Original Paper

From Knowledge Transmission to Thinking Teaching: The Integrated Design of Interdisciplinary Curriculum for Empowering Minds

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Abstract

From the perspective of strategic development, quality education with the goal of developing core competencies has become an important dimension of global competition in the era of knowledge economy. The interdisciplinary curriculum restores the overall understanding and internal connection of oneself, nature, and society, with the goal of promoting learners' mental health. It has become a necessary choice for the current development of core competencies, reflecting a shift in educational value orientation. Interdisciplinary courses utilize the relevant attributes of the edges of different disciplines to bridge the gap between disciplines, not only the integration of knowledge and skills, but also the careful integration of ideas and methods. The value orientation of interdisciplinary courses lies in enabling learners to construct open thinking patterns from their internal knowledge structure system, and cultivating learners' literacy and abilities through subject integration and thinking integration. The implementation approach should gradually shift from integrating various courses and disciplines to integrating students with society, students with life, and forming an internal unity of knowledge and personality. The design of interdisciplinary courses has methods but no fixed form, and grasping its essence of thinking and constituent elements is the basis for design.

Keywords

Interdisciplinary courses, Curriculum integration, Core competencies, Knowledge iteration

1. Introduction

In the highly information-oriented era centered on knowledge innovation, education needs to timely meet the urgent needs of technology driven and innovative talents, treating students as complete and comprehensive individuals to adapt to the complex social development and changes, as well as the

innovation and comprehensive application of knowledge. The multi-disciplinary knowledge structure is the core element and significant feature of the quality of innovative talents. Therefore, innovative education models guided by the flow and production of cross-border knowledge have emerged one after another, showing a trend and feature of breaking disciplinary barriers and achieving disciplinary integration.

In the 20th century, there was a tendency towards comprehensive curriculum reform, with correlation, integration, and multidimensional integration becoming the norm in the curriculum implementation. In the basic education stage, curriculum integration has become an important content of China's new curriculum reform, and the integrated characteristics of curriculum content have become a global trend. In the "Outline of Basic Education Curriculum Reform (Trial)" released in 2001 (Che & Han, 2017), The goal of curriculum integration has been set: "To change the current situation of curriculum structure that places too much emphasis on subject orientation, too many subjects, and lack of integration, and to establish a nine-year consistent curriculum category and class hour ratio, as well as comprehensive courses to meet the needs of different regions and student development, reflecting the balance, comprehensiveness, and selectivity of curriculum structure." The deepening trend of curriculum reform and the introduction of STEM education concepts in the United States, The interdisciplinary teaching in the form of STEM education has formed a wave of innovation that has devastated the world. The New Media Alliance of the United States released its "Horizon Report (2017 Basic Education Edition)" in September 2017 (Jin, Hu, & Song, 2017) as a mid-term trend for the future development of the education field, predicting key trends, major challenges, and important developments in the field of educational technology that can affect the transformation of basic education in the next five years, And pointed out the importance of interdisciplinary concepts advocated by STEM education, with STEM curriculum construction and application organization as key implementation contents. The trend and characteristics of this comprehensive curriculum reform directly refers to the current education reform centered on improving 21st century literacy and skills.

2. Humanistic Education towards the Core Competencies of the 21st Century

In the June 2016 Education Innovation Summit (WISE) "Global Experience Report on Core Literacy Education in the 21st Century", the term "literacy" was used instead of skills (Liu, Wei, Liu, et al., 2016). From a semantic perspective, the term 'literacy' encompasses a wider range, including not only knowledge and skills, but also attitudes. The cultivation of literacy as an essential dimension aims at promoting the harmonious development of learners' cognition, emotions, attitudes, and skills, and cultivate autonomous and comprehensive individuals. Therefore, there is an urgent need to tailor our education based on the core competencies of the 21st century and the skills that 21st century learners should possess, that is, to see students as individuals with complete personality and all-round development, and to establish a more humanistic education.

