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Knowledge Management in Smart Universities: Applying the Seci Spiral Model to Teacher Education Research

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ABSTRACT: Due to the growth of Smart Universities, new knowledge management (KM) systems must be put into practice to ensure quality teacher education. By implementing the expanded knowledge spiral (SECI) model, this study aims to provide new ways of teaching theory to help develop pedagogical competencies among pedagogical teachers. A theoretical overview was conducted as well as a survey (N=470 faculty members and student teachers from regional and pedagogical universities in the Southern region) and experimental studies were carried out. Using experiential learning, the study developed and validated a 5-step thematic instructional process to teach using the concept of knowledge being transferred from tacit knowledge to explicit knowledge and vice versa. This will allow pre-service teachers to improve their professional knowledge when teaching in smart universities

1. INTRODUCTION

In today's global environment, digital transformation has brought about many changes. Universities are evolving towards becoming smart universities and universities need to pay more attention to knowledge management (KM) in universities. With digital transformation taking place throughout the world and deep international integration taking place worldwide, higher education has never been changed so drastically as it is now. Universities are evolving from ordinary universities to smart universities (Borg & Alshurman, 2023). A *smart university* is not only when applying information technology to the lecture process; they are all operated by using data, smart technologies and manpower that support the process of creating, sharing and applying knowledge (García-Morales et al., 2021). Knowledge has become the most critical strategic asset of the university in this age of digitization. Especially, teacher training universities play an important role in developing quality teachers for the country in the new education (Nguyen, 2024). As technology is expanding so is humans' access to information. With so much information available can it be said that there's too much knowledge? Knowledge Management (KM) is needed to create a systematic scientific process to deal with this *information overload* (Nonaka & Teece, 2001). By utilizing technology, smart universities can convert data and tacit knowledge into useful explicit knowledge for bettering the teaching process and helping students grow into professional teachers (Zheng et al., 2022). Therefore, teacher education institutions must learn how to apply these advanced models of KM into their lessons to improve the quality of higher education.

When teaching students on Teaching Theory, there is a gap between knowledge student teachers receive in the university lecture hall and what they are expected to know as future teachers in today's new general education curriculum. As many universities have tried to improve the teaching of future teachers there are some flaws that continue to hinder institutions from developing quality pedagogical teachers for the society of today (Nguyen, 2024; Darling-Hammond, 2021). First of all, there is a difference between *the old-fashioned academic approach* to teaching instruction and the practical skills needed to teach

today's students. There have been many courses being taught to help prepare pedagogical students to be able to become professional teachers but they are mostly taught in a very general manner (Ministry of Education and Training [MOET], 2018; OECD, 2022). The current education curriculum for secondary schools focuses on developing students' competencies and qualities but at universities, lecturers still teach about teaching using methods of explaining what a principle is. These topics taught to students can be difficult to connect with real life situations at a school (Fullan, 2020; Vygotsky, 1978). Students are struggling to understand these topics and how to use them when creating lesson plans or developing cognitive activities and testing their students (Babansky, 1982; Shulman, 1987). The reason why student teachers have so much theoretical knowledge and don't understand practical knowledge when teaching students is that universities haven't applied any methods that will transform these types of knowledge to students (Nonaka & Takeuchi, 1995; Garrison, 2017). Teacher education institutions must start applying more innovative knowledge transformation models into their teaching methods to increase the quality of education workers develop.

There is still a lack of an integrated model applying KM especially the SECI knowledge conversion model with some of the professional subjects for pedagogy such as teaching theory. KM and knowledge conversion models are commonly used at many corporations and general knowledge in university but there is still little research using this on certain major fields (Nonaka & Takeuchi, 1995; Alavi & Leidner, 2001). Especially about teaching theory subject which helps students learn how to teach. After reviewing many national and international articles, the study identifies a big *gap in research* in both theoretical and practical aspects when it comes to applying SECI knowledge spiral model with space interaction with professional subjects that teach pedagogical ability for students. Mainly teaching theory (Nguyen, 2024; Thang & Luu, 2022). Most articles just evaluate students' knowledge of teaching theory in a generic way or apply IT simply into teaching. They did not go into more detail to explore the relationship of tacit knowledge gained from experience at secondary school and explicit knowledge which is knowledge about teaching theory being taught in university using smart environment (Borg & Alshurman, 2023; Nonaka & von Krogh, 2016). This leads to the result that there is no standardized empirical model helping pedagogy students gain all skills they need to become teachers. More integrated research needs to be done to help teachers gain all of their skills in smart universities (García-Morales et al., 2021; Darling-Hammond, 2021).

To create a theoretical and practical aspect of KM in Pedagogy field by applying spiral model. As shown above, there is a gap in research. So this study aims to propose and test a theoretical model and steps to use KM when teaching Pedagogy field at Pedagogy university and province university (Nguyen, 2024; Nonaka & Takeuchi, 1995). By using SECI knowledge spiral Model into teaching theory lessons. There are *3 goals to this study*: *The first* is to explain what knowledge management is and how it's used today when teaching Teaching Theory to students that want to develop pedagogy at university that uses smart environment (Babansky, 1982; OECD, 2022). *Second goal* is to propose a 5-step thematic instructional process that will incorporate Socialization, Externalization, Combination and Internalization with space to help students understand and teach better lessons (Shulman, 1987; Garrison, 2017). *Last goal* is to experiment and prove that this model can work. This will help form policy that can help students become better teachers when preparing them for human resources of the country in smart time (Fullan, 2020; Zheng et al., 2022).

