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RESEARCH FACTORS AFFECTING STUDENTS' ACADEMIC RESULTS IN LEARNING PROJECT SUBJECTS ORIENTED CDIO IN VINH UNIVERSITY

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ABSTRACT

The teaching of CDIO-oriented courses in the form of project-based learning is a new direction to meet the social demand for high-quality human resources. The article aims to test the impact of the following factors: Learning motivation, Consistency in learning; Competition in learning; Learning methods; The university brand on the learning results of project subjects oriented to CDIO of Vinh University students. Quantitative research methods were used in this article with survey data of 200 students of diverse majors at Vinh University through analysis of linear structural model SEM. Research results show that 4 factors are affecting academic results in learning project subjects oriented CDIO of students at Vinh University, including 3 original factors: Learning Method, Consistency in learning, and University Brand and a new factor "will to learn" has a positive correlation with learning results. On that basis, some recommendations are made to affect the factors of the model, to improve the results in learning project subjects of Vinh University students, meeting all 4 pillars of the CDIO.

Keywords: Academic results of learning project subjects, CDIO, Project subjects oriented CDIO, Vinh university.

INTRODUCTION

CDIO is a model for improving training programs, helping to bridge the gap between training institutions and the labor market, and initiating educational reforms so that learners have comprehensive development of knowledge, personal and professional skills, and quickly adapt to the ever-changing professional working environment.

The goal of CDIO training is to help students acquire the necessary hard and soft skills upon graduation, to meet the requirements and demands of society as well as keep pace with the rapidly changing of real life. Good students can master and adjust their learning methods positively.

Outstanding features of the CDIO teaching method include Integrated learning and active experience; Providing highly skilled human resources. Concerning bridging the gap the training schools and the requirements of human resource users, the CDIO model helps with training to make parallel students' working capability with the necessities of employers.

Teaching in the form of a project-oriented CDIO approach is the construction of teaching contents in the form of survey articles on a certain field, helping readers to deeply understand a

topic being studied. From there, the project often points out the advantages and disadvantages of a problem, points out limitations, and proposes and recommends solutions.

The implementation of project subjects helps students and readers, who are unknown or unfamiliar with the area of the research project, to understand the problem in a general way. The course project offers the opportunity to undertake detailed, independent research on an issue under the guidance of an academic supervisor (lecturer). Currently, the implementation of Project subjects oriented CDIO in higher education programs is aimed at completing the requirements of the training program, conducting the in-depth investigation on a specific topic, focusing on several specific fields of a particular subject.

According to the current trend, the assessment of students' learning results is not limited to knowledge assessment. Students anticipate acquiring all the required skills from the university and using them while working during their carrier progress (Thu, 2015). And this assessment must be aimed at determining the level of achievement of the teaching objectives, which plays a vital contribution in improving the learning results of students. In other words, competency-based assessment is the assessment of knowledge, skills, and attitudes in a meaningful context (Pil, 2011).

For CDIO-oriented project subjects, the assessment of learning results is usually based on the four pillars of CDIO (Conceive – Design – Implement – Operate). To properly assess the learning/training results compared to the output standards, in the teaching process, it is necessary to influence students, help students form the necessary competencies, create breathing space for students to decipher difficulties status quo in real-life, from which, students can apply their knowledge, skills, and their own experience to complete learning tasks.

It can be seen that choosing and persisting with a CDIO-approach training method over the years is the right direction of Vinh University. Most of the school's staff and lecturers have properly realized the role and importance of innovating teaching methods according to the CDIO approach, contributing to improving training quality and meeting labor market needs.

According to previous studies, to influence academic results in learning project subjects oriented CDIO, the following factors can be considered:

Firstly, characteristics of learners, including Learning motivation; Learning Methods (Feldman, 2017; Nguyen, 2020); The degree of competition in learning (Kildea, 1983). These factors have a positive influence on the learning results of students' project subjects. Although for “Level of competition in learning” there is still much controversy about the positive and negative of competition.

Secondly, family conditions, studies showed that increased investment in learning also has constructively analyzed students' academic performance (Checchi, 2000).

Thirdly, the resources of universities, especially the university's brand name (Aaker, 1996; Balmer & Liao, 2007) have the effect of reinforcing students' confidence in learning, so the impact is indirect on student learning results (Tho *et al.*, 2009). In addition, factors such as facilities (Mushtaq & Khan, 2012; Phan *et al.*, 2020), scholarships (Omeje & Abugu, 2015; Vo, 2017) have a positive impact on the learning results of students in learning project subjects.