Literacy is an intangible, abstract, and complex concept that represents an individual's ability to resolve the problems, execute plans, and apply knowledge in complex and concrete real life situations. It does not constitute an independent existence, but a comprehensive ability formed by multiple interweaving. Therefore, literacy fundamentally breaks away from the original disciplinary knowledge center and single evaluation criteria, emphasizing the integration and integration of skills, knowledge, and attitudes, and more towards human behavioral abilities, i.e. overall human abilities, with practical and behavioral orientation. If core competencies are decomposed into tangible and measurable learning objectives such as skills, knowledge, and attitudes, they can be manifested as internal development marked by appreciation, criticism, and critical power towards complex knowledge, rather than external development marked by memory, mastery, understanding, and application of a single knowledge.

Entering the era of core literacy, in order to cultivate literacy and abilities, it is necessary in order to avoid premature "disciplining" in the basic education stage. A single and closed corrective system of teaching disrupts the correlation of knowledge, hinders the interconnection of knowledge, and can easily lead to knowledge rigidity, detachment from students' lives and existing experiences, seriously limiting students' horizons. In addition, students are constrained by a distinct discipline, which may affect their overall judgment of scientific phenomena and make it difficult to correspond to practical social problems. At the same time, it also hinders the progress of students' innovative spirit, practical ability, and even personality.

Core literacy is a key ability that can adapt to lifelong progress and social development. It emphasizes the comprehensive development of learners' physical and mental well-being and the infiltration of social context; However, the current evaluation of academic performance still focuses on the objective and abstract systematic construction of the subject knowledge system, while the shaping of learners' physical and mental personalities is ignored. The all-round development of an individual's body and mind has three dimensions: autonomy, sociality, and instrumentality. Autonomy refers to an individual's ability to achieve autonomous development; Sociality refers to an individual's social participation ability and social attributes. Instrumentality refers to the ability to master knowledge and social culture. Among them, cultural literacy is a necessary foundation for individual independent development and social participation, and independent social participation is an essential prerequisite and fundamental guarantee for individuals to adapt to society and achieve personal values. The three dimensions are intertwined and interact with each other. Premature disciplinization overemphasizes the instrumental nature of learning while neglecting the autonomy and sociality of learning, which does not contribute to cultivating learners' interest in learning and promoting their comprehensive development. This goes against the original intention of quality schooling.

In summary, literacy education aims at achieving the coordinated development of learners' non cognitive and cognitive abilities, with a focus on cultivating learners who meet the needs of social development and adapt to lifelong development in terms of physical and mental health. Quality education needs to start with curriculum integration. The interdisciplinary curriculum has become the

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source of the entire curriculum system with core competencies, changing the traditional subject based teaching approach that overly emphasizes the differentiation of disciplines and majors, and restructuring the teaching form, which is a new trend exhibited in current subject teaching. The future curriculum emphasizes the internal connections between disciplines and is more of an integrated form to highlight the integrity of the knowledge system and the correlation between knowledge and the real world. This indicates a shift in educational goals towards a more life oriented and humanistic value orientation, namely the cultivation of thinking and personality shaping. In the basic education stage, the curriculum should particularly adopt a curriculum integration perspective, allowing students to perceive the complexity, system, and integration of knowledge, cultivating students' diverse knowledge foundation composition and global perspective, as well as the ability to integrate multiple knowledge skills and apply innovative thinking to solve problems in the real world.

3. Research and Development of Interdisciplinary Courses

The essential feature of interdisciplinary studies is to break down disciplinary boundaries and achieve the intersection of various disciplines. The National Academics' definition of interdisciplinary research in its report "*Promoting interdisciplinary research*" is a team or individual research model that combines data, information, tools, skills, concepts, viewpoints, and theories from two or more disciplines or professional knowledge groups to deepen basic understanding and solve problems that cannot be solved by a single discipline or research field (Cheng, 2005). In short, interdisciplinary is the combination of ideas and methods rather than just piecing together two disciplines.

