior will be motivated and directed by the set goal, which enables students to "transcend the dictates of their immediate environment and regulate the present to fit a desired future" (Bandura, 2001, p. 7). This is to say that motivation is one of the variables between SRL and anticipated outcome. In this scenario, the higher motivation students possess, the more confident they would be despite ongoing challenges. Also, we would like to discuss whether the learned skills would be transferred to different areas of expertise. Judging from this, we put forward the following hypothesis;

H_6: Learning motivation affects learning transfer.

Learning Transfer, SRL, and Self-efficacy

Zimmerman (2002) gave a constructive insight into the development of SRL. He considered SRL as lifelong learning skills, which explain its malleability of theoretical application. In other words, SRL can be applied in different environmental settings, such as business settings, recreational settings, and self-employment settings (Zimmerman, 2002). In this regard, the linkage brings us farther to various settings. The relevant literature in the cognitive theory associates well with learning transfer. According to Harris et al. (2008), learning transfer is viewed as the process whereby learners will be able to apply the skill acquired in one context and achieve the related performance in a different context. In discussing learning transfer, Marini and Genereux (1995) summarized three conditions influencing transfer – task, learner, and social context. The features bear striking similarities to those in the theoretical development of SRL. As a result, we underline the following hypothesis;

H_7: Learning transfer affects self-regulated learning.

The basic assumption is that SRL and learning transfer can co-exist. Recognizing the similar features, we also take students' capabilities into consideration. We suggest that greater conceptualization is essential about the plasticity of self-efficacy in support of SRL. In our questionnaire, self-efficacy can be interpreted as a belief in one's capabilities to pursue better performance, the connotations of which refer to students' confidence. We associate self-efficacy with learning transfer for further investigation. As a result, we put forward the final hypothesis;

H_8: Self-efficacy affects learning transfer.

Up next is Fig. 1.

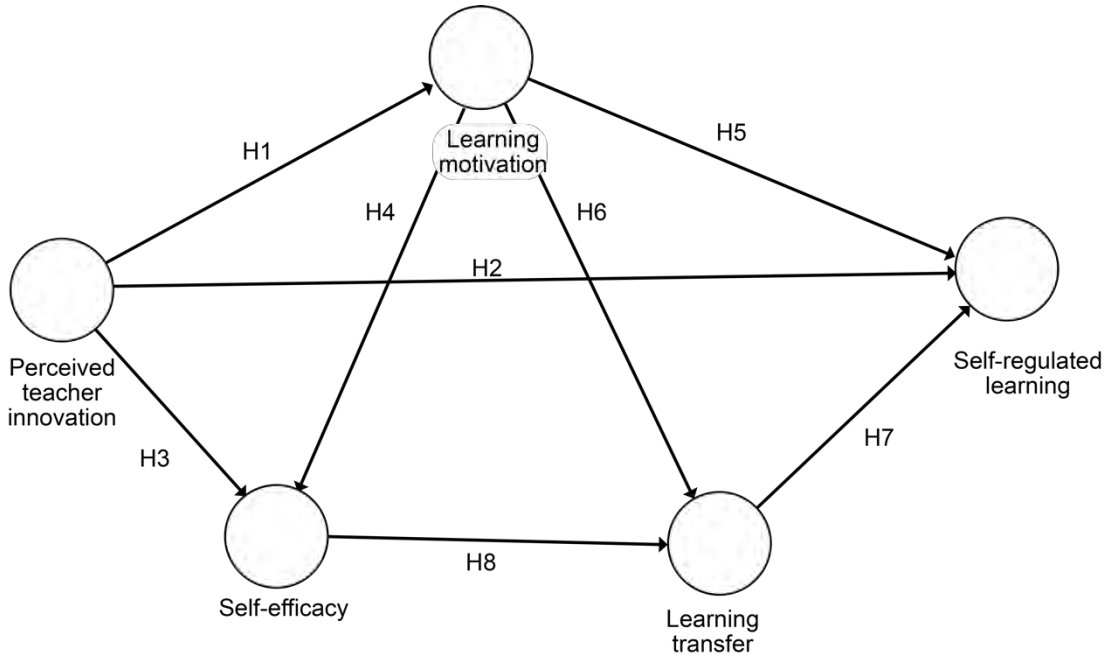

Figure 1. The Framework of Structural Model

Figure 1 illustrates the framework of the structural model of this paper. It summarizes the interplay between 8 variable pairings and supplements textual discussion in the literature review section. The origin and direction of the arrows illustrate instances where variables assume the role of independent or dependent variables, respectively. But more importantly, it outlines the possible effect/s one variable has over the other/s. Interestingly, only PTI and SRL have never exchanged roles; PTI has been the independent variable in 3 instances, while SRL has always been the dependent variable for also three instances. Other influencing variables in student-teacher relationships like learning motivation, self-efficacy, and learning transfer have all assumed both roles.

