Towards a Framework for Deeper Learning in Smart Classrooms at Higher Education Institutions in China: A Conceptual Paper on Methodology

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Abstract. The research on deeper learning is gaining popularity, which has led to the publication of policy documents such as "Deeper Learning: Policies for 21st Century Education" in the US. Despite the fact that the 21st century emphasizes the use of ICT and the creation of many ICT-rich smart classrooms in China, there is a scarcity of studies on how deeper learning in smart classrooms could be facilitated, particularly in Higher Education Institutions in China. Hence, there is a need to develop and validate a framework for deeper learning in smart classrooms at Higher Education Institutions in China. Accordingly, this paper aims to describe the proposed research methodology, which is deemed most appropriate to realize the development and validation of a Framework for Deeper Learning in Smart Classrooms suitable for use in Higher Education Institutions in China. This proposed methodology capitalizes on Klerk's five-step methodology, which entails both qualitative and quantitative methods. In essence, Klerk's methodology enables the development of a proposed framework, comprising literature search, development of a draft framework, validation of the draft framework, adjustment of the draft framework to create the final framework, and final framework validation. The process is succinctly discussed and judiciously elaborated in this conceptual paper. [202 words]

Keywords: Deeper Learning, Smart Classrooms, Framework, China

1 Introduction

Deeper learning emphasizes the comprehensive application, analysis and evaluation of knowledge, and focuses on cultivating students' problem-solving ability, innovation ability, decision-making ability and other higher-order thinking skills, which is an important way to cultivate the skills of talents in the 21st century. China's Education Informatization 2.0 Action

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Plan states that a smart learning support environment should be built and a learner-centered, intelligent teaching support environment should be constructed [1]. Smart learning environments can deliver personalized learning resources and learning paths, as well as provide intelligent learning devices and interactive tools, so students' deep learning cannot be achieved without the creation of smart learning environments. In China, the smart classroom continues to be the paradigm of smart learning environments, incorporating a variety of advanced artificial intelligence technologies and digital devices, and has become the preferred type of classroom environment [2]. However, a literature review and field research found that although schools at all levels have carried out teaching practices based on smart classrooms, there are still problems such as formalization and mechanization, resulting in a lack of opportunities for students to be able to enhance their creative thinking skills and comprehensive ability to solve real-life problems [3]. The reason for this is probably the lack of "depth" in the current smart classroom teaching, i.e., most teachers integrate technology with classroom teaching at a shallow level without a deeper understanding of the theoretical basis, spiritual meaning, and core concepts of the smart classroom, which makes it difficult to achieve the purpose of cultivating students' competencies [4]. For this reason, providing a complete implementation framework for higher education institutions becomes the key to solving the problem of change. Based on this, this study utilizes Klerk's research methodology to develop a framework for deeper learning in higher education institutions under smart classroom and conduct framework validation with the aim of developing higher-order thinking skills of students and thus achieving meaningful learning.

1.1 Problem Statement

Deeper learning is the core goal and ultimate direction of the smart classroom, which influences the construction of the choice of the internal theory of the smart classroom and the external practice methods [4]. Existing works of literature concerning the topic of deeper learning theory from three perspectives: learning styles, learning processes, and learning outcomes, but have ignored the practical value, making it difficult to activate deeper learning effectively [5]. In practice, many researchers have tried to explore how to promote deeper learning effectively through various teaching strategies, including Team-Based Learning [6], Game-Based Learning [7], Blended Learning [8], Project-Based Learning [9], Problem-Based Learning [10], and Practical Learning [11]. While most of the research mentioned above utilized scaffolding to some extent, there are scarce studies that provide a comprehensive approach incorporating scaffolding for deeper learning.

Current research on how to conduct scaffolding in deeper learning is not rare, and one of the most generative studies is the Understanding by Design (UbD) framework developed by Stanford professors Wiggins and McTighe and others, who developed the UbD framework incorporating deeper learning concepts: it pursues student understanding and focuses on the development of transferable skills [12]. However, this framework scaffolds teachers' instructional design rather than student learning and is not suitable for direct student service. In accordance with the "Drawing on Backward Design" concept, Green et al. [13] have developed a set of scaffold assignment tools that provide students with a "Gradual migration from algorithmic problems of good construction to application problems of poor construction" (p. 142-158). His experimental results show that this scaffolding tool not only facilitates deeper learning of economic theory but also enhances students' transferability of the skill into the learning of other courses. In such a scenario, this study focused on students' homework rather than classroom learning. Therefore, many gaps remain regarding the development of a

model or framework that incorporates scaffolding to support students' deeper learning in the smart classroom.