The application of teaching project subjects according to the CDIO approach at Vinh University in the past 5 years has brought many results. Most students feel interested in project-based learning. Many students highly appreciate the outputs of the courses, especially helping students discover themselves, form a teamwork style, develop critical and creative thinking, etc. However,



expectations for Project are still a gap between students' CDIO-oriented subjects compared to reality, mainly because students still do not highly appreciate the practicality of project tasks in comparison with professionals in real life. The teaching methods have not yet fully exploited the initiative, creativity, cooperation, and competition among groups of students in learning project subjects.

Based on an overview of related works, the study builds models and tests the factors affecting Academic results of learning project subjects according to the CDIO approach. In the circumstance of Vinh University, the investigation outcomes not only show that the learning motivation element has not yet had an impact on the student's learning results; or factors of Consistency in learning; Competition in learning and University brand name have a positive impact on academic results in learning project subjects oriented CDIO of students at Vinh University; but also pointed out a new factor "Will to study" that affects the Learning results of Project subjects oriented CDIO of students at Vinh University. These are theoretical and practical contributions, helping Vinh University and its lecturers have a more intuitive view of the current situation of factors affecting the learning results of the students of the Project subjects oriented CDIO, then there is possible to make adjustments to the output standards, curricula, detailed outlines, and teaching methods to influence and improve the academic results in learning project subjects oriented CDIO of students in the time ahead.

Hypotheses and Literature Review

Literature Review

The greater achievement of students is to acquire all the skills from universities. Students make every effort to arm themselves with what colleges have to offer to incorporate knowledge and experience. Students expect to learner all the necessary skills to survive during their carrier progress (Nguyen *et al.*, 2017). From the perspective of CDIO capacity development, learning results are not only the ability to reproduce learned knowledge but also the ability to creatively apply knowledge in different application situations. learning in a meaningful context (Pil, 2011). According to standard number 11 in the table describing 12 CDIO standards, student learning results include results in personal and communication skills, product, process, and system conceiving and building skills, as well as professional knowledge.

For the learning results of the project subjects, CDIO competencies are emphasized more in terms of product, process, and system creation skills, rather than knowledge and communication skills, and teamwork skills. This means that when completing the CDIO-oriented project subjects, learners must be able to demonstrate certain skills and knowledge acquired from both home and college while utilizing the experiences. Therefore, over the accomplishment of certain responsibilities in any circumstance, individuals be able to at once gauge the intellectual skills leadership skills and principles, and passions of learners. On the contrary, such knowledge and expertise assessment do not have to be the medium to measure the dimensions or the entire subject education program, because capacity is a synthesis and crystallization of knowledge, skills, attitudes, feelings, values, ethical standards, etc. are formed from many fields of study and the natural social development of a person.

For each student, academic results in learning project subjects oriented CDIO are influenced by many subjective and objective factors, they include:



Firstly, the subjective factors from the learner's side (student's characteristics), including Learning motivation; Learning Methods, and Competition in Learning.

Previous studies have shown that a student's good or bad academic performance largely depends on their learning motivation. Learning motivation can be distinguished into internal and external motivation. The motivation of each internal person is formed from the interest in learning activities to satisfy the need for knowledge (Pratama 2017). The external motivation is formed not by the self's interest in learning but by the enjoyment of learning results such as getting good grades, rewards, avoiding punishment, or pleasing someone. Those who go to school without learning motivation are like pedestrians who just go around without a destination (Luu *et al.*, 2021).

Regarding learning methods, Feldman (2017) said that higher education learning methods help students learn more effectively. According to Thanh Huong NHAC and Nguyen Binh Minh LA (2018), making a study plan, making a timetable for studying, learning about the project's goals before the project starts, finding a suitable learning method for each projects subjects (for example, reading all the materials guided by the teacher, actively looking for more reference materials, preparing lessons before going to class), thinking manipulation (including the ability to self-study, the record fully lessons according to their understanding, summarize and find the main ideas when reading documents, apply learned knowledge to practice exercises, practice...); Interactive learning methods (including constructive speech; discussion, group study; debate with lecturers; participation in scientific research activities...) help students to be more active and positive in learning project subjects (Jayanthi *et al.*, 2014). As a result, students can master the knowledge, master skills, and have the right attitude when performing the tasks of the project, the learning results are also better (Dinh *et al.*, 2018).