Methodology

Research Goals

This paper aimed to analyze those influencing variables and implications in teacher student-relationship at a university in the central part of Taiwan. Variables in focus were perceived teacher innovation, self-efficacy, learning transfer, self-regulated learning, and learning motivation.

Sampling and Data Collection

The study's target population was participants who enrolled in the general education course called "Design Thinking for Data Scientists" delivered in the way of MOOCs. There were 620 students from various schools, such as the School of Management, the School of Humanities, Engineering, and the School of Design. We constructed the questionnaire in terms of perceived teacher innovation, self-efficacy, learning motivation, learning transfer, self-transfer, and self-regulated learning. We distributed 355 questionnaires and received 213 (60%) valid questionnaires: 115 males and 98 females. They all signed the consent form and volunteered to take part in the study.

A 47-item self-made questionnaire was used to collect the data needed by this paper. One set of data measured teachers' innovative practices with questionnaire items initially sourced from Mayer (1999), Moore (2011), and Organization for Economic Co-operation and Development (OECD, 2014) and later enhanced to fit with the research environment. The other data set within the same questionnaire determined students' level of cognitive engagement (self-regulated learning and transfer of learning) and affective engagement (learning motivation and self-efficacy). After establishing the data-gathering instrument's reliability, this group of researchers first asked whether the students were willing to accept the academic questionnaire survey, and questionnaires were then issued after consent was obtained. In the questionnaire's opening statement, assurance was given that the study was purely for academic purposes only.

Research Tools

Questionnaire items on self-regulated learning, learning motivation, transfer of learning, and self-efficacy were sourced mainly from Pintrich (1989, 2004), Kirkpatrick (1967), and Kirkpatrick and Kirkpatrick's (2016) four-level model, and a good number of works of literature from Bandura (1997), Lee et al. (2010) and Solberg et al. (1993). These were later revised to harmonize with the research environment as well as the paper's objectives. The said data-gathering instrument was submitted to and has subsequently passed the validity and reliability tests by confirmatory factor analysis (CFA). Additionally, the research constructs were developed solely on existing validated measures. All scale items were rearticulated to relate precisely to the context of the current study's requirement. A four-point Likert scale was employed to measure the constructs ranging from "1-strongly disagree" to "4-strongly agree." *Reliability & Convergent Validity*

To demonstrate the reliability and validity of our model, composite reliability (CR) and average variance extracted (AVE) put forward by Bagozzi (1980) were estimated in this study. The strong reliability of the composite index should be CR ≥.70 and AVE≥.5. Table 1 below brings to fore the accuracy statistics and illustrates the relationship between and among the implicit and explicit variables.

Convergent validity shows internal consistency, the extent to which multiple items of a test measure the same construct in focus and come up with consistent and dependable results (Babin & Zikmund, 2016). As shown in Table 1, the AVE values ≥.5 for all the constructs indicate nothing less than convergent validity, a condition showing the "relatedness" of said constructs (Bagozzi & Yi, 1988; Fornell & Larcker, 1981). In this respect, the overall measurement model is henceforth deemed satisfactory.

Table 1. Accuracy Statistics

Latent variables	Observed variables	Number of questions	Cronbach's alpha	CR	AVE	Factor loadings
Learning Transfer	(LT_1) Problem-solving behavior	3	.842	.927	.863	.924
	(LT_2) Outcomes	3				.934
Learning Motivation	(LM_1) Expectancy	4	.836	.901	.752	.845
	(LM_2) Value	4				.875
	(LM_3) Affective	3				.882
Perceived Teacher Innovation	(PTI_1) Teaching material	4	.846	.907	.765	.885
	(PTI_2) Teaching assessment	3				.875
	(PTI_3) Teaching methods	4				.863
Self-regulated Learning	(SRL_1) Cognition	6	.890	.892	.931	.914
	(SRL_2) Environment	3				.901
	(SRL_3) Time	3				.900
Self-efficacy	(SE_1) Academic performance	4	.828	.920	.852	.937
	(SE_2) Physiological index	3				.909

Discriminant Validity

In the words of Cook and Campbell (1979), discriminant validity is the degree to which items differentiate between variables or measure different variables. It can be assessed by examining the correlations between variables. Each item should correlate more highly with other items of the same variable than with other variables. To determine this, Fornell and Larcker (1981) made clear that the squared correlation (shared variance) between two variables should be less than the average variances extracted by the items measuring the variables.