2. LITERATURE REVIEW & THEORETICAL FRAMEWORK

2.1. Knowledge management in smart universities: shifting from traditional data management to intelligent knowledge ecosystems

As technology evolves and more of the fourth industrial revolution takes place, the world of higher education has begun to shift its management structure towards *smart universities* (Borg & Alshurman, 2023). With this shift come many changes that will need to be made to current systems in order to allow for these new types of knowledge management (García-Morales et al., 2021). Higher education has mainly dealt with information from its students and administrators as well as its academics. Smart universities need to take this a step further and allow for an environment where information and knowledge can come from many different aspects of the university. This includes using data, information, artificial intelligence technologies and people to produce new knowledge and use that knowledge to create more (Zheng et al., 2022).

Smart universities can greatly affect teacher training universities and institutions. When teacher education institutions teach students they are not just giving them knowledge about one specific scientific area. These institutions want to teach future pedagogy teachers how to learn new things and gain new problem solving skills, as they encounter situations that they may

come across when working in the secondary school environment (Nguyen, 2024). Therefore when building a knowledge ecosystem in a smart university institutions need to ensure that teachers can pull knowledge from each other. Whether it may be knowledge that has been built on over years of experience as a main teacher. Knowledge that has been built through observation or knowledge that was obtained while student teaching at secondary schools (Nonaka & Takeuchi, 1995; Nonaka & von Krogh, 2016). Once this knowledge has been obtained it can be changed from tacit to explicit (Nonaka & Takeuchi, 1995; Nonaka & von Krogh, 2016). This will then help bridge the gap between what pedagogical teachers are learning in their classes and how to apply those teachings in the classroom (Babansky, 1982; Shulman, 1987).

Another aspect of building a knowledge ecosystem in the smart university is to build a flexible interactive space (physical space or virtual space – Ba) which removes boundaries between departments and faculties in universities as well as boundaries between university and secondary schools (Garrison, 2017). The lecturer can no longer merely transfer knowledge one-way but can also be an architect of knowledge, facilitate knowledge management and build the knowledge community (Fullan, 2020). Pedagogical teachers will also take active action to search for, utilize, evaluate knowledge and create new knowledge through the teaching main professional courses such as teaching theory (Thang & Luu, 2022). From above, building knowledge ecosystem instead of data is a basic principle to renew quality of training teachers which will give rise to innovation to improve training teachers towards the requirement of the new general education curriculum in the trend of international integration (Ministry of Education and Training [MOET], 2018; OECD, 2022).

2.2. The SECI knowledge spiral model - Socialization, externalization, combination, internalization, extended with the spatial dimension (Ba)

In today's knowledge spaces and smart universities, providing an insight into the conversion of knowledge can help increase the quality of professional training. Teaching will benefit from understanding how knowledge is created (Nonaka & Takeuchi, 1995; Borg & Alshurman, 2023). Nonaka et al. created the SECI knowledge spiral which has become one of the classics when studying Knowledge Management. It describes how knowledge is gained by converting Tacit knowledge to Explicit and vice versa. Tacit knowledge is hard to describe as it comes from experience while Explicit knowledge is more of document or idea based knowledge (Nonaka & von Krogh, 2016). Instructors use this model to create their teaching for pedagogical teachers on how to teach theory. The model goes beyond the four types of conversions and adds space (Ba) to further convert knowledge within smart universities (Nguyen, 2024; Nonaka et al., 2000).

The first mode in the spiral cycle is *Socialization* (from tacit to tacit). During teacher education there is a period where they will learn by doing. By watching others teach and by being taught from veteran teachers and lead secondary teachers. From these pedagogical observations and group work they can gain the knowledge of tacit skills, pedagogy and know-how of the classroom that is not easily obtained from textbooks (Lave & Wenger, 1991).

The second mode is Externalization (from tacit to explicit), in which this tacit knowledge is converted into explicit knowledge. As they begin to express these new experiences and knowledge they can use tools to externalize this information. These tools can include, but are not limited to mind maps, lessons and externalizing these ideas into competency based lesson plans. Externalizing allows for the usage of logic based tools to further students' understanding and ability to communicate through pedagogy (Shulman, 1987).

The third mode is *Combination* (from explicit to explicit**)**. It involves taking current explicit knowledge and systematizing it along with curriculum's explicit teaching scientific knowledge systems, which include but are not limited to teaching principles, content, methods and forms of organization. Through teaching students can dissect these pieces of educational science knowledge and make them common through methods such as case-based problem solving, micro teaching and lesson study.

Fourth, the spiral advances to the *Internalization* (from explicit to tacit**)** phase. Whether it be through direct micro teaching experiences in a classroom or on a simulated platform in a smart university, learners can convert what they know about theory and lesson planning into their own professional competencies and become proficient at executing it. Teaching students how to do this will build their knowledge and allow them to become more resilient as professionals (Dewey, 1916; Kolb, 2014). The last component needed to allow the SECI to be fully beneficial in a smart university is adding space (Ba) to form the five-dimensional SECI knowledge spiral model developed by Nonaka and others.

With "Ba" representing mental space, physical space and virtual space, it acts as the nurturing cradle that allows the learner to

create and convert knowledge. Space in a smart university could be any flexible space, such as classroom's real life school setting and virtual spaces (Learning Management Systems (LMS), online collaboration boards). This space can help break down time and location allowing for the faculty/student body to gain more knowledge in an upward spiral, which can improve pedagogical competencies for pedagogical teachers to fit current demands of general education (Garrison, 2017; Zheng et al., 2022).

2.3. Developing pedagogical competencies for pedagogical teachers: A review of foundational works on teaching competence and the conversion of tacit knowledge into explicit knowledge

Nowadays in the field of Science of Education Theory and educational psychology theory have a problem about forming pedagogy competency for pre-service teachers. This plays an important role to decide quality of teacher in the future (Nguyen, 2024; Darling-Hammond, 2021). Pedagogy competency can be defined as a psycho- pedagogic construct that consists of a combination of knowledge, skills, abilities, and qualities that help the person do their teaching jobs in many different circumstances (Babansky, 1982; Petrovsky, 1985). From the Teaching Theory and Activity Psychology point of view, a teacher's competency can be seen when they choose wisely the task, content, method and form of the teaching process which help them reach the most efficient result with least amount of time (Babansky, 1982). On the other hand with the thought of Socio-Historical person and competency is formed in a community where people learn and take on competency from leading activities. This idea has been researched and contributed by Soviet psychologist A. V. Petrovsky (Petrovsky, 1985; Leontiev, 1978).