1.2 Purpose of study

To promote the implementation of deeper learning, this study will propose a design to develop a framework for deeper learning in the smart classroom within the context of higher education in China and clarify the implementation strategies and steps for classroom teaching. This deeper learning framework will assist teachers in designing and teaching with scaffolds.

2 Literature review

In past research, deeper learning has been seen as a superior learning method to traditional methods, and many authors have strongly recommended that deeper learning be considered in the design of higher education programs for teaching [14].

2.1 Deeper learning

The concept of deeper learning was introduced by Swedish educational psychologists Marton and Säljö as early as 1976, which is also universally recognized as the origin of deeper learning [15][16]. Deeper Learning and Surface Learning were first introduced by Marton and Säljö as „deep-level processing learning“ and the term „surface-level processing“. Based on Bloom‘s Taxonomy theory, they analyzed the different learning orientations of students in reading texts and found that there are two approaches to learning to read texts. The first approach involves understanding the text as a whole, summarizing the main idea, and relating it to oneself. The second approach focuses on scrutinizing specific parts that may raise questions and attempting to retell them. The former is referred to as the „Deep/Deeper Learning Approach“ while the latter is known as the „Surface Learning Approach. Consequently, deeper learning and surface learning have begun to receive more and more attention and sparked discussion among education researchers as two levels of learning [17].

Subsequently, deeper learning becomes a distinct learning method in contrast to surface learning. Researchers [18][19]considered deeper learning as a form of cognitive processing that involves higher levels of comprehension and active learning, as opposed to low levels of cognitive processing, rote memory, and passive surface learning [20]. Further differentiation between these two learning strategies was summarized by Czerkawski (2014) [21] and are presented in Table 1 below.

Table 1. Learning Strategies for Deep versus Surface Learning

Deeper Learning	Surface Learning
Meaning Making and Comprehension	Reproduction and Repeat
Declarative Learning	Procedural Learning
Higher Order Thinking	Highly Influenced by Assessment
Meaningful Learning and Active Engagement	Engagement only when required
Intrinsic Motivation	Extrinsic Motivation
Knowledge Transfer	Difficulty connecting ideas to prior learning

Adapted from Czerkawski (2014)

Before 2005, research on deeper learning in higher education was very scarce [22]. During this period, deeper learning was not without the attention of scholars. Entwistle and Ramsden [20] expanded the meaning of deeper learning from mere information processing to a complex cognitive and metacognitive process, noting that deeper learning involves not only the organic connection of ideas, the search for principles, the use of evidence and logical arguments, but also the development of learners‘ monitoring of their own understanding. However, the purpose of surface learning is simply to cope with the task and to treat the course content as irrelevant pieces of information, resulting in a more limited learning process, especially rote memorization.

In 1987, Biggs further emphasized that deeper learning is the interaction between the individual learner and the teaching environment and established the 3P model (Presage-Process-Product) [19], which empirically demonstrated that the factors influencing deeper learning include not only individual factors, but also a large number of factors in the teaching designs, such as teaching objectives, teaching strategies, and assessment. In this model, deeper learning means that students are interested in learning content and actively seeking to understand it deeply. Conversely, surface learning means that students lack interest in the learning content and merely engage in emorization, without effectively integrating the new knowledge into their existing cognitive structure.

After entering 2006, there was an international wave of deeper learning in the field of education. The E.U. released the Core Literacy Framework for Lifelong Learning in 2006 [23], and P21 released the 21st Century Learning Framework in 2007 [24]. In 2010, the William and Flora Hewlett Foundation in the United States launched the Deeper Learning Strategic Initiative [25]. The long-term goal of the program is to have 80% of U.S. school students committed to deeper learning by 2025; in the short term, the program’s funding goal is to ensure that 8 million students are taught deeper learning skills by 2017. Additionally, in 2016, New Pedagogies for Deeper Learning (NPDL) was initiated by Michael Fullan, Joanne Quinn, and Joanne McEachen, which focuses on gathering teachers, school leaders, families, and policymakers together to find ways to transform teaching and learning and provide conditions that promote deeper learning [26]. In this period, the Hewlett Foundation coined the phrase “deeper learning” to express its concern that American schools are not effectively preparing students to meet the economic, technical, and sociological challenges of the future. The Hewlett Foundation identified six competencies [27] linked to deeper learning after assembling leaders in the education field to discuss these issues. Please refer to Table 2 for further details.