Table 2 presents the result of the test for discriminant validity.

Table 2. Discriminant Validity

	LM	LT	PTI	SE	SRL
Learning motivation (LM)	.867				
Learning transfer (LT)	.774	.929			
Perceived teacher innovation (PTI)	.758	.745	.874		
Self-efficacy (SE)	.793	.756	.763	.923	
Self-regulated learning (SRL)	.769	.81	.73	.821	.905

Referring to the results obtained in Table 2, all square roots of AVE exceeded the elements in the corresponding rows and columns. As per Fornell-Larcker criteria, the square root of the AVE exceeds the correlations between the measure and entire other measures (Hair et al., 2013). Thus, the result shown in Table 2 complied with discriminant validity criteria, hence confirming adherence to the Fornell and Larker's criterion.

Goodness of Fit

The goodness of fit (GoF) statistics was calculated using Tenenhaus et al. (2005) formula illustrated below. First, the averages of the AVE were multiplied by the averages of the R^2 values. Second, the product was squared to determine the GoF.

GoF $=\sqrt{AVE * R^2}$

$=\sqrt{.832 * .659}$

$= \sqrt{.548}$

$= .740$

As shown above, the calculated GoF was .740, which visibly exceeded the threshold of GoF>.36 (Wetzels et al., 2009). This study henceforth concluded that the research model enjoys a clear GoF.

Data analysis

The data generated by the survey questionnaires were tallied, tabulated, and, with the aid of smart PLS 3.2.7, were all subjected to statistical analyses and interpretations consistent with its research objectives and hypotheses.

Findings / Results

At the onset, the PLS analysis was performed for the structural model of this study to determine the explained variance (R^2), standardized path coefficient (β), and t values. The hypothesized relationships between the constructs were thereafter analyzed using Smart PLS 3.2.7 software. The path coefficient and the R^2 value are the primary indicators of the model (Chin, 1998). For purposes of accuracy, the resultant hypotheses were further validated courtesy of the bootstrapping strategy. Three hundred (300) bootstrap samples were chosen and subjected to a one-tailed test (Hair et al., 2006), adhered to the critical t statistical values of 1.65 and 2.33, both representing the significance level of 5% and 1%, respectively.

Subsequent results show the closeness of data to the fitted regression line. First, the R^2 value of .653 for learning transfer that 65.3% of the variance was explained by the affective, normative, and calculative commitment. Second, the R^2 value of .574 for learning motivation that 57.4% of the variance was explained by the affective, normative, and calculative commitment. Third, the R^2 value of .717 for self-regulated learning that, 71.7% of the variance was explained by the affective, normative, and calculative commitment. Finally, the R^2 value of .691 for self-efficacy that, 69.1% of the variance was explained by the affective, normative and calculative commitment.

The ensuing analyses on three other variable pairings on PTI and learning motivation, PTI and self-regulated learning, and PTI and self-efficacy recorded positive significant results. Specifically, H_1 on PTI and learning motivation (β =.758, μ =26.026, α = .00 < .01); H_2 on PTI and self-regulated learning (β = .173, μ = 2.775, α = .006< .05); and H_3 on PTI and self-efficacy (β =.38, μ =5.305, α = .00 < .01). The discussion section will later highlight some papers which either enthusiastically validated the foregoing findings or took some precautionary stance on their own.

Meanwhile, subsequent analyses recorded similar outcomes on the following variable pairings: H_4 on learning motivation and self-efficacy (β =.505, μ = 6.926, α =.00 < .01); H_5 on learning motivation and self-regulated learning (β = .276, μ =3.598, α = .00 < .01); and H_6 on learning motivation and learning transfer (β = .471, μ = 5.295, α = .00 < .01). The discussion section will later bring into focus a number of papers validating these findings.

Moving on, the hypothesized relationships between variables illustrated in Figure 2 and Table 3 prove that H_7 on learning transfer and self-regulated learning registered a positive and highly significant with path coefficient value, t-statistics value, and probability value respectively as (β = .467, μ = 5.968, α = .00 < .01). The discussion section further explains these findings.