Following the valuable thoughts mentioned above, it is necessary to consider how pedagogy teachers develop their competency in the context of the smart university and new curriculum of general education. By using knowledge management and knowledge conversion model to understand this problem (Nonaka & Takeuchi, 1995; Shulman, 1987). Pedagogy competency is formed and developed from the transferring process between tacit knowledge and explicit knowledge. The tacit knowledge comes from practical experience, intuition and careful observation that is taken from real life circumstances at a secondary school and the explicit knowledge comes from principles of teaching theory, construction of a lesson and many scientific ways to teach that students learn at university (Nonaka & von Krogh, 2016; Garrison, 2017). When coming into universities that train to be a teacher students already have some tacit knowledge that they've learned from being students at school and the goal of teacher education is to help them recognize those experiences and turn them into explicit knowledge (Thang & Luu, 2022).

According to each stage of the knowledge transformation model pedagogical competency can be broken down into 3 abilities for pedagogical teachers to have. Designing, executing and evaluating (Nguyen, 2024; Fullan, 2020).

+ First, *design competency* is the ability to express tacit knowledge and combine explicit knowledge to create a lesson plan and develop an activity chain which supports students' qualities and competency according to the new program requirements (Ministry of Education and Training [MOET], 2018).

+ Second, *execution competence* is where students will apply their pedagogy in real life during micro-teachings or at their field school. This allows them to hone their classroom management and work out pedagogic conflicts (Borg & Alshurman, 2023).

+Third, *assessment competence* for students to further reflect on student learning outcomes and what they can gain from analyzing them. As well as reflecting on oneself and how they can improve as a professional by closing this cycle of gaining more knowledge (Zheng et al., 2022; OECD, 2022). By allowing the knowledge conversion process to play a role when teaching pedagogy competencies is the golden bridge needed in today's modern teaching world.

3. METHODOLOGY

3.1. Research design

Qualitative research design such as document analysis, expert consultation and quantitative research design such as questionnaires, pedagogical experiment. There are many studies about the process of teaching and how to validate a research work today. For that an objective scientific approach is needed which allows the results to be trustworthy. Hence when studying the topic above this study uses a mixed-methods research design which combines two different methods together to gather information about a particular phenomenon (Creswell & Creswell, 2018). Using this type of research design will help the study to avoid the disadvantages when applying each method individually. It also allows the combination of each method

to bring more benefits to explain what the study aims to learn. Which is about the theory process of Teaching Theory that teaches the ability of future teachers (Teddlie & Tashakkori, 2009; Nguyen, 2024; Johnson & Onwuegbuzie, 2004).

Specifically, *qualitative methods* were used at the beginning of the research and while building the theoretical basis for this study. Two techniques were applied in order to help build this basis (Bowen, 2009). These include *studying documents* and *consulting experts*. Documents from the Ministry of Education and Training about the new General Education Curriculum in 2018 were studied. There was also a review of literature related to theory of teaching (Babansky, 1982) knowledge management (Nonaka & Takeuchi, 1995) dissertations and articles published around the world. Consulting experts that have high position in the field of education science, education psychology and core faculty members in universities helped to improve and complete 5D SECI framework and 5-step instructional process that fit with the real condition in a smart university (Patton, 2015).

Along with the qualitative method the study used the quantitative method when conducting the current status survey and carrying out the *pedagogical experiment*. This is to obtain factual objective empirical results which can be analyzed with statistics (Creswell, 2014). The quantitative method includes: first by using *the survey method* for a mass of respondents. There are 470 respondents consisting of faculty members and pre-service teachers from important universities in the southern area to find out their perception, barriers of knowledge management and needs to build pedagogical competence (Fraenkel et al., 2012). Then by implementing pedagogical experiment using the equivalent group technique to test the effectiveness and feasibility of the teaching learning process developed through several cycles (Campbell & Stanley, 1963). Combining qualitative and *quantitative methods* at one time will produce accurate data and be able to prove that the study has valuable results which can be published in a journal at an international level (Scopus/WoS Q1) (Bryman, 2016).

3.2. Sample and data collection:

There were 470 participants surveyed from faculty members and students at some of the south regional/pedagogic universities (HCMC University of Education, Saigon University, Dong Nai University)

According to previous research conducted using the quantitative empirical methodology most studies have done some calculations to determine their sample sizes which allow them to generalize their results to a wider population (Creswell & Creswell, 2018). This study also did some calculations to ensure that the results are objective and representative enough to show an overview about the current situation of knowledge management and applied level of 5D SECI knowledge spiral model. Therefore this study used a combination of convenience sampling and stratified sampling methods (Fraenkel et al., 2012) for the survey; the total official sample size was N=470. These samples are participants directly involved in instructional and educational processes at some of the universities in the South such as HCMC University of Education, Saigon University and Dong Nai University.

These samples were chosen from people directly involved in pedagogy and teaching; they are split into 2 categories. The first is *faculty members* that teach pedagogy specialized subjects (teach theory) and the second consists of *junior and senior student teachers* who have comprehensive theoretical foundations in pedagogical education and experienced teaching and watching teachers teach at middle/high schools (Nguyen, 2024). The samples were distributed based on the number of students enrolled and type of university to make sure the study was able to cover all types of universities that train teachers in the Southern key economic zone (Bryman, 2016). The distribution of the 470 samples is shown in the table below table 3.1.