Table 2. Deeper Learning Competencies

Competencies
1. Master core academic content
2. Think critically and solve complex problems
3. Work collaboratively
4. Communicate effectively
5. Learn how to learn
6. Develop academic mindsets

Adapted from William & Flora Hewlett Foundation (2013)

These competencies as shown in Table 2 are applicable to higher education even though they were initially proposed for K–12 students and conventional classroom [22]. It is evident from the above that deeper learning not only focuses on the active involvement of students in the learning process and the strategies they adopt, but also on the mastery and transfer of higher-order skills. This study defines deeper learning as meaningful learning based on understanding and transferable application, which promotes the development of higher-order knowledge skills and the application of these skills in new contexts or the generation of new higher-order knowledge skills by deeply engaging students in the learning process and adopting advanced learning strategies in an appropriate manner. This definition has three main dimensions: a) deeper engagement in learning, b) adoption of higher-order learning strategies, and c) focus on the development of higher-order knowledge skills.

2.2 Deeper learning in smart classroom

The development of students' deeper learning cannot take place without the development of a smart learning environment since it may push individualized learning materials and learning paths as well as offer intelligent learning gadgets and interactive activities. The effectiveness of deeper learning is not satisfactory, despite the creation and deployment of smart learning environments in China's major universities [28].

Smart classroom is the materialization of smart learning environment and the high-end form of the digital classroom [29]. As an essential part of smart environment, smart classroom is a constituent part of smart education. With features such as openness, networking, connectivity, intelligence, and interactivity, smart classrooms can comprehensively record and mine, and analyze students' learning process data, effectively assess the learning process through these educational big data and provide learners with accurate learning evaluation; they can provide support for implementing personalized teaching and learning and promote the occurrence and achievement of deeper learning for learners.

He (2018) [30] contends that a smart learning environment is essential for the success of deeper learning. However, the smart classrooms that are currently being constructed, furnished, and employed with smart tools and gadgets have not yet enabled deeper learning to take place as we anticipate [31]. As a result, the extent to which smart classrooms can effectively support deeper learning remains largely unexplored.

3. Conceptual framework

3.1 Research questions

Based on the justifications in the preceding section of the literature review, the following research issues will be looked into in this study:

Research question 1:
How to develop the draft framework for deeper learning in smart classroom?

Research question 2:

How can we establish the validity and reliability of the Teacher Instruction Sheets for Deeper Learning that were created based on the framework developed in Research question 1?

Research question 3:

How do we gauge the effectiveness of the framework reflected in the form of Instruction Sheets for Deeper Learning as opposed to Conventional Learning?

3.2 Conceptual framework

The study aims to examine the impact of the independent variable, which is the types of learning, on the learning participation, learning strategy, and creativity of Chinese higher education students (dependent variable). Specifically, it investigates the use of Teacher Instruction Sheets for Deeper Learning (TISDL) in comparison to traditional learning. The conceptual framework utilized in this study is illustrated in Figure 1.

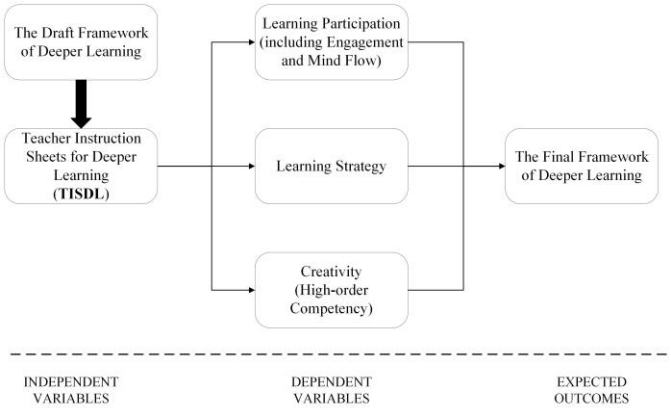

Fig. 1. Conceptual framework

4. Methodology

This section provides an overview of the methods employed to develop, validate, and evaluate a framework for promoting deeper learning in smart classrooms at higher education setting in China. Generally, three research methods will be employed: (i) semi-structured interview method to explore and identify the elements of deeper learning in smart classrooms, which will form the basis of the draft framework; (ii) open-end questionnaire will be used to assess the effectiveness of the TISDL; and (iii) a quasi-experimental approach will be utilized to validate the final deeper learning framework, and confirm its effectiveness.

4.1 Research design

This research adopts Klerk's five-step method as it is relevant for developing and validating a framework. Klerk [32] has outlined a five-step method for framework development, which comprises conducting literature search, developing a draft framework,

validating the draft framework, adjusting the draft framework to create the final framework, and validating the final framework. To validate the final deeper learning framework, implementation of the TISDL is essential during the experiment. Therefore, the whole process of developing the TISDL will be conducted before the fifth step of Klerk's method.