Finally, H_8 on self-efficacy and learning transfer showed statistical analyses on path coefficients, T-statistics and P-values (β = .382, μ = 4.247, α = .00 < .01). The discussion section brings to fore the scarcity of research on major determinants of learning transfer both at the meso- and macro-levels. We are reminded, nonetheless, of Hung's (2013) assertion that knowledge application and transfer continue to generate such enviable interest in education. Self-efficacy comes very close to the equation.

Up next is Table 3.

Table 3. Results of Structural Equation Model Analysis

Hypotheses	Hypotheses No.	Path coefficients	t-Statistics	p-values
PTI->LM	H_1	.818	35.508	.00
PTI -> SRL	H_2	.248	.782	.00
PTI-> SE	H_3	.299	.528	.00
LM -> SE	H_4	.537	6.613	.00
LM->SRL	H_5	.293	3.617	.00
LM->LT	H_6	.560	6.776	.00
LT->SRL	H_7	.377	4.962	.00
SE ->LT	H_8	.263	.881	.004

PLS, which is known as a variance-based SEM, helps to understand the relations among sets of observed variables (Hair et al., 2012). As shown in Table 3 and Figure 2, positive and highly significant relationships were found to exist between those paired variables among those eight (8) hypotheses. Up next is Fig. 2 that illustrates the structural model of the study.

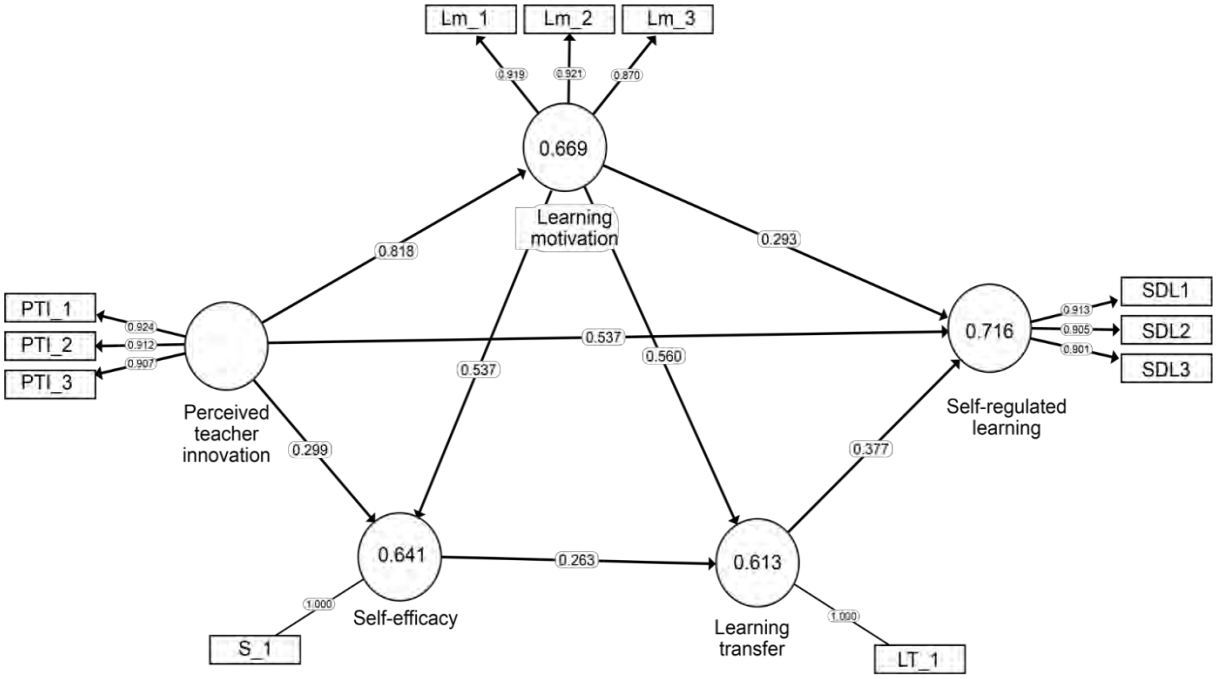

Figure 2. Structural Model of the Study

Discussion

As earlier explained and further illustrated in Figure 2 and Table 3, multiple analyses on three other variables on PTI paired with learning motivation, self-regulated learning and self-efficacy all recorded positive significant results. Johnson (2017) made a perfect hit on H_1 by stating that while the desire to learn is inherent in students, the external support teachers provide has, without a doubt, a significant impact on student learning. The same author went on to assert that encouraging support for student autonomy, relevance, and relatedness to the material heightens student motivation to learn.