Regarding competition in learning, studies showed that individual competition plays an important role in human social relations. Many studies have shown that to achieve success in life, career, and social recognition, people need to work hard, which means they have a competitive orientation. However, there is still much debate about the positive and negative aspects of competition (Kildea, 1983).

Second, objective conditions include family conditions and school resources. According to Checchi (2000), family conditions affect children's ability to invest in education. Although for university students, there is relative independence and self-discipline, and responsibility for international relations, family resources still have a strong influence on students' learning results (Alshammari *et al.*, 2018).

Regarding the university's resources, studies also show that the university's brand name plays an important role for both students, families, faculty, and employers. Once students have an impression of a university, they perceive a university as having a good reputation, they tend to believe that this university has the quality and they will have many job opportunities after graduation. And they believe that the university will equip them with the necessary baggage in future work. This perception also helps them to strengthen their confidence in learning (Tho *et al.*, 2009). In addition, teaching facilities and scholarships are also influential and meaningful factors for students, stimulating students' desire to study and research (Mushtaq & Khan, 2012; Phan *et al.*, 2020).

Hypotheses



Learning Motivation and Academic Results in Learning Project Subjects Oriented CDIO

H1: There is a beneficial impact amongst Learning Motivation and Learning outcomes of students' project subjects.

Consistency in Learning and Learning Results in CDIO-Oriented Project Subjects

H2: There is a beneficial impact amongst Consistency in learning and the Learning results of students' project subjects.

Competition in Learning and Learning Results of CDIO-Oriented Project Subjects

H3: There is a beneficial impact amongst Competition in learning and the Learning results of students' project subjects.

Learning Method and Learning Result of CDIO-Oriented Project Subjects

H4: There is a beneficial impact amongst the University's brand name and the Learning results of students' project subjects.

University's Brand Name and Learning Results in CDIO-Oriented Project Subjects

H5: There is a beneficial impact amongst the Learning method and the Learning results of the students' project subjects.



The five hypothesis mentioned above are illustrated in **Figure 1**.

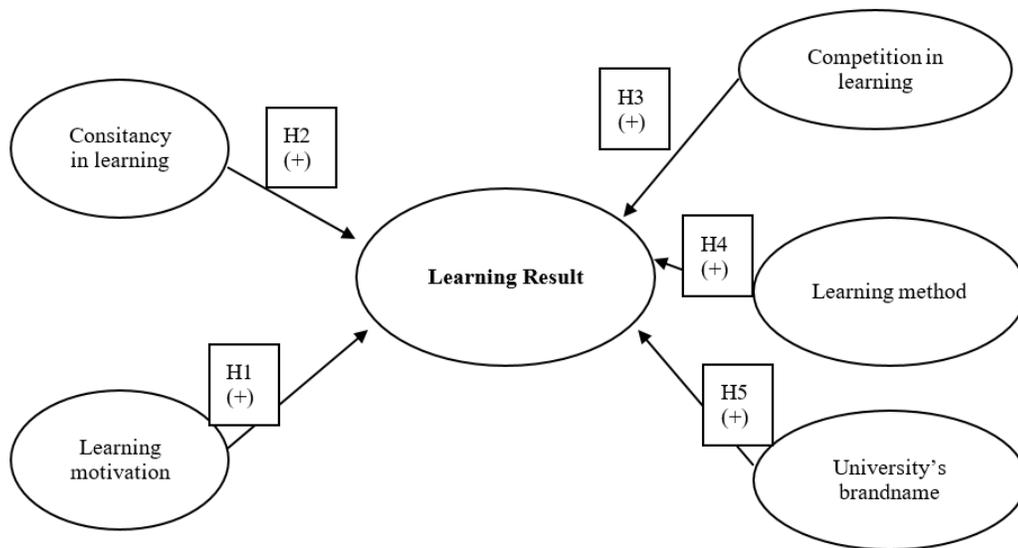


Figure 1. Theoretical model of the study

MATERIALS AND METHODS

Research Model and Scale

To build the research model, the article uses 6 concepts in the form of latent variables including:

