

Design and implementation of teaching excellence knowledge-based systems for technical and vocational school teachers: a cognition apprenticeship perspective

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ABSTRACT: The main aims of this study were to integrate the concept of *cognition apprenticeship* into teachers' professional development activities; to develop a teaching excellence knowledge-based system (TEKS) for technical and vocational school teachers; to design action plans, such as distance teaching, community practice models, peer coaching and collegial supervision; diagnostic teaching practices; and to investigate technical and vocational school teachers' cognitive changes in the teaching profession. To achieve these aims, this study involved the action research method, and established TEKS for technical and vocational school teachers, so as to investigate eight technical and vocational school teachers as research subjects. The research tools were interviews, Problem Vignettes (PROB), focus group standardised protocol, and teaching portfolios, to collect teaching-related data. For data analysis, the critical incident technique (CIT) was utilised, to understand the concept of action plan development for technical and vocational school teachers, and the changes enacted.

INTRODUCTION

The gap in the quality and quantity of the industrial labour force in Taiwan continues to increase. In addition, due to the influences of higher education expansion, decreases in the vocational high school admission rate, and the significant reduction in the birth rate, the number of technical and vocational schools increased from 46 to 149, and the ratio of technical and vocational school students to general college students was 4.98, and 5.02 in the 2007 academic year. The ratio of vocational high school students to high school students changed from 7:3 eight years ago, to 4.5:5.5 in the 2007 academic year. In other words, the number of technical and vocational schools has increased, whereas the number of students has decreased. Moreover, an urgent need by industry for industrial labour has a significant influence on the pursuit of teachers' teaching excellence in technical and vocational schools [1].

In recent years, the development of the college teachers' teaching profession has attracted the attention of colleges all over the world. In Taiwan, with the promotion of teaching excellence projects and top university teaching programme policies by the Ministry of Education, each college has begun to establish units such as centres for teaching development and faculty development and instructional resource centres. The main purpose of these units is to develop individual schools' features; handle relevant training programmes or workshops for novice college teachers and teaching assistants; offer consultations to teachers regarding teaching problems, and so on, to improve college teachers' level of teaching profession, as well as to improve their growth in the teaching profession [2].

The concept of cognition apprentice suggests that learners can learn from practical activities at the workplace with counselling and guidance provided by other teachers, and places emphasis on the cultivation of learners' contextual thinking. Through teaching strategies based on the learner-oriented cognition apprenticeship, which includes teaching activities, such as demonstrations, guidance, provision of scaffolding, gradual removal of obstacles, explanations, reflections and investigations. Students are cultivated to become learners with abilities in independent thinking and problem-solving [1-4]. In response to the diversity of industrial environments and availability of student resources in future college education, teachers will face increased challenges in teaching strategies and teaching methods. The establishment of TEKS for technical and vocational school teachers, and the practical application of its teaching strategies, are issues worth investigating [3-5].

In terms of the factors affecting the successful teaching careers of teachers, and in addition to teachers' abilities in understanding students' prior knowledge and the learning problems they may encounter, teachers' application of teaching methods and strategies have an important role [5][6]. Relevant mechanisms for improving teachers' teaching excellence can be divided into four major categories, namely, distance teaching, community practice models, diagnostic teaching practices and peer coaching with collegial supervision [7-11]. This study integrated the cognition apprenticeship theory into the development of professional teaching activities, to develop TEKS for technical and

vocational school teachers. Action research was conducted, and experimental results were analysed to investigate the concept and transformation of teachers' participation in TEKS for technical and vocational school teachers, in order to respond to the implementation of teaching excellence award schemes, and the development of effective experimental schemes for improving technical and vocational school teachers' metacognitive abilities for teaching excellence.

Based on the research motivations above, the aims in this study were:

1. To develop a course design where the cognitive apprenticeship theory is integrated and, thus, develop TEKS for technical and vocational school teachers.
2. To investigate cognitive insights and implementation outcomes of teaching professional developments upon the participation of technical and vocational school teachers in TEKS.

METHODS AND IMPLEMENTATION

Research Method and Subjects

The subjects were eight technical and vocational school teachers. For the purpose of effectively developing TEKS for technical and vocational school teachers, this study integrated the cognitive apprenticeship theory into teachers' professional developmental activities, to develop the TEKS action plans for technical and vocational school teachers. The implementation outcome was analysed and technical and vocational school teachers' cognitive insight in teaching excellence was investigated.