Bringing the spotlight on H_2, Voskamp et al. (2020) admitted that most teachers find it challenging to integrate self-directed learning into their practice. Nonetheless, the authors continued, innovative teachers keep entertaining means by which they can provide self-regulatory opportunities and requirements for students through tailored activities through innovative activities. Moving on, there appears to be a dearth on literature directly linking PTI and self-efficacy. Nonetheless, this section refers to Margolis and Mccabe's (2006) contention that many struggling learners have low self-efficacy for academics and believe that they lack the ability to succeed. To reverse this observation, this section needs to reconnect with Johnson (2017), focusing on external support coming from teachers to regain back student confidence in themselves.

Meanwhile, the positive significant results between variable pairings in H_4, H_5, and H_6 either validated earlier findings or showed some cautious statements of their own. On H4, Shin's (2018) experimental study on the effects of problem-based learning hinted at how students reflect upon their learning materials that, in the process, increased their motivation and self-efficacy. Nafukho et al. (2017) also pointed out that learner motivation has a positive influence on the transfer of learning. Additionally, Ersanlı (2015) corroborated the findings on H_4 on a research entitled "The relationship between students' academic self-efficacy and language learning motivation: A study of 8th graders." Subsequent results showed a significant correlation between learning motivation and self-efficacy of nursing students.

On H_5, Winne and Hadwin (2012) appear to have corroborated the findings on H_5, that learning motivation does affect self-regulated learning (SRL). The duo declared that the analysis of SRL and learning motivation could either be completely simple or outrightly complicated. Simple said the authors because anything a student does can be motivated, and without motivation, there can be no behavior, or perhaps no SRL. But beneath this simplistic understanding is the researcher's curiosity to distinguish "just behaving" from SRL.

Moving on to H_6, true motivation to transfer, says James (2012), is rare. This was the finding of the study entitled "An investigation of motivation to transfer second language learning," which saw print in the Modern Language Journal. The paper, nonetheless, listed eight factors influencing students to transfer. Additionally, Ngeow (1998), in a paper entitled "Motivation and Transfer in Language Learning," made clear that transfer and motivation are two mutually supportive variables in teachers' aim of creating an optimal learning environment. The paper concludes with suggestions on instructional strategies to enhance student motivation and learning transfer.

Like in H_1, H_2, H_3, H_4, H_5, H_6, and H_8, the hypothesized relationship between learning transfer and self-regulated learning on H_7 proved positive and highly significant. These are, nonetheless, in sharp contrast to the findings of Raaijmakers et al. (2018), who claimed the absence of substantive evidence that students subsequently utilize their applied skills during self-regulated learning in mathematics. As a final point, H_8 on self-efficacy and learning transfer update Tonhäuser and Büker (2016), who both declared research gaps on the major determinants of learning transfer both at the meso- and macro-levels. Thanks to Godinez and Leslie (2015), whose paper studied a facilitated student-centric approach to creating a learning environment that promotes self-efficacy and learning transfer. However, the researchers recommended others factors like feedbacking, coaching, and peer organizational support believed to affect learning transfer.

Conclusion

To summarize, the paper has found that PTI had a significant effect on students' commitment to obtain the highest level of comprehension at one university in the central part of Taiwan. PTI is a dynamic concept, and it is only from the perspective of teachers. Instead, its connotations should be interpreted as the learning interaction between students and teachers. This has underlined the potential effects of learning motivation, self-efficacy and learning transfer, and self-adjusted learning. University teachers are encouraged to take more innovative teaching modalities to motivate students' engagement in activities as long as they are conscious of its potential relevancies to students' learning experiences.

PTI and student engagement are two sides of the same coin; one could not seem to live without the other. Teaching innovation, as a strategy, should evolve from the group of participatory students in a specific classroom context. In such a circumstance, we shall not neglect the continuance of teaching innovation and the importance of classroom management. As a result, the effects of motivation, self-efficacy and learning transfer, and self-adjusted learning are self-evident.