The concept of interdisciplinary teaching originates from interdisciplinary learning. In 1989, American scholar Shoemaker (Zheng, An, Lu, & Hu, 2013) first defined interdisciplinary teaching as crossing the boundaries of various disciplines in teaching, forming meaningful connections between them, and combining them together, allowing students to learn in a broader field. Subsequently, the application of interdisciplinary methods in the curriculum design and teaching mode research and practice has also achieved rapid development. Zhang Hua believes that interdisciplinary courses are not only a special form of curriculum with comprehensive themes, but also a curriculum concept with interdisciplinary awareness as the focus, and a deep learning method with comprehensive and exploratory significance. Li Kedong believes that interdisciplinary curriculum integration is a curriculum organization method and the design theory that revolves around a common theme, breaks disciplinary boundaries, organically integrates theories and methods from different disciplines and fields, designs and organizes curriculum content and teaching activities purposefully and systematically, with the ultimate goal of improving students' abilities and promoting their comprehensive development. The basic characteristics of interdisciplinary courses summarized by Liu Dingyi (2016) are: (1) The goal of the course is to develop students' experiences, strengthen the connections between different subject knowledge, and have a holistic understanding of the world; (2) In terms of content setting, comprehensively consider the development of students in various aspects such as society, life, emotions,

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and physical and mental health; (3) In terms of curriculum organization and implementation, starting from students' basic problems and life experiences, integrating multidisciplinary content or skills, crossing the boundaries of knowledge and reality, school and society, and organizing teaching around a central approach between teachers and students. Reflected in the practice of the curriculum field, STEM education has been a typical interdisciplinary curriculum integration case based on real-life situational themes in recent years. Various interdisciplinary connection and thinking tools (intelligent tools) has been applied to learners' knowledge integration and innovation. At present, research on interdisciplinary courses has evolved from meaning elaboration to the stage of value and application.

4. Three Value Orientations of Interdisciplinary Curriculum

4.1. The development of interdisciplinary courses since the 1980s represents a significant change in the way curriculum is organized. This is reflected in interdisciplinary courses that streamline the boundaries between disciplines, embody nonlinear horizontal connections, connect the applied orientation of specific problems and the depth of theoretical research, and reflect the structural optimization and reorganization of various disciplinary elements; traditional subject teaching, on the other hand, is a linear and in-depth teaching that explores the objective laws of the subject's own development. Unlike traditional subject teaching, interdisciplinary courses have a certain disciplinary foothold, but their focus is not on deep exploration, but on horizontal correlation, searching for contradictory unity in relevant fields and disciplines to generate and develop new growth points.

4.2. The development of interdisciplinary courses reflects a shift in educational value, which advocates shaping learners' healthy personalities through a holistic understanding and internal connection of themselves, nature, and society through practice. Specifically, the value orientation of education has shifted from imparting knowledge to generating wisdom; from focusing on learners' academic performance to emphasizing the development of comprehensive qualities; And pay more attention to the mental development necessary for learners to achieve success throughout their entire career or life. For example, compared with the 3R of basic literacy, numeracy and numeracy, interdisciplinary courses pay more attention to life-long high-level, multi-dimensional and complex 4C skills (critical thinking, cooperation, creativity).

4.3. Interdisciplinary courses showcase the natural dimensions of the curriculum. Individuals, nature, and society are inherently closely related, and interdisciplinary disciplines stem from life. By weaving the three dimensions of individuals, nature, and society, the connection between learners, nature, and society is enhanced, achieving learners' overall understanding and internal connection to themselves, nature, and society, shaping learners' sound minds and enabling them to take responsibility for themselves, society, and the environment they live in.

In summary, the value orientation of interdisciplinary courses lies in enabling learners to construct open thinking patterns from their internal knowledge structure system, and cultivating learners' literacy and abilities through subject integration and thinking integration. The implementation approach should

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gradually shift from integrating various courses and disciplines to integrating students with society, students with life, and achieving the internal unity of knowledge and personality. Therefore, interdisciplinary courses focus on cultivating students' holistic and collaborative thinking. From a thinking perspective, they represent the acquisition of non cognitive abilities, which is significantly different from traditional subject based teaching that focuses on cognitive abilities.