- Learning result (KQ) with 04 surveillances figures (Young *et al.*, 2003), authors added the KQ5: “In general, I have learned a lot of knowledge, skills, improved professional attitude in studying project modules” to match the CDIO pillars
- Consistency in learning (KD) with 07 surveillances figures (Le 2016; Cole *et al.*, 2017)
- Learning motivation (DC) with 04 surveillances figures (Cole *et al.*, 2017)
- Competition in learning (CT) with 04 surveillances figures (Tho *et al.*, 2009; Thornton *et al.*, 2011)
- University’s brand name (TH) with 04 surveillances figures (Aaker, 1996; Balmer & Liao, 2007)
- Learning method (PP) with 14 surveillances figures (Nguyen *et al.*, 2016; Feldman, 2017)

The scale used to measure variables is a 5-point Likert scale, where: 1: very dissatisfied (Never) and 5: Very satisfied (Very often). Indicators for measuring variables are applied with adjustments following the trait of the research sample from preceding studies.

Based on the model of Checchi (2000), the article builds the basic theoretical model as follows:
 $KQ_i = KQ (DC, KD, CT, TH, PP)$

Research Sample

Non-probability sampling method was used to select the research sample, which is comfort sampling. Data are obtained thru stratified sampling relative to the major, academic year, and gender of students at Vinh University. Subjects in the study are students from the first to the fifth year at Vinh University. The 200-sample size collection was conducted thru the data collection process according to online surveying (by Google docs). The surveyed figure collected 200 persons, the valid surveyed figure is 200 persons, the invalid surveyed figure is 0 persons. Hair *et al.*, 1998’s research has shown that the predictable sample size is the slightest quintuple to the observed variable figure. The article actuality has 38 observe variable figures, which incorporate 190 as the least sample size. Compared with the samples figure of 200, the analysis requirements are met. The completion of the data assemblage period is between October 2021 and November 2021.

Data Processing

Using quantitative methods, the research was carried out. AMOS and SPSS programs process data after collection and cleaning. Initial, appraisal of the consistency of the scale with the requisite Cronbach's Alpha value greater than 0.7. Succeeding, study on investigative feature investigation EFA to assess "distinctive significance of the scale" and "converging value" and with the requisite of Factor loading Greater than 0.5; Eigenvalue of the factors Greater than or Equal to 1; KMO coefficient Greater than or Equal to 0.5 and Less than or Equal to 1; Sig value. Less than 0.05, and the percentage of variance extracted was Greater than 50%. Next, the AMOS program is used to measure the appropriateness of the study prototypical thru CFA test and lastly test the hypotheses of study by evaluating the SEM linear structure model with requires chi-square/df indices < 3 (Kettinger *et al.*, 1995); GFI, TLI, CFI > 0.8; RMSEA < 0.09 (Taylor *et al.*, 1993).

RESULTS AND DISCUSSION



Testing the Scale Consistency

When the Cronbach's Alpha coefficients of all variables are > 0.8 and < 0.95 (**Table 2**), the analysis outcomes of Cronbach's Alpha test indicate the consistency of the scale used in the investigation. This shows that all scales are built very well, with clear distinctions.

Table 2. Cronbach's Alpha coefficient through Assessment of the consistency of the scale

No.	Variables	Abbreviations	Cronbach's Alpha coefficient
1	Learning result	KQ	0.925
2	Consistency in learning	KD	0.920
3	Learning motivation	DC	0.820
4	Competition in learning	CT	0.930
5	University's brand name	TH	0.841
6	Learning method	PP	0.949

EFA

Because this study uses many scales of studies conducted in many different countries, they have not been evaluated qualitatively to confirm the meaning of terms and content of the scale. The results show that the questions in the survey are clear; students understand the content and meaning of each question in the proposed scales. To assess the relevance of the scale, the evaluation of the research continues through the EFA exploratory factor analysis tool.

The scheme of gauged scales will be by the exploratory factor analysis as follows:

- Promax rotation method using the Principal Axis Factoring Extraction
- Concerned about standards: Maximum Factor Loading of both Item Greater than or Equal to 0.5
- Standard of Attention: Both Item, the dissimilarity between the largest Figure Loading and any Figure Loading must be Greater than or Equal to 0.3 (Jabnoun & Al-Tamimi, 2003)
- The overall change removed Greater than or Equal to 50% (Anderson & Gerbing, 1988)
- KMO Greater than or Equal to 0.5, Barlett test has statistical significance ($\text{Sig} < 0.05$) (Nguyen *et al.*, 2009)

Table 3. Result of EFA analysis

EFA analysis	KMO index	P-value	Extracted Variance Figure	Load Figure	Conclusion
Independent	0.933	0.000	72.688	All > 0.5	Ensure analysis request
Dependent	0.854	0.000	77.583	All > 0.5	Ensure analysis request

With the dependent variable Learning result (**Table 3**), the analysis shows that the remaining data is entitled to audit with the Eigenvalue of the factors ≥ 1 , coefficient $1 \geq \text{KMO} \geq 0.5$, Sig value. < 0.05 , percentage of variance extracted $> 50\%$ and satisfying two conditions of "Discriminatory value" and "Convergence value".