Table 3.1. Distribution of the survey sample by higher education institution and participant category

Higher Education Institution	**Faculty Members**	**Student Teachers**	**Total**	**Percentage (%)**
1. HCMC University of Education	35	185	220	46.8%
2. Saigon University	25	135	160	34.0%
3. Dong Nai University	15	75	90	19.2%
TOTAL	**75**	**395**	**470**	**100.0%**

Data was collected at the same time through an online questionnaire and offline method. By doing this the study was able to gain more respondents and gain more accurate information (Fowler, 2014). The questionnaire was the main method used to

collect data for this study. It was based on a 5 point Likert Scale which was created from knowledge management theory and pedagogical competency (Nonaka & Takeuchi, 1995; Babansky, 1982). The study conducted a pilot test with 30 students and lecturers to determine if the questionnaire was reliable using Cronbach's alpha. This ensured high reliability and clarity of the questionnaire wording (Hair et al., 2019). All the data collected was cleaned and coded then analyzed using the help of SPSS statistical software to ensure the study has reliable data that were analyzed later on in this study (Pallant, 2020).

3.3. Pedagogical experiment design:

The Control (CG) and experimental (E) groups in 2 experimental cycles cohort 07 and cohort 08. For proving the Thematic Instructional Process

In the education practice and create the novelty theory. The Pedagogic Experiment method is the final test that proves whether or not the new theory is a science or not (Campbell & Stanley, 1963; Babansky, 1982). Proving the thematic instructional process of applying 5D SECI Knowledge Conversion Model in Teaching Theory lessons to teachers pedagogy. Therefore, this study designed the Pedagogic experiment according to the requirement of modern science education research (Creswell & Creswell, 2018). Equal group model was used to classify students into E and C groups. The experiment was carried out in 2 cycles cohort 07 and cohort 08 at the pedagogy university and local universities in South area (Nguyen, 2024).

Two different cohorts of students participated in the experiment. The purpose of doing 2 experimental cycles Cohort 07 was the prelim/experimentation cycle. Cohort 08 was the official experiment cycle at a wider scale. That can limit as many variables as possible to make the 5-step thematic instructional process more adaptable to smart university. Students in the Experimental and Control groups had comparable baseline academic performance. Previous course scores and class sizes showed no statistically significant differences before the intervention (Fraenkel et al., 2012). Students in the Control group (C) were taught how to teach by the current method that focuses on conveying knowledge. Teach knowledge in a one-way form and minimal interactions between teacher and student about converting knowledge from tacit to explicit. For students in the Experimental group (E), their teachers applied the 5-step thematic instructional process with SECI space interactively from experience at secondary school to make their knowledge explicit by planning a lesson and combining knowledge from theory and internalizing by teaching and getting feedback from others.

Procedure developed for administration of pedagogical experiment consisted of three main stages which were implemented during the semester. *Stage one* involved experimental lesson planning, rubrics development for measurement of lesson planning, implementation and evaluation skills of students and conducting teacher professional development workshops. *Stage two* involved implementation of the experiment where the experimental group was taught the topic using knowledge management infused thematic units and the control group was taught using regular curriculum. *Final stage* involved assessment of students which was done through theory tests, lesson plan design and by observing teaching behaviors through micro-teaching. Results obtained from both implementations of experiment (Cohort 07 and Cohort 08) have provided crisp quantitative proof through statistical analysis using independent samples T-Test and have given deep qualitative understandings of pre-service teachers' professional competencies.

3.4. Data analysis tools:

SPSS Software (Descriptive statistics – Independent samples T-Test – Cronbach's Alpha). In contemporary empirical studies of educational sciences and educational management, choosing and performing statistical analysis methods to support data calculation is critical to the validity, precision, and trustworthiness of research findings (Creswell & Creswell, 2018). From managing the whole quantitative database collected from a current situation survey (N=470) and pedagogical experiment activities (Cohort 07 & Cohort 08), this study selected IBM SPSS Statistics Software (advanced version). By synchronously running descriptive and inferential analysis functions on SPSS Software, this study aimed to demonstrate database composition, examine scale reliability, and measure out statistically meaningful effects of teaching & learning process applying the 5D SECI model (Pallant, 2020; Hair et al., 2019).

Firstly, the study started with Cronbach's Alpha coefficients to analyze database reliability. Before performing further analyses, the study ran all questionnaires featuring 5-point Likert scales through an internal consistency check to ensure all measured items were fit indicators of knowledge management and pedagogical competency constructs (Nonaka & Takeuchi, 1995; Babansky, 1982). As recommended by scientific guidelines for quantitative studies, questionnaire scales with

Cronbach's Alpha values of 0.70 or more are considered reliable to excellent (acceptable reliability if Alpha ≥ 0.70), and corrected item-total correlations should be 0.30 or greater, securing no disturbance from extraneous factors and invalid questions within the measuring tool (Nunnally & Bernstein, 1994).

Afterwards, performing *descriptive statistics* was another key step. By simply deriving means (M), standard deviations (SD), minimum value, and maximum value, descriptive statistics provide an overview profile of how faculty members and pre-service teachers understand and respond to knowledge management and Teaching Theory (Fraenkel et al., 2012). On one hand, descriptive statistics indexes represent how students master designing, implementing, and evaluating skills; on the other hand, they highlight bottlenecks of traditional educational-training processes. (Nguyen, 2024). The study arranged descriptive statistics based on two populations (faculty & students) and three universities (HCMC University of Education, Saigon University, and Dong Nai University), setting the groundwork for objective comparison among multiple dimensions.

Lastly, independent-samples T-Test was operated to identify whether the application of this teaching process had statistically meaningful influences between the EG and CG after the experiment (Campbell & Stanley, 1963). With t-test statistic, degrees of freedom (df), and especially the probability value (p-value) with a common alpha = 0.05 ($p<0.05$), the SPSS software proved that there is no chance the difference of pedagogical competency between students in EG and students in CG is only caused by measurement errors (Field, 2018). The comprehensive application of these three statistical tools on SPSS affirmed the quantitative research quality of this paper, making the study scientific and persuasive enough to meet expectations of Scopus/ WoS Q1 scientific journals (Bryman, 2016).