Klerk's method utilizes both qualitative and quantitative methods [32]. The qualitative method involves the use of semi-structure interview, while the quantitative method involves quasi-experimental design. Consulting experts can be helpful when deciding how to move forward with the results of evaluation and contemplation in education [33]. The semi-structure method provides a more comprehensive approach to data collection, enabling a deeper understanding of the topic under investigation. This approach is particularly effective when dealing with professors who are considered experts and value their time. Additionally, semi-structured interviews allow the interviewer to explore different areas of interest that may arise during the interview [34]. To elaborate further, the research process for this study is as follows:

4.1.1 Literature search

In order to construct a draft framework for deeper learning, this part of the study will search Chinese literature in CNKI with the keywords "深度学习/深层次学习" and "学习模型/教学模型/学习框架/教学设计. The English literature will search in Scopus and WOS using the keywords "deep learning/deeper learning/deep understanding/deep approach/deep strategy/deep learner/deep processing" and "learning/guidance/teaching" + "model/module/framework/architecture" as keywords.

After collection, the remaining literature was further selected based on the following criteria: 1) the topic of the literature is about learning design or instructional design; 2) it helps to facilitate the implementation of deeper learning and fits with some of the ideas of deeper learning. In addition, this thesis advocates the application of existing smart classroom and resources for deeper learning, and does not focus on their design issues, so entries in these two areas of literature were also excluded.

To ensure the accuracy of the collection, the author will read and discuss the whole literature with two students and finally retain the literature that two or three people considered to be eligible. In the process of reading and discussing, the three students also sorted out the assertions that were potentially informative for building a deeper learning design framework: if one person considered it informative, the assertion was retained to collect as many potentially valuable assertions as possible.

4.1.2 Development of the draft framework

The draft framework construction consists of three research phases. In the first phase, a rough sketch of the frame is established, outlining the design components of the framework. In the second phase, the steps that may be included within each design component are identified, along with the connections between these steps. In the third phase, each design component of the framework and its corresponding steps are defined and described, culminating in the creation of a descriptive document.

During the development of the draft framework, this study will consult with three experts. The consultation format is that of a face-to-face conversation. In order to ensure a common understanding of the concept of Deeper Learning, the authors will briefly introduce to the three experts about the concept of deeper learning and its architecture advocated by this study. Following the interviews, the potentially informative recommendations from the experts will

be compiled, and the draft framework will be constructed according to these recommendations.

4.1.2 Validation of the draft framework

The draft framework of deeper learning is determined based on the experts' perspectives through the semi-structured interviews. The interviews will follow the outline that will be developed using high-quality assessment criteria.

4.1.3 Adjustment of the draft into the final framework

The draft framework for deeper learning will be revised based on the experts' statements and the resulting new framework will be sent back to the previously interviewed experts. A check item, along with the expert's feedback from the interview will also be included to determine if the new framework addresses the issues they have identified. This process will be repeated until all experts agree that the new framework is comprehensive and addresses all concerns.

4.1.4 Develop the Teacher Instruction Sheets for Deeper Learning

This step aims to address the research question: How can we establish the validity and reliability of the Teacher Instruction Sheets for Deeper Learning. To this end, this phase will develop a deeper learning scaffold - Teacher Instruction Sheets for Deeper Learning (TISDL) - based on the new framework of deeper learning in smart classrooms. Given that the deeper learning framework is already well-guided and operational, this part will directly refer to its concept to build a draft of TISDL and then invite excellent teachers from Xinyu University to participate in the trial work and make iterative corrections based on the suggestions from the trial feedback, and the revised deeper learning sheet will be evaluated by these teachers in terms of quality to form a final version that can be delivered and implemented. The revised deeper learning sheets will be quality-assessed by these faculty members to form a final version that could be implemented. In addition, the process of teachers' instructional design in the deeper learning sheets is also the process of practising the draft framework of deeper learning framework. So partly, it could also be an opportunity to assess the practical usefulness of the deeper learning framework.

4.1.5 Empirical evaluation of the final framework

This step aims to answer the research questions: How do we gauge the effectiveness of the framework reflected in the form of Instruction Sheets for Deeper Learning as opposed to Conventional Learning? Therefore, this study will conduct class experiments to test its effectiveness with data. Based on the characteristics of Deeper Learning, this study will examine the effectiveness of Deeper Learning in four dimensions: deeper engagement, deeper learning strategies, higher-order knowledge development, and transfer applications. In this class experiment, lecturers will apply the Teacher Instruction Sheets for Deeper Learning to their instructional design and apply them to the smart classroom as scaffolding, so the class experiment process is also a process to verify the effectiveness of the Deeper Learning framework.