However, scholarly debates do not emphasize institutional catalysts to change the classroom. This paper urges that higher education institutions could take the lead in the promotion of innovative curriculum design and classroom renovation. The former focuses on practical materials that could be used in our daily lives, while the latter emphasizes the change of interior redesign in the learning environment. Altogether, it means educational innovation should not be limited to specific subjects, spaces, and practices. The implications of this article might be for further research and suggest additional lines of inquiry for future research.

Recommendations

The findings of this paper offered evidence of the significant influence PTI has on self-regulated learning, self-efficacy, and learning motivation. In turn, the latter has shown promises to exert influence on self-efficacy, learning transfer, and self-regulated learning. It appears clear that, of the multiple variables brought into focus, PTI is the primer of change education stakeholders hope to see in schools. Hence, along this line, we recommend the adoption of a university-wide rewards system for teacher innovations aimed at enhancing learning motivation and student engagements to the maximum. Finally, since the present research is a quantitative one, we also recommend using either qualitative or mixed methods on similar studies in the future.

Limitations

This paper confines its analysis on those five (5) influencing variables and implications in teacher student-relationship with its research environment from the schools of management, engineering, and design at a university in central part of Taiwan for School Year 2018-2019. A total of 213 filled questionnaires were gathered from 355 participants and eventually formed part of the data that were later analyzed and interpreted in accord with the paper's objectives. Nonetheless, this research endeavor conformed to the ethical standards of research as chosen respondents all signed the consent form and volunteered to take part in the study.

Acknowledgments

We would like to thank our anonymous reviewers and editors for their valuable comments and suggestions that eventually led to the refinement of this research paper.

Authorship Contribution Statement

Hu: Concept and design, data acquisition, data analysis / interpretation, securing funding. Asistido: Editing, reviewing, supervision. Villanueva: Drafting manuscript, editing, material support.

References

Babin, B., & Zikmund, W. (2016). *Essentials of marketing research* (6th ed.). Cengage Learning.

Bagozzi, R. P. (1980). *Casual models in marketing*. Wiley.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structure equation models. *Journal of the Academy of Marketing Science 16*(1), 74-94. http://doi.org/10.1007/BF02723327

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*, 1-26. https://doi.org/10.1146/annurev.psych.52.1.1

Capon, N., & Kuhn, D. (2004). What's so good about problem-based learning? *Cognition and Instruction, 22*(1), 61-79. https://doi.org/10.1207/s1532690Xci2201_3

Chin, W. (1998). The partial least squares approach for structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295-336). Lawrence Erlbaum Associates.

Clark, C. M., & Peterson, P. L. (1986). Teachers' thought processes. In M. C. Whittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 255-296). Macmillan.

Colliver, J. (2000). Effectiveness of problem-based learning curricula: Research and theory. *academic medicine, 75*(3), 259-266. https://doi.org/10.1097/00001888-200003000-00017

Cook, T. D., & Campbell, D. T. (1979). Quasi-experimentation: Design and analysis issues for field settings. Houghton Mifflin.

Cooney, T. J. (1994). Research and teacher education: In search of common ground. *Journal for Research in Mathematics Education, 25*(6), 608-636. https://doi.org/10.2307/749575

Credé, M., & Kuncel, N. R. (2008). Study habits, skills, and attitudes: The third pillar supporting collegiate academic performance. *Perspectives on Psychological Science, 3*(6), 425-453. https://doi.org/10.1111/j.1745-6924.2008.00089.x

Elliot, A. (1997). Integrating the 'classic' and 'contemporary' approaches to achievement motivation: A hierarchical model of approach and avoidance achievement motivation, In M. L. Maehr & P. R. Pintrich (Eds.) *Advances in motivation and achievement* (vol.10., pp. 143-179). JAI Press.

Ersanlı, C. Y. (2015). The relationship between students' academic self-efficacy and language learning motivation: A study of 8th graders. *Procedia-Social and Behavioral Sciences*, *199*, 472-478. https://doi.org/10.1016/j.sbspro.2015.07.534

Fornell, C., & Larcker, D. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal Mark Researcher, 18*(1), 39–50. https://doi.org/10.2307/3151312

Gaskill, P. J., & Hoy, A. W. (2002). Self-efficacy and self-regulated learning: The dynamic duo in school performance. In J. Aronson (Ed.), *Improving academic achievement* (pp. 185-208). Academic Press. https://doi.org/10.1016/B978-012064455-1/50012-9

Gist, M. E., & Mitchell, T. R. (1992). Self-Efficacy: A theoretical analysis of its determinants and malleability. *The Academy of Management Review, 17*(2), 183-211. https://doi.org/10.2307/258770

Godinez, E., & Leslie, B. B. (2015). Army civilian leadership development: Self-efficacy, choice, and learning transfer. *Adult Learning*, *26*(3), 93-100. https://doi.org/10.1177/1045159515583259

Hair, J. F., Black, B., Babin, B., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Pearson Prentice Hall.