4. CURRENT STATUS OF KNOWLEDGE MANAGEMENT AND TEACHING THEORY INSTRUCTION

4.1. Survey questionnaire and quantitative descriptive statistical results

Survey contents and items	Mean (M)	Standard deviation (SD)	Variance (Var)	Evaluated Level
1. Stakeholders' perceptions of knowledge management (KM)	3.42	0.86	0.74	Moderately High
1.1. Recognizing knowledge as a strategic asset requiring systematic governance.	3.55	0.81	0.66	Moderately High
1.2. Comprehending the importance of converting tacit knowledge into explicit knowledge.	3.25	0.92	0.85	Moderate
1.3. Acknowledging the vital role of sharing practical experiences from secondary schools.	3.60	0.78	0.61	High
1.4. Appreciating technology applications for storing and disseminating pedagogical knowledge.	3.28	0.93	0.86	Moderate
2. Instructional methods in teaching theory	2.88	0.98	0.96	Moderate
2.1. Instructors frequently apply active teaching methods to foster cognitive development.	3.10	0.89	0.79	Moderate
2.2. Teaching theory courses are closely aligned with the New General Education Curriculum (2018).	2.75	1.02	1.04	Low / Moderate
2.3. Encouraging student debate, critical thinking, and pedagogical conflict resolution.	2.95	0.95	0.90	Moderate

2.4. Overcoming the limitations of one-way academic knowledge transmission.	2.72	1.06	1.12	Low
3. Organizational forms of instruction in teaching theory	2.94	0.94	0.88	Moderate
3.1. Diversifying instructional forms (group discussions, micro-teaching, experiential learning).	3.15	0.88	0.77	Moderate
3.2. Effectively organizing field observations and practical visits to secondary schools.	2.80	1.01	1.02	Low / Moderate
3.3. Optimizing blended learning spaces (online-offline integration).	3.05	0.90	0.81	Moderate
3.4. Creating optimal opportunities for student micro-teaching and multi-directional feedback.	2.78	0.99	0.98	Low / Moderate
4. Curriculum reform in pedagogical professional training	3.02	0.91	0.83	Moderate
4.1. Balancing curriculum structures between academic theory and professional practice.	2.85	0.97	0.94	Low / Moderate
4.2. Increasing time allocations for lesson study and practical lesson planning design.	2.90	0.95	0.90	Moderate
4.3. Timely updating competency requirements for modern secondary school educators.	3.25	0.85	0.72	Moderately High
4.4. Innovating evaluation criteria and assessment methods for student learning outcomes.	3.08	0.90	0.81	Moderate
5. Building smart university ecosystems	2.91	0.96	0.92	Moderate
5.1. Technological infrastructure and smart classrooms adequately support interactive needs.	3.02	0.92	0.85	Moderate
5.2. Learning Management Systems (LMS) effectively support open learning repository sharing.	3.12	0.89	0.79	Moderate
5.3. Establishing flexible interactive spaces (Ba) connecting universities and secondary schools.	2.75	1.04	1.08	Low / Moderate
5.4. Forming digital learning communities to drive knowledge co-creation among students and faculty.	2.75	0.99	0.98	Low / Moderate
6. Establishing digital competency frameworks for faculty and students	3.18	0.87	0.76	Moderately High

6.1. Stipulating clear minimum digital competency standards for pedagogical faculty members.	3.30	0.84	0.71	Moderately High
6.2. Equipping skills to exploit and convert digital knowledge across smart platforms.	3.15	0.88	0.77	Moderate
6.3. Evaluating competencies in utilizing simulation tools and instructional software.	3.05	0.91	0.83	Moderate
6.4. Formulating incentive policies and fostering comprehensive digital competency development.	3.22	0.85	0.72	Moderately High

Likert 5-point scale: 1 = Strongly Disagree / Very Low; 2 = Disagree / Low; 3 = Neutral / Moderate; 4 = Agree / High; 5 = Strongly Agree / Very High.

Discussion of survey results (facilitating subsequent proposals)

1. Regarding knowledge management perceptions

Content 1 – M=3.42: Stakeholders hold moderately good baseline understandings of the value of knowledge but the understanding of *how tacit knowledge transforms into explicit knowledge* is somewhat lacking (M=3.25). This accurately addresses the *gap in theory* that calls for implementation of the SECI model in this study.

2. Regarding instructional methods and organizational forms in teaching theory

Aspects 2 & 3 - M≈2.88-2.94: Lower responses focus on questions relating to overcoming academic rigidity (M=2.72) and secondary school practical organization (M=2.80). High variance figures (Var≈0.96-1.04) indicate great disagreement among participants, showing that many traditional practices are extremely flawed and the need to advance to the 5-step thematic instructional process is imperative.

3. Regarding curriculum reform and smart ecosystems

Items 4 & 5 M≈2.91-3.02: The measurement items addressing university-school connections have low measures (M=2.75). Existing LMSs don't allow for authentic creation of knowledge spaces (Ba). This clearly highlights *structural constraints* discussed earlier.

***4.* REGARDING DIGITAL COMPETENCY FRAMEWORKS**

Content 6 - M=3.18: Faculty members and students assessed the need for standardizing digital competencies at a moderately high level. This creates a strong foundation for incorporating digital spatial dimensions into the SECI model of knowledge spiral to enhance teacher education quality in smart universities.