Ideas for the Establishment and Implementation of TEKS for Technical and Vocational School Teachers

This study integrated the four components of the cognitive apprenticeship theory into the course-design concept to design professional teacher development activities, as based on TEKS for technical and vocational school teachers and viewed from the perspective of the required metacognitive abilities listed in the teaching excellence award scheme. The theoretical foundation, content components, method components, social situation components, and programme components for the establishment of TEKS for technical and vocational school teachers were described as follows:

1. *Theoretical foundation*: this study integrated the theoretical foundation of the cognition apprenticeship theory into the course-design concept, to develop TEKS activities for technical and vocational school teachers. The theoretical foundation included conceptual learning, scaffolding learning, co-operative learning, situational learning and elaboration learning.
2. *Content components of the cognitive mechanism*: according to the cognitive apprenticeship model, as first proposed by Collins, Brown, and Newman, experts and teachers should possess content components, such as field-specific knowledge, problem-solving and practical experience strategies, control strategies and learning strategies [12]. With the implementation of distance teaching, the community of practice models included peer coaching and collegial supervision, diagnostic teaching practices, and professional teacher development activities, such as aspects of quality teaching, quality teacher hall of fame, professional e-teaching and a teaching excellence reading club.
3. *Method components for implementation*: method components referred to the teaching methods that conveyed integrative knowledge to teachers, such as demonstrations, guidance, scaffolding and removal, connections, reflections and exploration. Applied in this study were programmes for TEKS technical and vocational school teachers, including development, implementation, evaluation and amendments, as based on the method components, to systemically present methods of teaching excellence and, thus, achieve the implementation.
4. *Social situation components of the implementation methods*: social situation components referred to the training courses of content components. The implementation method for social situations, in this study, was the cognition apprenticeship system. The implementation methods of this action plan can be adjusted according to situations in practical teaching environments. Mechanisms, such as situational learning, development of co-operative mechanisms, cultivation of expert implementation, development of competitive mechanisms and intrinsic motivation were put into practice. Action research was conducted on aspects of quality teaching, the e-teaching profession, quality teacher hall of fame, teaching excellence reading club, instantaneous instructional supervision, taken from the perspectives of teachers, expert teachers, school supervisors, peer teachers and professors of teacher counselling groups so as to understand teachers' cognitive development.
5. *Programme components of data collection*: programme components referred to the order of presentation during teaching, including increasing complexity and increasing diversity, where the overall presentation was presented prior to the presentation of local skills. The design of data collection and assessment tools was developed based on programme components, including Problem Vignettes (PROB), focus group standardised protocol and a teaching portfolio.

Research Tools and Data Analysis

Various research tools were applied in this study, for example, interviews, Problem Vignettes (PROB), focus group standardised protocol, reading feedback, teaching strengths and weaknesses analysis form, expert teacher teaching

feedback, a teaching observation feedback form, a self-assessment of teaching ability form, classroom recorded observations form, reading club activity record form, reading club feedback form, concept map and teacher perception scale, a form to collect teaching-related data. To perform data analysis, CIT was applied; and modified to provide constant comparative analysis applied to the qualitative data.

RESULTS AND DISCUSSION

Analysis of the Development of Distance Learning for Technical and Vocational School Teachers

It was found that technical and vocational school teachers could obtain teaching materials from the curriculum-on-demand network system for distance teaching, and then control the teaching content presentation according to individual learning speed, which allowed students to receive the training according to their individual needs and time. This research result is consistent with that obtained from the study conducted by MacMillan, where a computer mentoring model was utilised to develop a technical and vocational educational curriculum to instruct experts in information technology how to act as mentors, and to expand the number of expert teachers giving instructions to novice teachers through the Internet, which effectively combined expert teachers with computer technology to establish a learning network [7]. The interviews were summarised as follows:

- The school uploads training activities to the network, which is convenient for teachers interested in receiving such training, but due to commitments are unable to attend scheduled training (A4).
- The convenience of e-learning renders lifelong and autonomous learning an inevitable trend and the mainstream of teachers' further education (B1).

Analysis of Development of Community Practice Models for Technical and Vocational School Teachers

It was found that the community of practice models for technical and vocational school teachers utilised methods, such as teachers' participation in training, further education activities, education reform and peer coaching, to implement professional teacher development activities. The teachers' role in the interactions between social cultures and schools' organisational culture is to effectively teach students in the school classrooms for the implementation of social cultural activities [13][14]. In addition, teachers in their role of teacher, are able to perceive professional insights, such as professional knowledge, skills and service attitude during the implementation of teaching in a community of practice models and interpersonal interactions, which assists them to perceive and monitor self-oriented learning abilities. Therefore, to improve teachers' perceptions of efficacy during the development of the teaching profession is an important factor in achieving teaching excellence. The interviews are summarised as follows:

- *I think that the main purpose of the community of practice models is to determine one's own ability. Teachers can perceive an inspiring statement or common experience through reading and community practice models, and find their own stories, which helps them to cultivate themselves, and arouses the interest of learning in students given sufficient environmental stimuli and thinking space (F2).*
- *Teachers can read, discuss, and share their feelings and teaching experiences in a reading club. A reading club enables teachers to learn what is not taught at schools, to develop innovative ideas, and to share their knowledge and experiences with others (H5).*

Analysis of the Development of Diagnostic Teaching Practices for Technical and Vocational School Teachers

It was found that, during diagnostic teaching practices, technical and vocational teachers attempted to include student interactions and classroom management into teaching; however, the function was not brought into full play. The reason was that teachers' participation in teaching activities, such as practical teaching situations or teaching observations, where systemic teaching design and teaching preparation were required, had a positive influence on their teaching excellence.