Table 4. Independent and dependent variables for Rotation matrix in EFA investigation

Pattern Matrix^a

	Component				
	1	2	3	4	5
PP05	.996				
PP06	.915				
PP03	.800				
PP07	.793				
PP02	.773				
PP01	.750				
PP08	.719				
PP09	.706				
PP04	.704				
PP13	.690				
PP12	.655				
CT3		.852			
KD2		.849			
CT4		.834			
CT2		.781			
KD1		.671			
KD6			.896		
KD4			.841		
KD3			.743		
KD7			.587		
KD5			.539		
KQ				.918	
KQ4				.879	
KQ3				.788	
KQ1				.766	
TH4					.907
TH3					.841
TH2					.740

Method of Extraction: Analysis of Principal Component.

Rotation Method: Promax with Kaiser Normalization.

a. Variation converged in 7 restatements.

In the last EFA, there are 4 factors drawn (**Table 4**):

- Factor 1: PP1 → PP09, PP12 and PP13 → Name it "Learning method" (PP)
- Factor 2: CT2 → CT4, KD1, KD2 → Rename it "Will to study project subjects" (YC)
- Factor 3: KD3 → KD7 → Named "Consistency in learning" (KD)
- Factor 4: TH2 → TH4 → Name it "University's brand name" (TH)
- Overall variance withdraw (total described variation) is 73.634% (>50%) and KMO = 0.930 (>0.5), Bartlett test has statistical significance (Sig=0.00<0.05). Then, the hypotheses are re-established as follows:

H1: DELETED

H2: There is a parallel benefit amongst Consistency in learning and the Learning results of students' project subjects.



H3': There is a proportional relationship between the students' Will to study the project courses and the Learning results of the project subjects.

H4: There is a parallel benefit amongst the University's brand name and the Learning results of students' project subjects.

H5: There is a parallel benefit amongst the Learning method and the Learning results of the students' project subjects.

CFA

This research operates with four key principles to measure the model's fit with market data, explicitly Comparative Fit Index (CFI), Chi-squared, Goodness of Fit Index (GFI), and (RMSEA) Index. Greater than or Equal 0.8 model, RMSEA figures Less than, 1 Greater than or Equal to (CFI, TLI) Greater than or Equal to 0.9, then shows the good fit model (Figure 2).