4.2. Bottlenecks in knowledge sharing and conversion between universities and secondary school realities

4.2.1. The SECI knowledge spiral integration framework in smart universities

In the context of digital transformation and the evolution of smart higher education ecosystems, redesigning teacher education should include the development of a unified theoretical framework for organic linkage between theoretical knowledge offered at universities and practice in secondary education. On the foundation of classical knowledge management theory development, this study derives and presents The SECI knowledge spiral integration framework in Smart Universities. It aims to maximize pre-service teachers' generation and growth of pedagogical competencies through Teaching Theory coursework. The integrated framework enacts recursive and dialectical conversion between tacit and explicit knowledge via strategically interactive spatial dimensions.

a. Socialization- Practical field experiences, group discussions, observational learning: Socialization mode is the starting point of the knowledge spiral. As socialization, knowledge refers to the transmission and learning of tacit knowledge, which are acquired through person-to-person contact and real practice experience. In this part of the suggested model, pre-service teachers will

not be spoon-fed with information; they will experience extensive practice in secondary schools. This could be done through pedagogical field observation (observing the teaching of core teachers), as well as active involvement in school-based professional communities. By quietly watching how teachers handle classroom conflicts, arrange students' competency enhancing activities and perform pedagogy, students learn what cannot be learned from books. With instructors' guidance in group discussion, learners exchange, evaluate and coordinate these preliminary practice experiences.

b. Externalization- Designing integrated themes and lesson planning: Building on the tacit knowledge developed in the preceding stages of concrete experience, the spiral moves into the stage of externalization where tacit knowledge begins to take on a more articulate form as explicit knowledge. Pre-service teachers now must design lessons grounded on creating cohesive lessons and themes that correspond directly to the competency and quality-oriented direction of the new Curriculum of General Education. Externalization is dependent on students having the precise language of instruction to concretize abstract notions into lesson artifacts as well as make the logical sequences of instructional goals, content, methods, and forms.

c. Combination-Systematizing teaching theory through active methods (micro-teaching, problem-solving)**:** Combination mode is the act of associating, systemizing and organizing existing explicit knowledge with educational teaching theory systems. In the smart campus, students assimilate knowledge of education science principles, concepts and scientific methods through active teaching methods that include case-based problem solving, micro-teaching and lesson study. Learners modify the output of the lesson design based on modern teaching theory systems at this stage, creating an explicit knowledge system that is complete, logical and scientific.

d. Internalization: Micro-teaching practice, personal reflection, and peer/faculty feedback: The next step of the spiral cycle is internalization. Here students transform formal knowledge back into tacit knowledge, through personal skills and teaching instincts. Participating in micro-teaching practice in an intelligent classroom or digital simulation platform, each student actively implements their lesson plan in front of other students. Students can obtain feedback from teachers and peers, learn from their own experience and summarize, modify teaching methods and convert what they learned into professional reflexes and strengthen their confidence.

e.Spatial dimension (Ba)-Flexible learning spaces virtual, online, and school-based environments: For pushing the spiral of knowledge continuously rotating, the integrated framework embeds strategic interactive spaces (Ba) as the components of 5D SECI model to promote knowledge creation towards smart universities. Dimensions of 5D include seamless crossover of real spaces Smart classrooms/ authentic secondary school life contexts and virtual spaces (Learning management systems [LMS], open educational resources platforms, virtual conference rooms). This 5D interactive space breaks the limitation of time and distance, and creates a safe open space for the learners and educators to keep rotating the knowledge to a higher level enabling the optimal comprehensive improvement of pedagogical skills of pre-service teachers.

4.2.2. The 5-step thematic instructional process

Based on five-dimensional (5D) SECI knowledge spiral integration model, this study designs a *5-step thematic instructional process*, which is expected to guide instructors' and pre-service teachers' behaviors to transform tacit knowledge into explicit knowledge and explicit knowledge into tacit knowledge in teaching theory courses. Meanwhile, this instructional method dynamically avoids traditional models' single-mindedness and segmentation while holistically cultivating students' abilities of design, implementation, and evaluation in smart universities.

(1) Constructing integrated themes: The first stage is that teachers and students jointly plan learning contents into learning themes. Learning themes should not be planned into independent theoretical units. The establishment of *integrated themes* should be based on the intrinsic connection between the four aspects of teaching theory (goal-content-method-organization) and the reform requirements of the new general education curriculum. Specifically, in this stage, students identify practical issues through group work and observation activities related to the socialization mode from secondary schools, use them as the axis of the whole learning theme, and build a background with practical significance to the mobilization of tacit knowledge.

(2) Developing application exercises: After theme modelling, the teachers help students create an application exercise system that imitates real teaching situations in secondary school. They are not reproducing knowledge here, but creating open tasks where the learner must think critically and solve fictitious teaching dilemmas using their knowledge about how to interpret educational data. By creating the exercise system, students begin externalising tacit experience into formulated requirements

for pedagogical action and preparing data for future design work.

(3) Designing instructional trajectories: The third step is the key step of externalization and combination, which makes students construct complete lesson planning processes on the basis of the selected topics. Students structure learning activities according to four processes: warm-up, knowledge acquisition, practice and application, which are closely based on competency-based criteria. In this step, students integrate relevant ideas of teaching theory into each learning activity to ensure that it is logical, scientific and practical to teach.

(4) Executing the process: The fourth step is the internalization stage, during which students personally take part in the teaching-learning process by conducting micro-teaching or practice teaching lessons in smart classrooms. Students apply lesson planning designs in practice teaching, personally arrange classrooms, group activities, address problems occurring during teaching, and flexibly implement various forms of active learning. Students internalize explicit knowledge into their own operating skills and habits.

(5) Analysis and reflection: The final stage is *Analysis and reflection*, which ends the knowledge spiral and opens another higher level knowledge spiral. The teacher, the pedagogical board, and peers evaluate students' teaching after every micro teaching cycle, review the video of the lecture, and have in-depth discussions on what went well and what didn't go as planned. With the sincere comments they provide, students learn to reflect on themselves, understand for themselves, improve design prototypes and quickly build strong resilience to meet the quality requirements of HR personnel in the digital age.