Technical and vocational school novice teachers' development of practical knowledge was affected by the early learning experiences and educational ideas, among which practical teaching experience was a key factor affecting the development of practical knowledge. Teachers' teaching content included four interactive knowledge entities, their understanding of students, teaching knowledge, teacher role knowledge, and situational teaching knowledge, which were affected by their former experiences, practical teaching experiences, teaching problems, and suggestions generated from aids applied during the development of the course. Among them, was a great difference between former and current teaching experiences, resulting in a constant compromise [12][17][18]. The interviews were summarised as follows:

- *I recorded my teaching and asked my colleagues or senior teachers to review it and offer suggestions on amendments. This method does not interfere with either the teacher or the students, and can improve teaching (G1).*
- *To teachers, diagnostic teaching enables them to reflect on the appropriateness of course design and teaching activities from another's perspectives (E3).*

Analysis on the Development of Peer Coaching Meetings for Technical and Vocational School Teachers

It was found that teachers' participation in meetings on collaborative peer coaching helped them to understand their reflections and provide consultations to other teachers. Teachers may further transform their teaching concepts through reflections on their professional beliefs [12][13]. Teachers understand the duties required at their workplace, as seen from the practical situation in schools, and it is necessary for expert teachers to instruct novice teachers, through teaching demonstrations, and on how to transform their teaching knowledge and elaborate on their action plans [7][19]. The use of a course scheme, as developed from action research to investigate teachers' beliefs and cognitions, as well as the instructions provided through cognitive diagnosis and the apprenticeship of a professional teacher. Development of a curriculum can help establish a teachers' concepts of how practically teach. The interviews were summarised as follows:

- *Teachers can understand the learning problems of various subjects, such as mathematics, economics, accounting, and statistics experienced by students at the School of Management through collaborative peer coaching meetings with teachers who specialise in the same field. In addition, senior teachers can instruct novice teachers in teaching skills, and share their teaching experiences, to help lay a foundation for professional competence which, in turn, helps teachers learn to assist their students with follow-up learning of the professional core curriculum (C4).*
- *Not until this meeting was held did I understand that some teachers make efforts to encourage students to actively learn, inspire them to encourage one another and use interesting and vivid competitive methods to motivate students to learn, so as to further improve the teaching of a common professional core curriculum (D6).*

CONCLUSIONS AND IMPLICATIONS

The development of distance teaching requires expert teacher-oriented video curriculum-on-demand teaching materials and communications platforms, so as to implement the community of practice models and diagnostic teaching practices for technical and vocational school teachers. The provision of actual situational learning, demonstrations, simulation practices, support and fading out, self-oriented learning, generalised reflection and investigations, as based on the teaching model of distance learning for apprenticeship cognition, can effectively support the teachers' teaching profession.

The community of practice models enables teachers to participate in communities of practice as learners, thus allowing them to learn the beliefs and hidden behaviours of this field. Once novice teachers have participated in the practice and move towards the centre from the periphery, they can become more spontaneous and dedicated to the culture of the communities, where they further act as experts or senior members. Further, teachers' teaching content and knowledge will be developed gradually during their interactions within the teaching environment. During this process, in addition to the integration of theories and practice, assistance from experienced teachers enables novice teachers to learn and grow.

Diagnostic teaching practices are implemented by using the teaching and counselling strategies of teachers and guidance counsellors, so as to observe other teachers' teaching practices, attending teaching observation and discussion meetings, and by referring to reflection diaries and portfolios, to improve teachers' reflection on teaching excellence. Diagnostic teaching practices enable less-experienced teachers to make improvements in their teaching practices; contrarily, inexperienced teachers attach greater importance to teaching skills and presentation methods. Diagnostic teaching practices enable teachers to achieve significant improvements in their teaching performances and perceptions, as teachers are affected by various factors before, during and after teaching; thus, diagnostic teaching practice can help develop practical teaching experiences.

Peer coaching meetings are a collaborative action research method for technical and vocational school teachers, as conversations regarding professional experiences and theories of peer teachers, expert teachers, technological college professors, and experienced teachers are integrated with action observations, which facilitate self-reflection. During the action research, novice teachers are assisted in the roles in demonstrations, coaching, scaffolding and fading out to discover and amend potential problems. The design of the course, and the execution, assessments and amendments of action research schemes are repeatedly implemented, which helps technical and vocational school teachers to improve their teaching excellence.

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