Hair, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2013). A primer on partial least squares structural equation modelling (PLS-SEM). SAGE Publications Incorporated.

Hair, J. F., Sarstedt, M., Ringle, C., & Mena, J. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science, 40*(3), 414–433. https://doi.org/10.1007/s11747-011-0261-6

Harackiewicz, J., Barron, K. E., Carter, S., Lehto, A., & Elliot, A. (1997). Predictors and consequences of achievement goals in the college classroom: Maintaining and making the grade. *Journal of Personality and Social Psychology, 73*(6), 1284-1295. https://doi.org/10.1037/0022-3514.73.6.1284

Harris, S., Lowery-Moore, H., & Farrow, V. (2008). Extending transfer of learning theory to transformative learning theory: A model for promoting teacher leadership. *Theory into Practice, 47*(4), 318-326. https://doi.org/10.1080/00405840802329318

Hung, W. (2013). Problem-based learning: A learning environment for enhancing learning transfer. *New directions for Adult and Continuing Education*, *2013*(137*)*, 27-38. https://doi.org/10.1002/ace.20042

James, M. A. (2012). An investigation of motivation to transfer second language learning. *The Modern Language Journal*, *96*(1), 51-69. https://doi.org/10.1111/j.1540-4781.2012.01281.x

Johnson, D. (2017). The Role of Teachers in Motivating Students to Learn. *BU Journal of Graduate Studies in Education*, *9*(1), 46-49. https://www.brandonu.ca/master-education/files/2019/09/BU-Journal-of-Graduate-Studies-in-Education-2017-vol-9-issue-1.pdf

Jufrida, J., Kurniawan, W., Astalini, A., Darmaji, D., Kurniawan, D. A., & Maya, W. A. (2019). Students' attitude and motivation in mathematical physics. *International Journal of Evaluation and Research in Education*, *8*(3), 401-408. http://doi.org/10.11591/ijere.v8i3.20253

Kirkpatrick, D. L. (1967). Evaluation of training. In R. L. Craig & L. R. Bittel (Eds.), Training and Development Handbook (pp. 87-112). McGraw Hill.

Kirkpatrick, J., & Kirkpatrick, W. K. (2016). *Kirkpatrick four levels® evaluation certificate program*. ATD Press.

Lee, J. C.-K., Zhang, Z., & Yin, H. (2010). Using multidimensional rasch analysis to validate the Chinese version of the motivated strategies for learning questionn- aire (MSLQ-CV). *European Journal of Psychology of Education, 25*(1), 141-155. https://doi.org/10.1007/s10212-009-0009-6

Marini, A., & Genereux, R. (1995). The challenge of teaching for transfer. In A. McKeough, J. Lupart & A. Marini (Eds.), *Teaching for transfer: Fostering generalization in learning* (pp. 1-19). Lawrence Erlbaum Associates.

Mayer, R. (1999). Fifty years of creativity research. In R. J. Sternberg (Ed.), *Handbook of Creativity* (pp.449-460). Cambridge University Press. https://doi.org/10.1017/CBO9780511807916.024

McMahon, T. (2006). Teaching for more effective learning: Seven maxims for practice. *Radiography, 12*(1), 34-44. http://doi.org/10.1016/j.radi.2005.03.009

Molden, D. C., & Dweck, C. S. (2000). Meaning and motivation. In C. Sansone & J.M. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation* (pp.131-159). Academic Press. https://doi.org/10.1016/B978-012619070-0/50028-3

Moore, I. (2011). *The national HE STEM programme curriculum innovation projects. A guide to practice: Evaluating your teaching innovation*. University of Birmingham.