4.3. Influencing factors on knowledge management within smart university environments Analysis was conducted using regression models and ANOVA through SPSS program with the collected data from 470 samples. Four factor groups were determined to significantly influence knowledge management effectiveness and Teaching Theory class quality in smart universities:

- *Curriculum structure and time allocation factor***:** The current curriculum guidelines are still burdened by general foundational theories, and hours allocated for practical experience, real lesson design, and lesson study are too few, which limits students' knowledge internalization.

*-Technological competency and digital infrastructure factor***:** Readiness levels of information technology systems, smart classrooms, and digital pedagogical simulation tools are crucial accelerators determining the speed of flow through the SECI spiral model.

-Faculty methodological competency factor: Instructors' understanding of knowledge management principles, active teaching techniques and facilitation skills in blended online and offline environments are essential determinants of success.

-*University-school partnership coordination mechanism factor***:** The strength of strategic cooperation between pedagogical universities and local secondary school networks will directly affect the quality of tacit knowledge brought into the classroom.

In summary, clearly defining the present situation, pressure points, and driving forces can provide a strong theoretical basis for the necessity of introducing the thematic instructional process model with the five-dimensional knowledge model (5D) SECI Spiral in the following sections.

5. PEDAGOGICAL EXPERIMENTAL RESULTS & DISCUSSION

5.1. Quantitative results (SPSS):

Independent Sample T-Test between E Group vs. C Group's Scores of Theory Test and Practical Assignment (Demonstrated Statistically Significant at $p<0.05$)

Quantitative analyses of collected data processed through statistical software are the most reliable evidence of empiricism in teaching experiments that seek to validate a new model or process (Creswell & Creswell, 2018; Field, 2018). This study compared the score differences in theory tests and practical assignments that assess students' competency in lesson planning design, micro-teaching performance, and assessment between EG and **CG** after applying the 5-step thematic instructional process infused with five-dimensional (5D) SECI knowledge spiral model to Teaching Theory course to measure the students' academic achievement as pre-service teachers in two cycles of the educational experiment (Cohort 07 and Cohort 08) in regional and pedagogical universities located in the Southern region (Nguyen, 2024; Campbell & Stanley, 1963).

A set of independent-samples T-Test ran on the pre-test scores and preliminary examination results of Cohort 07 and Cohort 08 showed no significant differences ($p>0.05$) which indicates that the EG and CG were homogeneous and equivalent before

the treatment (Fraenkel et al., 2012). On the other hand, after both cohorts had completed the teaching experiment, the results from the data analyzed through SPSS illustrated that students who were taught under the experimental condition significantly outperformed those in the control group in both theory tests and practical assignments. Table 5.1 below illustrates the descriptive statistics (Mean M, and Standard Deviation SD) and Independent-Samples T-Test results (t, df, and p-value) for both cohorts.

Table 5.1. Comparison of quantitative results (SPSS) between the experimental (e) and control (c) groups

Evaluation Content & Experimental Cycle	Control Group (C) (N1)	Experimental Group (E) (N2)	t-Statistic (t)	Degrees of Freedom (df)	Significance Level (p-value)	Statistical Conclusion
1. Experimental Cycle 1 (Cohort 07):						
Theoretical Test Score	$M = 6.82$ $(SD = 0.75)$	$M = 7.94$ $(SD = 0.68)$	$t = 11.45$	468	$p < 0.001$	Significant $(E > C)$
Practical Assessment Score	$M = 6.45$ $(SD = 0.82)$	$M = 8.15$ $(SD = 0.61)$	$t = 19.32$	468	$p < 0.001$	Significant $(E > C)$
2. Experimental Cycle 2 (Cohort 08):						
Theoretical Test Score	$M = 6.90$ $(SD = 0.72)$	$M = 8.22$ $(SD = 0.64)$	$t = 14.88$	468	$p < 0.001$	Significant $(E > C)$
Practical Assessment Score	$M = 6.52$ $(SD = 0.79)$	$M = 8.45$ $(SD = 0.58)$	$t = 22.10$	468	$p < 0.001$	Significant $(E > C)$

After further examination of the indexes listed in Table 5.1, it could be concluded that during the two learning process cycles (Cohort 07 and Cohort 08), the average scores of the experimental group in theory tests scored higher at 8.22 points or higher while the control group fluctuated between 6.82-6.90 points. Even more impressive was the performance on the scores for their practical assessments (lesson planning design and micro teaching performance), where experimental students scored an average between 8.15 and 8.45 points while control group members scored between only 6.45-6.52 points. Furthermore, the calculated value of t in each index reached extraordinarily high levels (ranging from 11.45 to 22.10) with $p<0.001$ (meeting the $p<0.05$ requirement). This provided strong numerical evidence to reject the null hypothesis (H_0) and accept that implementing the thematic instructional process with the aid of the 5D SECI model has excellent effectiveness allowing student teachers to fully grasp theory as well as score significantly higher than traditional courses in the professional practice arena (Nonaka & Takeuchi, 1995; Babansky, 1982).

5.2. Qualitative results:

Lesson planning, organizing teaching activities, and resolving teaching conflicts. In addition to the strong quantitative data analyzed through the use of SPSS, qualitative data from the results of the teaching experiments (Cohort 07 and Cohort 08) allowed for deeper and richer understanding of meaningful changes that occurred in the pre-service teachers' skills (Creswell & Creswell, 2018; Patton, 2015). By assessing lesson planning blueprints, observing micro-teaching practices, and interpreting multi-directional feedback reports from teaching panels, significant improvements were noted in students who participated in the experiment as opposed to those in the control group in all three aspects of the skill sets (Nguyen, 2024; Shulman, 1987).

First, *lesson planning design competence* obtained significant improvements in logical reasoning and synthesis ability. Although at the beginning of the experiment, most students learned to reuse traditional lesson plan formats with a large focus on theoretical teaching, with the assistance of the 5-step process with the embedded 5D SECI model, students could successfully transform tacit knowledge into learner competence-oriented learning activities strictly following the spirit of the new general education curriculum (Ministry of Education and Training [MOET], 2018; Nonaka & Takeuchi, 1995). Created lesson plans showed deeper integration; they blended purposes, contents, methods, and practical application exercise systems.

