

Research on the Key Success Factors of Literacy-Oriented Courses Using DANP Method

Chia Wei Wang, National Taiwan Normal University, Taiwan

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Abstract

To align with international trends emphasizing Literacy-Oriented teaching, Taiwan's educational authorities officially implemented a new curriculum in 2019. These guidelines are based on the core principles of "autonomy," "interaction," and "common good." They emphasize three dimensions: "autonomous action," "interactive communication," and "social participation," along with nine specific core competencies that integrate knowledge, skills, and attitudes in learning. To examine the difficulties and challenges schools have encountered in implementing Literacy-Oriented instruction since the new curriculum was introduced over four years ago, this study focuses on seed teachers in the national professional communities of technical high school educators. By reviewing literature, we developed a prototype framework of key success factors. After refining this framework using the Delphi method, eight experts were invited to evaluate the influence weights of different factors. We combined the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method with the Analytic Network Process (ANP) to explore the key success dimensions and criteria for Literacy-Oriented teaching. The study identified four major dimensions: "philosophical alignment," "teacher empowerment," "administrative support," and "evaluation and feedback." According to the DEMATEL causal diagram and ANP network, the "philosophical alignment" dimension is central and has a direct impact on other dimensions. The second most influential dimension, "teacher empowerment," also affects "administrative support." Moreover, the elements within the "philosophical alignment" and "teacher empowerment" dimensions exhibit internal influences. The findings of this study can serve as a reference and provide suggestions for future interdisciplinary curriculum development in Literacy-Oriented education in technical high schools.

Keywords: Core Literacy, Literacy-Oriented Teaching, Decision Making Laboratory Analysis

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Introduction

To align with international trends emphasizing Literacy-Oriented teaching, Taiwan's educational authorities officially implemented a new curriculum in 2019. High schools have since faced significant curriculum reforms, including offering diverse elective courses and flexible learning time to provide students with opportunities for varied and adaptive exploration.

However, the practice of Literacy-Oriented teaching poses significant challenges for most teachers in the field. More than four years since the new curriculum's introduction, the implementation of Literacy-Oriented teaching remains far from meeting policy expectations. Schools face numerous difficulties, particularly technical high schools, which tend to adhere to a skill-based approach. Many vocational subject teachers exhibit resistance to competency-based teaching, often characterized by reluctance to understand or adapt their teaching methods, resulting in limited implementation effectiveness.

Promoting Literacy-Oriented teaching requires the establishment of interdisciplinary teacher communities and the infusion of various resources. These include teachers' in-depth understanding of Literacy-Oriented instruction, curriculum leadership from principals and academic directors, and administrative support and resources. For technical high schools, it is essential to break the barriers of subject-specific skill-based teaching to advance interdisciplinary Literacy-Oriented curricula. Additionally, the distinct groups within technical high schools bring unique cultures and challenges.

To realize the concept of Literacy-Oriented teaching, this study employs multi-criteria decision-making analysis—specifically the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method to identify interdependencies among key success dimensions and the Analytic Network Process (ANP) to determine the weights of evaluation criteria. These serve as considerations for advancing Literacy-Oriented teaching initiatives.

Literacy-Oriented Teaching

The primary research on the development of core literacies by international organizations focuses on the "United Nations Educational, Scientific and Cultural Organization" (UNESCO, 2003), which identified five dimensions and twenty-one specific elements of core literacies; the "Organization for Economic Cooperation and Development" (OECD, 2005) with its DeSeCo framework comprising three dimensions and nine specific elements; and the "European Union" (EC, 2005), which outlined eight dimensions and seven specific elements of core literacies.

The Ministry of Education in Taiwan adopts an integrative perspective from the EU and OECD, defining "literacy" as the indispensable knowledge, skills, and attitudes required by individuals for sound development and to meet the needs of various life contexts (Tsai & Chen, 2013). The concept of core literacies has increasingly gained the attention of scholars, many of whom emphasize the necessity of designing curriculum based on core literacies to address the challenges of an ever-changing social environment.

Literacy-oriented curriculum design and the transformation principles of teaching materials stress the importance of holistic learning, avoiding an exclusive focus on knowledge. It emphasizes a balanced integration of knowledge, skills, and attitudes, fostering meaningful

learning through contextual and situational approaches. Lin Yong-Feng (2017) highlights the need to combine learning content with inquiry processes through curriculum planning and instructional design, enabling students to develop self-directed learning skills. Greater student participation and proactive learning contribute to the cultivation of more effective cognitive and affective dimensions of literacies. Through hands-on learning and reflective practices in real-life contexts, students achieve skill transfer, comprehensive expression, and continuous improvement (Lin, 2017).