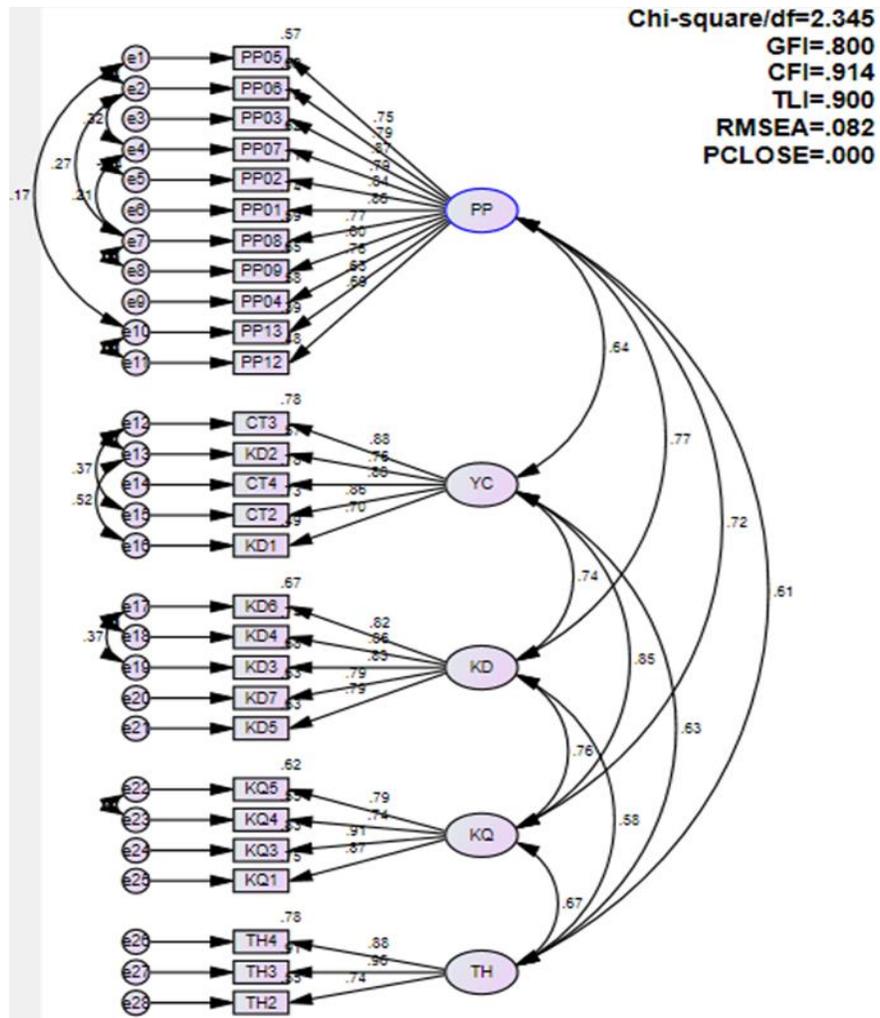


Figure 2. Model of factors affecting Learning results in learning project subjects of students at Vinh University

The critical measurement model has 328 degrees of freedom. The CFA outcomes outlined that the model achieves compatibility with the collected data Chi-Square/df = 2.345 < 3, which is suitable with sample size 200, GFI Equal to 0.80 (≥ 0.80); CFI Equal to 0.914 (≥ 0.90); TLI Equal to 0.90 (≥ 0.90); RMSEA Equal to 0.082 (< 0.09). This shows that the construction model is highly suitable.

The results of CFA analysis show that the normalized weights of the scale are all high (> 0.5) and all have statistical significance P-value = 0.0000, so the concepts have convergent values (Anderson & Gerbing, 1988).