In general, Klerk (2018) [34] has outlined a five-step method for research, and this method enables the development of a new framework. Based on the research questions, the

present study will be conducted in three parts and six steps, as shown in Table 1:

Table 3. The relationship between questions and methods under Klerk's five-step method

Questions	Methods	Klerk's method
Part 1 Q1. How to develop the draft framework for deeper learning in smart classroom in China?	Collect, analyze, and organize existing articles on Deeper Learning and Deeper Learning framework.	Step 1: literature search
	Consult three experts who hold the title of professor and have over ten years of teaching experience.	Step 2: development of the draft framework
	The draft framework constructed in the previous step is validated by conducting semi-structure interview with five instructional design experts.	Step 3: validation of the draft framework
	The final framework is established based on the draft framework which has been adjusted according to the calibration results.	Step 4: adjustment of the draft framework to create the final framework
Part 2 Q2. How can we establish the validity and reliability of the Teacher Instruction Sheets for Deeper Learning that were created based on the framework developed in Research question 1?	Inviting two experts who were involved in the development of the draft framework (out of 3 experts) to review the TISDL draft. Subsequently, inviting 11 lecturers to participate in the trial and final quality assessment of the TISDL through an open-ended questionnaire	Step 5: Develop the TISDL based on the final framework developed in step 4.
Part 3 Q3. How do we gauge the effectiveness of the framework reflected in the form of Instruction Sheets for Deeper Learning as opposed to Conventional Learning? Q3a: Does TISDL active students' deeper engagement? Q3b: Can TISDL lead students to adopt deeper learning strategies? Q3c: Does TISDL promote the development of higher-order knowledge? Q3d: Can TISDL make students understand and transfer concepts deeply?	Through the quasi-experimental method, the four scales - SCS (Smart Classroom Inventory), SES (Student Engagement Scale), FSS (Flow State Scale), and R-SPQ-2F - along with 1 CDWR rubric, will be used to answer those questions.	Step 6: Empirical evaluation of the final framework

4.2 Data analysis

4.2.1 Qualitative Data Analysis

Among the methods of qualitative research, thematic analysis has been widely used to analyze interview data. According to Braun and Clarke (2006) [35], thematic analysis is a method used to "identify, analyze, and report patterns (themes) in data". (p.77-101) This rigorous method of data analysis is often used to answer specified research questions and often leads to some very insightful aspects [36].

Bazeley and Jackson (2013) [37] note that NVivo is helpful for managing data and ideas, querying, visualizing, and reporting from data that is recorded. With the application of the software, researchers often have a whole new perspective on the data, information that would generally have been ignored without the use of the software.

All interviews will be recorded on the mobile application "Voice Memos". At the same time, the researcher records the results of the interviews by means of field notes, including gestures and expressions that could not be represented within the digital recordings. At the end of the interview, the researcher thanks the participant and informed him/her that a follow-up interview might be scheduled in order to triangulate the data or perform bias exclusion.

The complete interview recordings will be imported into NVivo. Importing of the interview recordings will be done immediately after each interview. After importing, the recordings are then analyzed by NVivo to try to identify themes that had not been focused on. The strength of the software is that it helps researchers quickly identify common perspectives during the interviews [38].

4.2.2 Quantitative Data Analysis

This study will use statistical analysis software for social sciences (SPSS 25.0) to conduct the third research question: How do we gauge the effectiveness of the framework reflected in the form of Instruction Sheets for Deeper Learning as opposed to Conventional Learning? Between the two groups, the experimental group (Group A) and the control group (Group B), a one-way ANOVA on students' engagement, mind flow levels, and learning strategies on the process of experiment in the smart classroom, and an ANCOVA on the creative produced at the end of the experiment. More specifically, ANCOVA will be used to answer the first two sub-research questions posed in the third question, and the third sub-questions will be analyzed by using to exclude the interference of creative experiences. In order to further investigate the influence mechanism of the TISDL, the last sub-question of this study will be analyzed by multiple regression to answer the third question of how much each factor of interest contributes to the development of creativity level.

5 Conclusion

This research plans to develop a deeper learning framework toward 21st competencies in China, by Klerk's five step method. This conceptual paper is the incipient article produced from the research. It highlights the problem statement that there is scarce research focus on how to provide a framework with a scaffold for students' deeper learning in the smart classroom. The *"Deeper learning"* concepts are also discussed. Future publications that come from this research will go into greater detail about the methods utilized in the experiments, the administration and instruments used for the surveys, the descriptive and inferential results, and

the managerial implications of this research. The findings of this study will help implement and improve the design of instruction in smart classrooms in order to improve students' competencies.

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