Therefore, the implementation of curriculum concepts should not merely stop at policy announcements or the publication of curriculum guidelines. The key lies in how these ideas are practically applied in teaching environments (Lin, 2021).

Decision-Making Trial and Evaluation Laboratory-Based Analytic Network Process (DANP)

DANP combines the DEMATEL (Decision-Making Trial and Evaluation Laboratory) and ANP (Analytic Network Process) methods. It is commonly used to address interdependencies and feedback issues in multi-criteria decision-making by analyzing the mutual influences among dimensions and criteria, ultimately deriving weights and priorities.

DEMATEL (Decision-Making Trial and Evaluation Laboratory)

The Decision Making and Trial Evaluation Laboratory (DEMATEL) is a method developed by the Battelle Memorial Institute of Geneva between 1972 and 1976 as part of the Science and Human Affairs Program. This method is designed to solve complex and intertwined problems. DEMATEL enhances understanding of specific issues, organizes interrelated problems into groups, and provides a hierarchical structure to identify feasible solutions (Tzeng et al., 2007). The key feature of DEMATEL lies in its ability to illustrate the interrelationships among dimensions or clusters and to identify the core criteria that represent these dimensions or elements effectively. (Hori & Shimizu, 1999; Chiu et al., 2006; Liou et al., 2007; Wu & Lee, 2007; Wu et al., 2009).

ANP (Analytic Network Process)

The Analytic Network Process (ANP) theory and application were proposed by Saaty (1996) as an extension of the Analytic Hierarchy Process (AHP). ANP is designed to address decision-making problems where elements exhibit dependence and feedback. Thus, the ANP can be described as a mathematical theory capable of systematically handling problems involving interdependence and feedback. In addition, the hierarchical structure of AHP is linear, whereas ANP adopts a non-linear network structure (Deng, 2005). The ANP analysis method incorporates interdependence and feedback, using a supermatrix to calculate weights. While the AHP framework represents problems with unidirectional hierarchical relationships, ANP allows for more complex interrelationships within and between levels or elements.

Research Framework

This study is based on the research framework proposed by various scholars on the key factors of competency-based teachers, synthesizing literature. A group of eight teachers from national technical high schools, all of whom are current or former first-level administrative leaders and have participated as guiding teachers in competency-based teaching professional

communities, was selected as the expert panel. The study integrates key factors identified by scholars for promoting competency-based teaching in schools. A first-round Delphi expert questionnaire was conducted, and the framework was adjusted based on expert opinions. The following month, a second round of expert interviews was held to further refine the framework. This was done to understand the difficulties and challenges faced by schools in implementing competency-based teaching, while also gathering further insights from experts. After two rounds of expert interviews and revisions, a final research framework was established, which includes four dimensions and twelve criteria. The formal evaluation levels and definitions were then compiled.

DEMATEL Result Analysis

This study evaluates the interrelationships between the four dimensions of competency-based teaching success factors: Conceptual Alignment, Teacher Empowerment, Administrative Support, and Assessment and Feedback. The aim is to establish an ANP evaluation framework. Therefore, the DEMATEL method was used to clarify the causal relationships between these dimensions and measure the degree of influence of each criterion. The results are analyzed as follows:

Establishing the Direct Relationship Matrix

In this study, the geometric mean of the responses from 8 expert questionnaires was calculated to derive the direct relationship geometric mean matrix A (as shown in Table 11). From the direct relationship matrix, it can be seen that the degree of influence between the Conceptual Alignment dimension and the Teacher Empowerment dimension is extremely high (above 4). The degree of influence between the Administrative Support dimension and the Assessment and Feedback dimension is high (above 3.5).

Table 1: Direct Relationship Matrix

	Philosophical	Administrative	Teacher Professional	Assessment
Philosophical	5	4.63	4.13	3.75
Administrative	4	5	3.75	3.75
Teacher Professional	3.63	3.63	5	3.5
Assessment	3.5	3.5	3.75	5

Standardized Direct Relationship Matrix

By calculating the sum of the values in each row and each column of the matrix, we can determine the total sum for each row and column. The maximum total sum is 17.5. By dividing the values in the matrix by the maximum total sum of 17.5, we can obtain the normalized D matrix.