SEM Analysis

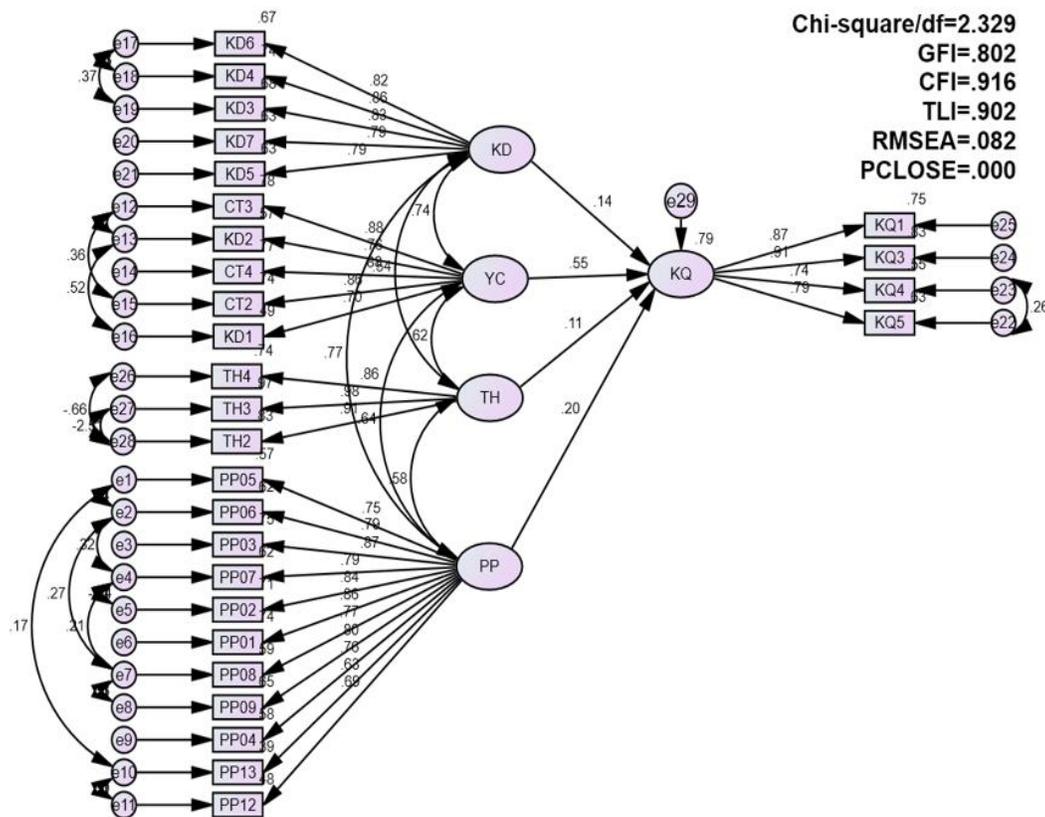


Figure 3. SEM Model

Composites index was discovered were agreeable in the examination of the SEM model that mentioned in **Figure 3** for the study model, explicitly, Chi-square/df Equal to 2.329 (Less than 3); P Equal to 0.000; GFI Equal to 0.802 (Greater than 0.8); TLI Equal to 0.902 (Greater than 0.9); CFI Equal to 0.916 (Greater than 0.9); RMSEA Equal to 0.082 (Less than 0.09) (Hair *et al.*, 2010).

The valuation outcomes of the connections in the model indicate the study model is appropriate; the significance stage of P Less than 0.05 is accepted with all the hypotheses.

Comparing the level of P in **Table 5** with the H hypotheses set out in Section 4.2, it can be concluded:

First, reject "H1: There is parallel impact amongst Learning Motivation and Learning outcomes of students' project subjects "because Motivation in learning variables (DC) have been removed from the model.

Second, reject "H2: There is parallel impact amongst Consistency in learning and the learning outcomes of the students' project subjects " by the value $P=0.137 > 0.05$.

Third, accept "H3: There is a proportional relationship between the will to study the project subjects and the learning results of the students' project subjects" by the value $P= 0\%$

Fourth, accept "H4: There is parallel impact amongst between University's product name and the Learning outcomes of students' project subjects" by the value $P=0.046 < 0.05$.

Fifth, accept "H5: There is a proportional relationship between the Learning method and the results of the Learning results of the students' project subjects" by the value $P=0.010 < 0.05$.

Table 5. Associations in the model SEM analysis outcomes

Hypothesis	Relationship	Weight	S.E.	C.R.	P	Conclusion
H2	KQ <-- KD	.113	.076	1.486	.137	Rejected
H3'	KQ <-- YC	.442	.070	6.341	***	Accepted
H4	KQ <-- TH	.082	.041	1.999	.046	Accepted
H5	KQ <-- PP	.178	.069	2.590	.010	Accepted

CONCLUSION

Based on an overview of related studies, the article builds a model and tests the factors that affect the Learning results of the project subjects according to the CDIO approach of students at Vinh University. The results show that the factors of Will to study, University's brand name, and Learning method have a positive impact on Learning results of CDIO-oriented project subjects. The initial factors including Motivation in learning and Competition in learning have not shown a positive correlation with Learning results. The research results have influenced the authors in making some recommendations for influencing and stimulating factors for academic results in learning project subjects oriented CDIO of students at Vinh University as follows:

First, for the Will to learn, lecturers need to encourage and promote the will to study and complete the project's tasks from individual students and groups. It is necessary to design tasks that are both challenging and encouraging, helping students to improve their skills, group skills, and critical thinking. In particular, it is necessary to focus on the practicality of the tasks and arouse interest in learning from students.

Second, for the University's brand name, the school needs to focus on building and strengthening the brand. Through the development of a CDIO-oriented training program, promoting project subjects with training links with enterprises, helping to build a reputation for training and a brand in providing exceptional human resources to both employers and students.

Third, for the Learning method, teachers need to encourage students to use a variety of active interactive methods, there should be a distinction between traditional learning methods, inverted and interactive learning methods, to help form and develop critical and creative thinking skills of school students. This requires investment in teaching facilities (online) in the context of the current epidemic, using many combined teaching methods, building reverse-project classes as

well as helping lecturers approach professional practice, design project tasks close to students' future job requirements.

Fourth, currently, the two factors Competition in learning and Learning motivation have not had an impact on the Learning result, showing that the project tasks have not created interest or the assessment of the project module has not been accurately assessed all the efforts and competition of individual students and groups in the class. This requires an adjustment in the detailed outline, a new approach, and the development of new assessment methods, ensuring an accurate assessment of the CDIO pillars in the CDIO -oriented approach project subjects.

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