Muller, F. H., Palekcic, M., Beck, M., & Wanninger, S. (2006). Personality, motives and learning environments predictors of self-determined learning motivation. *Review of Psychology, 13*(2), 75-86. https://hrcak.srce.hr/17410

Nafukho, F. M., Alfred, M., Chakraborty, M., Johnson, M., & Cherrstrom, C. A. (2017). Predicting workplace transfer of learning: A study of adult learners enrolled in a continuing professional education training program. *European Journal of Training & Development, 41*(4), 327-353. https://doi.org/10.1108/EJTD-10-2016-0079

Ngeow, K. Y. H. (1998). *Motivation and transfer in language learning.* ERIC. https://eric.ed.gov/?id=ED427318

Norman, G., & Schmidt, H. (2000). Effectiveness of problem-based learning curricula: Theory, practice and paper darts. *Medical Education, 34*(9), 721-728. https://doi.org/10.1046/j.1365-2923.2000.00749.x

Organization for Economic Co-operation and Development. (2014). *Measuring innovation in education: A new perspective, educational research and innovation*. OECD Publishing. https://doi.org/10.1787/9789264215696-en

Peterson, P. L., Fennema, E., Carpenter, T. P., & Loef, M. (1989). Teachers' pedagogical content beliefs in mathematics. *Cognition and Instruction, 6*(1), 1-40. https://doi.org/10.1207/s1532690xci0601_1

Pintrich, P. R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In C. Ames, & M. Maehr (Eds.), *Advances in motivation and achievement: Motivation enhancing environments* (pp.117-160). JAI Press.

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research, 31*(6), 459-470. https://doi.org/10.1016/S0883-0355(99)00015-4

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp.451-502). Academic Press.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*(4), 385-407. https://doi.org/10.1016/B978-012109890-2/50043-3

Raaijmakers, S. F., Baars, M., Paas, F., van Merriënboer, J. J. G., & van Gog, T. (2018). Training self-assessment and task-selection skills to foster self-regulated learning: Do trained skills transfer across domains? *Applied Cognitive Psychology, 32*(2), 270–277. https://doi.org/10.1002/acp.3392

Reason, R. D., Terenzini, P. T., & Domingo, R. J. (2006). First things first: Developing academic competence in the first year of college. *Research in Higher Education, 47*(2006), 149-175. https://doi.org/10.1007/s11162-005-8884-4

Roeser, R. W., & Peck, S. C. (2009). An education in awareness: Self, motivational and self-regulated learning in contemplative perspective. *Educational Psychologist, 44*(2), 119-136. https://doi.org/10.1080/00461520902832376

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemporary Educational Psychology, 25*(1), 54-67. https://doi.org/10.1006/ceps.1999.1020

Schuitema, J., Peetsma, T., & van der Veen, I. (2012). Self-regulated learning and students' perceptions of innovative and traditional learning environments: A longitudinal study in secondary education. *Educational Studies*, *38*(4), 397-413. https://doi.org/10.1080/03055698.2011.643105

Shin, M. H. (2018). The effects of project-based learning on students' motivation and self-efficacy. *English Teaching*, *73*(1), 95-114. https://doi.org/10.15858/engtea.73.1.201803.95

Solberg, V. S., O'Brien, K., Villareal, P., Kennel, R., & Davis, B. (1993). Self-efficacy and Hispanic college student: Validation of the college self-efficacy instrument. *Hispanic Journal of Behavioral Sciences, 15*(1), 80-95. https://doi.org/10.1177/07399863930151004

Sungur, S., & Tekkaya, C. (2010). Effects of problem-based learning and traditional instruction on self-regulated learning. *The Journal of Educational Research, 99*(5), 307. https://doi.org/10.3200/JOER.99.5.307-320

Tenenhaus, M., Vinzi, V. E., Chatelin, Y. M., & Lauro, C. (2005). PLS path modeling. *Computational Statistics & Data Analysis,* 48, 159-205. https://doi.org/10.1016/j.csda.2004.03.005

Tonhäuser, C., & Büker, L. (2016). Determinants of transfer of training: A comprehensive literature review. *International Journal for Research in Vocational Education and Training, 3*(2), 127-165. https://doi.org/10.13152/IJRVET.3.2.4

Voskamp, A., Kuiper, E., & Volman, M. (2020). Teaching practices for self-directed and self-regulated learning: Case studies in Dutch innovative secondary schools. *Educational Studies*. Advance online publication. https://doi.org/10.1080/03055698.2020.1814699

Wetzels, M., Odekerken-Schroder, G., & Van Oppen, C. (2009). Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration. *MIS Quarterly, 33*(1), 177-195. https://doi.org/10.2307/20650284

Winne, P. H., & Hadwin, A. F. (2012). The weave of motivation and self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning* (pp. 309-326). Routledge.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice, 41*(2), 64-70. https://doi.org/10.1207/s15430421tip4102_2