Table 2: Standardized Direct Relationship Matrix

	Philosophical	Administrative	Teacher Professional	Assessment
Philosophical	0.29	0.26	0.24	0.21
Administrative	0.23	0.29	0.21	0.21
Teacher Professional	0.21	0.21	0.29	0.2
Assessment	0.2	0.2	0.21	0.29

Establish the Total Relationship Matrix

To establish the Total Relationship Matrix (T), we use the following formula:

$$T = \frac{D}{I - D}$$

Next, based on the values of the Total Relationship Matrix (T), calculate the sum of each row and column to obtain the row sum (R) and column sum (C). Then, using the row sum (R) and column sum (C), calculate the sum (R + C) and the difference (R - C) for each row and column, as shown in Table 3.

Table 3: The Total Relationship Matrix

	Philosophical	Administrative	Teacher Professional	Assessment	R	C	(R+C)	(R-C)
Philosophical	4.0377	4.1347	4.0671	3.8586	16.09	14.90	31.00	1.19
Administrative	3.7399	3.9231	3.7943	3.6311	15.08	15.41	30.50	-0.32
Teacher Professional	3.5920	3.7066	3.7535	3.4977	14.54	15.23	29.78	-0.68
Assessment	3.5350	3.6478	3.6205	3.5528	14.35	14.54	28.89	-0.18

Set Threshold Values and Draw Causal Diagram

In order to identify the significant influence relationships among the clustered dimensions, the geometric mean calculated was 3.755. Based on Table 14 and expert decision results, the threshold value ($\alpha=3.75$) was set for the Total Relationship Matrix (T). If the values in matrix T exceed (α), it indicates a stronger mutual influence and are retained. If the values are below (α), indicating weaker relationships, they are removed and set to 0. Therefore, the Total Relationship Matrix T remains unchanged. Using the (R+C) values and (R-C) values from Table 14, with (R+C) as the X-axis and (R-C) as the Y-axis, a causal relationship diagram of the main dimensions and subdimensions is then drawn (as shown in Figure 1).

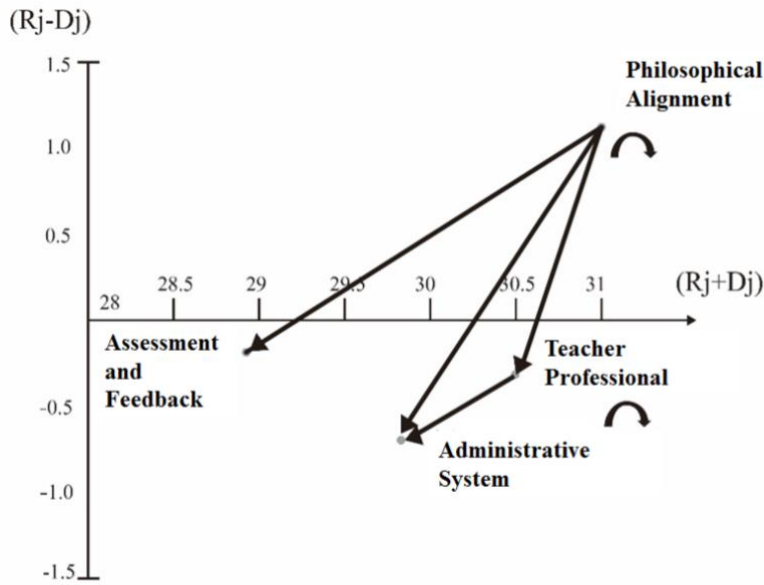


Figure 1: Causal Relationship Diagram (Threshold value $\alpha=3.75$)

Establishing the ANP Evaluation Framework

The results shown in Table 4 indicate that the "Conceptual Alignment" dimension is the central influencing factor. At the same time, the "Conceptual Alignment" dimension and the "Teacher Empowerment" dimension are significant driving factors, while the "Administrative Support" and "Assessment and Feedback" dimensions are outcome factors. Based on these relationships, a dynamic causal influence network diagram, required for the ANP method, can be established (as shown in Figure 2).