The structural feature of this course is to use abstract cultural symbols to impart specific subject knowledge primarily based on indirect experience to students. In traditional subject based teaching with cognitive ability as the teaching goal, the basic knowledge and skills of each subject are formed into subject based courses according to their own logical structure. Based on disciplinary classification and based on systematic knowledge, knowledge is organized and presented according to a strict disciplinary logical system. A systematic teaching system is used to teaching basic knowledge and skills, including course objectives for mastering certain disciplinary knowledge, the teacher centered course plans, course evaluation standards for exams or other assessments, and textbooks with a strong disciplinary knowledge system. Compulsory segmentation of learners' cognition and abilities limits the teaching process to imparting basic knowledge and skills, which goes against the cognitive development laws of learners in the basic education stage. Specifically, the knowledge content of some disciplines is repetitive and overlapping; the connection between the curriculum objectives of the basic education stage and the higher education stage is not close enough; the adaptability and systematicity of using textbooks in the course is not strong; insufficient development and utilization of curriculum resources. Therefore, there is a necessity to integrate the curriculum, while also providing us with space for curriculum integration.

Non cognitive interdisciplinary courses have diverse forms such as activity courses, comprehensive courses, and wide area courses, breaking through the previous curriculum structure. This trend stems from the trend of a globalized knowledge society. The focus of teaching is not on learners' acquisition of knowledge, but on enhancing the quality and ability of learners. Interdisciplinary courses emphasize the internal connections and applications between disciplines, and are activity courses based on learner development or basic human activities. It centers around students' activities, with the goal of mastering interdisciplinary knowledge as the curriculum objective, the learning process and innovative products as the curriculum evaluation, and the activity curriculum of organizing textbooks or materials with a weaker knowledge system. It emphasizes the openness of the learning process, the involvement of students' practical application and the cultivation of critical thinking, which are manifested in the ability to solve problems, use tools and information, creative thinking and artistic expression. In the basic education stage, this training of thinking based on ability and quality can lay a solid foundation for learners' future professional learning.

5. The Development Path of Interdisciplinary Courses

Since the 21st century, one of the core concepts of science education reform has been "integration and development". 'Integration' includes both structural integration, such as integrating multiple disciplines into the overall curriculum to change the content and structure of the curriculum and transform the entire curriculum system; It also includes tool line integration, such as integrating knowledge, media, and methods into various levels of teaching, cultivating students' learning concepts and comprehensive practical abilities; IT also includes the integration of knowledge. For example, constructing knowledge content by forming core disciplinary concepts, forming "Grouped by Discipline Core Ideas" (DCI) and inter disciplinary Big Ideas; It also refers to the effective association and integration of fragmentation knowledge at the edge of disciplines, and the content of these integration is reflected in the curriculum, teaching and evaluation. On this basis, practical activities are organized to achieve the unity of knowledge and practice, apply the learned knowledge to practice, and deepen the understanding of scientific knowledge in practice. Development emphasizes that the learning and practice of scientific knowledge are not achieved overnight. Based on students' different ages and cognitive abilities, the breadth and depth of concept teaching are designed, and the goal level of students at different stages is determined by following the spiral upward pattern. Along the improvement channel of the learning stage, a consistent, gradually deepening, and spiral upward framework is constructed for the learning and practice of the subject, thereby establishing a reasonable knowledge structure.

5.1 Breaking the Single Subject Teaching Mode

Interdisciplinary courses emphasize breaking the boundaries of disciplines in terms of content, infinitely expanding learning time and space, using life as a teaching material, allowing various course resources to be incorporated, integrated, constructed, and created, and achieving the integration and integration of national, local, and school-based courses (Wang, 2017). At present, specific reform measures have also been proposed in the "National Basic Education Curriculum Reform" goal: to change the current situation of too many subjects and lack of integration, no longer overly emphasizing subject based, adjust the curriculum structure to meet the needs of learners' quality and ability development, and pay attention to balance, comprehensiveness, and selectivity in the curriculum structure. At the same time, the curriculum reform of the new nine-year compulsory education has also been implemented, and the primary and middle school curriculum has been correspondingly adjusted to mainly teach comprehensive courses in the primary school stage, while in the middle school stage, a combination of subject based and comprehensive courses is implemented (Li, 2007). The implementation of curriculum integration in multidisciplinary fields has become a trend advocated the intersection, infiltration, and integration of various disciplines to form marginal and comprehensive disciplines.