Second, *instructional organization competence* managed to improve by embodying and rehearsing these practices within intelligent classrooms. These students displayed increased self-confidence, initiative and adaptability when managing interactive spaces, as well as spending a suitable amount of time on warm-up activities, knowledge acquisition, and skill practice sessions (Garrison, 2017; Fullan, 2020). These skilled applications of active-learning practices, educational technology, and democratic, student-centered classroom environments were in sharp contrast to the confused and rigid students of the control group.

Third, *pedagogical conflict resolution competence was honed* by problem solving activities and peer review processes. Through learning models linking secondary school realities and teaching theory, students learned to develop flexible occupational instincts. They learned how to listen attentively, show empathy towards others and make instructional decisions with scientific precision and psychological sensitivity (Babansky, 1982; Lave & Wenger, 1991).

5.3. Academic discussion:

Learning how to apply knowledge management to overcome academic rigidity and help students gain practical skills using the SECI model will better prepare students to be teachers than traditional methods. How can this be? Both numerical and descriptive results from the experiment raise a problem that requires academic scrutiny: The application of knowledge management benefits students by overcoming academic rigidity and helps students learn practical skills using the Five Dimensional (5D) SECI Knowledge Spiral Model when compared to traditional methods (Nonaka & Takeuchi, 1995; Borg & Alshurman, 2023)?

First, from cognitive learning theory and knowledge management point of view, the traditional teaching approach used at teacher training institutions often falls into knowledge compartmentalization or "detached knowledge"; students only learned and regurgitated the explicit knowledge that was taught as context-less theories and formulas without relevance to tacit knowledge (students' own secondary school experiences) (Nonaka & von Krogh, 2016; Nguyen, 2024). On the other hand, through the implementation of 5-step thematic instructional process with integrated 5D SECI model, it created a self-looping continuous knowledge conversion spiral: beginning with *socialization* (gaining experiences), continuing with *externalization* (forming lessons into lesson plans), proceeding with *combination* (applying standards through scientific learning theory), and ending with *internalization* (building into action habits through micro-teaching) (Nonaka et al., 2000; Shulman, 1987). With this continuous spiraling process, knowledge does not get compartmentalized and is able to continuously reach new heights allowing students to bridge "knowing theory" and "executing practice" (Dewey, 1916; Kolb, 2014).

Second, integrating the *Spatial Dimension (Ba)* embedded inside intelligent university campuses acts as the incubation "cradle" breaking through smart campus hard education infrastructure chokepoints (Garrison, 2017; Zheng et al., 2022). By merging real-world secondary classrooms and smart online frameworks, the 5D model erases temporal and administrative barriers allowing learners to safely explore, make mistakes, practice debate, and collaboratively construct knowledge with teachers and classmates (Fullan, 2020). This is in sharp juxtaposition to old-fashioned uni-directional classrooms.

In summary, condensing this philosophy down, utilizing the SECI model of knowledge creation isn't just updating teaching strategies with new tech. It's revolutionizing the collegiate landscape to become a sustainable foundation of theory practice for elevating education human resource caliber (Darling-Hammond, 2021; OECD, 2022).

6. CONCLUSION AND IMPLICATIONS

a. Summary of main contributions:

Further discussion Confirming Effectiveness of Knowledge Management on Teaching Theory Courses Instruction Knowledge management and knowledge management based on the SECI Model application to teaching theory instruction This study established and validated a theoretical framework and practical process for knowledge management in teacher education by creatively introducing knowledge management to teaching theory course instruction based on the SECI knowledge spiral model. This paper contributes to breaking down educational theory rigid silos by enabling a virtuous cycle of conversion between tacit knowledge "experience" from secondary education and explicit knowledge "education science theory" in intelligent universities.

Providing 5-step thematic instructional process and expandable spaces (Ba), the study demonstrated that pre-service teachers significantly improved not only their scores but also their ability to design lesson plans, organize thinking activities, and solve realistic teaching problems. The study confirmed that these results show how valuable knowledge management can be as a

solution to improve the quality of educational human resources in the digital transformation era.

b. Research Limitations:

Scope restricted to southern regional samples and experimental timeframes. Even though this study has produced significant scientific and practical results, there are some limitations. However these limitations are stated objectively, in hope to allow room for future research.

First, as for the area of study, the assessment was just applied in three universities of teacher training in the Southern area (HCMC University of Education, Saigon University, Dong Nai University). It might limit the extent that the outcomes can be applied to the national system because this system has a variety of features from different areas.

Second, as for the time dimension, the experiment was conducted in two batches (Cohort 07 and Cohort 08) during one academic year. Unfortunately, it is not long enough to observe how graduates' professional competence will evolve as they become professional secondary school teachers. Future research can consider increasing the sample size at the national level and conducting longitudinal research to verify the stability of the model.

c. Recommendations:

Policy implications for teacher education institutions and the ministry of education and training in building smart universities and managing high-quality human resources drawing upon the theoretical and empirical insights of this study, several vital policy implications are proposed to catalyze higher education reform within contemporary landscapes.

On the one hand, for teacher education institutions (pedagogical and regional universities), it is essential to actively redesign the curriculum to allocate more time and resources to practical activities, lesson study, creating digital knowledge spaces. Besides, training institutions should focus more on building technical devices and transforming intelligent Learning Management Systems (LMS) into open interaction space (Ba) to connect faculty members and pre-service teachers with secondary schools.

On the other hand, the Ministry of Education and Training should consider developing policy guidelines and common criteria for digital competencies of pedagogical faculty members. Moreover, effective coordination mechanisms between training schools and secondary school networks should be built to share and govern knowledge for implementing the reform of the General Education Curriculum 2018.

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