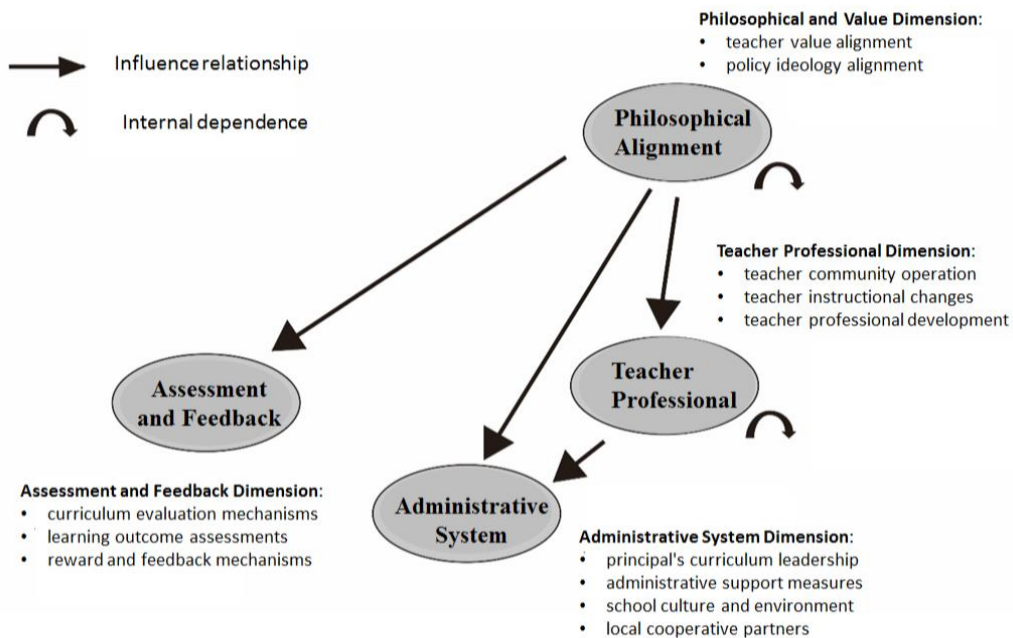


Figure 2: Dynamic Causal Relationship Network Diagram Using the ANP Method

Conclusion

This study synthesizes key success dimensions and elements from relevant literature on competency-based teaching. Based on the opinions of 8 expert scholars, the dimensions identified include "Conceptual Alignment," "Teacher Empowerment," "Administrative Support," and "Assessment and Feedback." Using the DEMATEL questionnaire's pairwise comparison matrix, a total impact relationship matrix was formed. In the causal relationship diagram, the "Conceptual Alignment" dimension directly impacts the "Teacher Empowerment," "Administrative Support," and "Assessment and Feedback" dimensions. The "Teacher Empowerment" dimension also affects the "Administrative Support" dimension, while both "Administrative Support" and "Assessment and Feedback" are influenced, without causing an impact on other dimensions. Additionally, in terms of internal dependencies, both the "Conceptual Alignment" and "Teacher Empowerment" dimensions have internal influences.

Through the ANP method, a dynamic causal relationship network diagram clearly presents that when promoting competency-based teaching policies, the alignment of teachers with the policy's conceptual framework is crucial. This includes whether teachers recognize the value of their roles in education. Secondly, the implementation of teacher empowerment depends on the operation of teacher communities and the enhancement of teachers' expertise, forming a learning organization within the school that promotes teacher growth and willingness to change teaching practices. Teacher empowerment not only relies on conceptual alignment but also influences school administrative support. When teacher motivation is high, curriculum leadership and administrative support are more willing to offer greater assistance, forming a robust support system for teacher empowerment. Furthermore, although "Assessment and Feedback" does not directly impact other dimensions, its internal mechanisms—curriculum assessments, learning outcome evaluations, and reward feedback systems—reflect whether the competency-based teaching philosophy is being implemented and how to adjust the promotion methods and outcomes.

This study finds that when schools promote competency-based teaching, the most important factor is the alignment of teachers with the policy's conceptual framework. Only with conceptual alignment will teachers be motivated to engage in teaching changes. Next, for competency-based teaching to be effectively implemented, teachers play the most critical role. Schools should focus on how to encourage teachers to participate in communities, continuously engage in professional empowerment, and implement teaching changes in the classroom. The school administration can offer reward mechanisms, results presentations, and exchanges to foster mutual growth in teaching between teachers and students, creating a positive school culture.

This study surveyed experts from technical high schools or vocational backgrounds. The findings may differ from those in general high schools or other educational stages, so future research could focus on comparing different educational systems. Secondly, due to the large number of pairwise comparison items and the complexity of the supermatrix in the ANP network analysis method, it is recommended that future studies further investigate to obtain more detailed weight rankings.

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Contact email: k80962002@gmail.com