Breaking the single subject teaching model means a non-linear path for imparting knowledge, but rather a complex and dynamic process of knowledge construction. It is necessary to adopt a holistic, interconnected, and dialectical perspective to understand the curriculum, the objectives of each course's

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education and teaching, teaching design, evaluation, and other elements, and to study the relationship between various factors in the teaching process, including educational ideas, teaching concepts, knowledge content in the teaching process, teaching strategies, learning activities, and so on. Under the same goal, design and cultivate a harmonious and interactive classroom state, and achieve a change in learning methods.

5.2 Design a Comprehensive to Professional Education Path

Dividing subjects design is beneficial to establish the depth of learners' knowledge acquisition, but at the same time, it also forcibly divides learners' cognition and abilities, limiting teaching to the scope of imparting basic skills and basic knowledge of the subject, which is not in line with the cognitive development laws of basic education. In the stage of basic education, education is characterized by enlightenment, foundational and comprehensive, and it is more suitable to establish an educational path from comprehensive to professional. At this stage, learners do not need to learn too profound knowledge, but should try to learn as much life knowledge as possible, to establish correct life values, establish learners'awareness of learning subjects, and focus on cultivating learners' learning interests and habits. For example, conducting comprehensive education in kindergartens and primary schools, with the teaching orientation of stimulating children's interests; In middle and high school, by dividing different subjects, students are encouraged to focus on the acquisition and accumulation of various basic knowledge; in the university stage, majors are finely divided into disciplines, and students construct their own depth of discipline through prior knowledge. The educational path from synthesis to professionalism is in line with the cognitive characteristics of learners' "from broad to deep".

5.3 Use Compound Thinking to Enhance Higher-order Thinking Abilities

Scholars Clark, Ivaniskaya, and others proposed in "Interdisciplinary Learning: Process and Outcomes" that interdisciplinary learning can help students strengthen high-level thinking skills, namely analysis, application, and synthesis, cultivate students to establish a more comprehensive interdisciplinary knowledge system, and guide them to conduct more in-depth research (Li, 2017). In interdisciplinary courses, the teaching goal is not to memorize knowledge, but rather to engage learners in high-level cognitive activities such as analysis, synthesis, comparison, evaluation, and creation through the use of disciplinary and interdisciplinary thinking. Disciplinary thinking is an essential understanding that is repeatedly applied in cognitive activities and has guided significance for the discipline; interdisciplinary thinking, on the other hand, is the process of extracting from various disciplines, grasping the structure and connections of disciplines as a whole, and organically connecting them. The perspective can cover multiple fields of knowledge and different cognitive styles, requiring the participation of diverse cultures to enhance the ability to analyze problems from different perspectives.

5.4 Transformation from Knowledge to Literacy

The accumulation of knowledge does not necessarily lead to the development of literacy. Literacy is not just knowledge, but literacy cannot be separated from knowledge. Without knowledge, literacy is like water without a source and a tree without roots. The bridge to transform knowledge into literacy is

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thinking. Without thinking participation, knowledge can only be empty, without innovation and vitality, and cannot form literacy. To transform the process of knowledge learning into the formation of literacy, it is necessary to change the view of knowledge, elevate knowledge into concepts, and establish a meaningful connection between curriculum knowledge and human life. Problem oriented and practical as a carrier and bridge, emphasizing the construction of learners' disciplinary thinking, continuously improving learners' knowledge transfer ability, situational solving ability, and survival and development ability, connecting learners' values, thinking ability, and creativity, achieving self awakening of learners' personality and interests, and achieving learners' independent design of learning plans. Through the transmission of curriculum knowledge, students' awareness of doubt, criticism, and exploration is cultivated, guiding learners' disciplinary thinking ability, cultivating lifelong learning abilities and habits of self transcendence, self cultivation, and self improvement, enabling them to possess cross disciplinary and core literacy, achieving the goal of teaching students according to their aptitude, and thus achieving the progression from exam oriented education to quality education.

With the arrival of the knowledge society, technology has developed towards a highly integrated development based on a highly differentiated foundation, with multiple disciplines interweaving and infiltrating, and the phenomenon of mutual influence is becoming increasingly common. Social sciences and natural sciences are constantly infiltrating and integrating at the methodological and theoretical levels, and many interdisciplinary disciplines are constantly emerging. Basic knowledge and skills are not fixed and unchanging, but rather a logical structure that constantly develops with the changing times. Knowledge tends to connect with each other and correspond to practical social problems. In summary, human scientific knowledge tends towards a unified knowledge whole. Correspondingly, in social life, the knowledge that learners come into contact with is no longer singular, but comprehensive and diverse. General education breaks the boundaries of disciplines, integrates knowledge from various disciplines, integrates subjects together, and integrates them scientifically in the curriculum, which is more conducive to applying overall knowledge to daily life, forming a scientific cognitive approach and reasonable literacy structure, as well as the ability to understand the world and the method of comprehensive thinking, so that learners can obtain a more reasonable and optimized knowledge structure system.

6. Conclusion

The design of interdisciplinary courses has methods but no fixed form. Currently, problem-based learning and project-based learning is two influential integrated teaching design methods for interdisciplinary courses. But whether it is based on problem-solving or project-based, it demonstrates the essence of curriculum being based on thinking rather than knowledge. A teacher is not only a knowledge transmitter, but also a supporter of expanding learners' thinking. Learners constantly understand, think, and create in the classroom, without dwelling on the knowledge memory. And this is

precisely the most lacking aspect of our current teaching, and it also deeply highlights the significance and value of interdisciplinary teaching.

6.1. The significance of integrating courses across borders lies in open thinking. Firstly, for teachers, there is no fixed textbook for curriculum integration, nor can there be standardized content for the classroom implementation. It is necessary for all subject teachers to break the original fixed thinking mode and explore the space for proactive and creative curriculum design. Secondly, for students, educational activities are designed based on the concept of curriculum integration. By understanding the differences in knowledge between different disciplines, students can discover the differences and connections between knowledge in different disciplines, and knowledge can also be presented in a new context and relevance through these issues and concerns. This interlocking and interrelated nature itself helps students to understand the diversity of knowledge, produce a holistic effect on the construction of knowledge, and form a unified and complete three-dimensional knowledge structure from fragmented knowledge. Thirdly, in the process of curriculum integration, the triggering of knowledge is rearranged, breaking away from the traditional concept of sequence. Maintain the knowledge structure sequence of each discipline, organize relevant content around the course theme, and mobilize the knowledge content of each discipline in a planned and step-by-step manner as the course context unfolds, combining the advantages of each discipline to form an integrated theme course.

6.2. Interdisciplinary courses focus on the natural dimensions of students' life growth. And the expansion of practical abilities. Emphasize the breadth of knowledge rather than just its depth, and advocate the application of content rather than just its form. Implementing the theme around the life theme situation makes knowledge not specific abstract or fragmentary, but meaningful, provides learners with multi-dimensional problem surfaces, enhances learners' critical thinking ability, and provides richer, authentic, and participatory practice expansion than traditional single subject experience. That is, through interdisciplinary learning, students can achieve the connection between textual learning and real life in the curriculum, cultivate learners' comprehensive literacy in various aspects, especially in establishing key skills for the future.

6.3. Interdisciplinary courses help learners become active builders. Bean believes that curriculum integration is a curriculum organization approach in which educators and learners collaborate to identify issues and issues around themes and beyond disciplinary boundaries, with the goal of enhancing the possibility of human and social integration. Therefore, the integration of comprehensive courses is not only a unilateral operation by teachers, but also a process of mutual learning and interaction between teachers, teachers and students, and students and students, as well as a continuous exchange of wisdom. From the perspective of developmental generation, both teachers and learners are dynamic interactive agents, designed together to enable students to actively participate and become another subject in the classroom, deepening the process of learners' active learning construction.

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