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Exploration of academic research trends of early childhood education in Taiwan through CATAR

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Abstract

Young children are fundamental elements of societal progress. Consequently, cultivating adeptness in early childhood education and childcare talents assumes paramount significance, with educators within tertiary colleges and universities taking a pivotal role therein. Furthermore, research literacy is what educators develop through applying theoretical knowledge and is deemed an indispensable competency in effective instruction. This proficiency is manifested in formulating superlative curricula and augmenting scholastic prospects for students. Hence, the primary objective of this study is to analyze the global academic progression within the domain of early childhood education across Taiwanese tertiary institutions from 2012 to 2022. Employing the content analysis toolkit for academic research technology, the investigation discloses three focal points of research interest: children's health, preschool curriculum design, and the professional competence of preschool educators. The inquiry discerns that personnel within Taiwan's higher education sphere have evinced remarkable research scholarly proficiency in early childhood education. This not only bolsters Taiwan's international scholarly standing but also emboldens nascent researchers to undertake more profound explorations within this academic arena, thereby amplifying Taiwan's global academic influence in early childhood education.

Keywords: bibliometric analysis, co-word, early childhood education, hierarchical cluster analysis, knowledge transfer

INTRODUCTION

The well-developed global Internet connects more and more higher education institutions and researchers. Academic cooperation has broken through national limitations and continued expanding with cross-lingual, cross-disciplinary, and cross-use of research methods and designs. The various uses and possibilities of academic research. Has Taiwanese higher education embraced broad scientific research trends in academic research in recent years?

Educators are confronted with an augmented demand for meticulously crafted preparatory pedagogical endeavors in the post-epidemic epoch. Darling-Hammond and Hyler (2020) underscore the bedrock of an education system characterized by exceptional achievement, which commences with unwavering excellence in pedagogy and scholarly exploration. Elevated benchmarks not only serve as indicators of the caliber of curriculum design but also furnish students with enhanced educational prospects (Darling-Hammond et al., 2017). Research literacy is deemed an imperative competence within pedagogy, achieved through the application and progression of research endeavors (Menter & Flores, 2021). Full engagement in research emerges as a pivotal proficiency

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Contribution to the literature

- Discover the critical cycle of research, teaching, and educational practice in early childhood education, was the most significant contribution of this study.
- Research hotspots of early childhood education in Taiwan from 2012 to 2022, focusing on children's health, preschool curriculum design, and the professional competence of preschool educators.
- Educational data mining and knowledge discovery methods and applications, has little research on early childhood education.

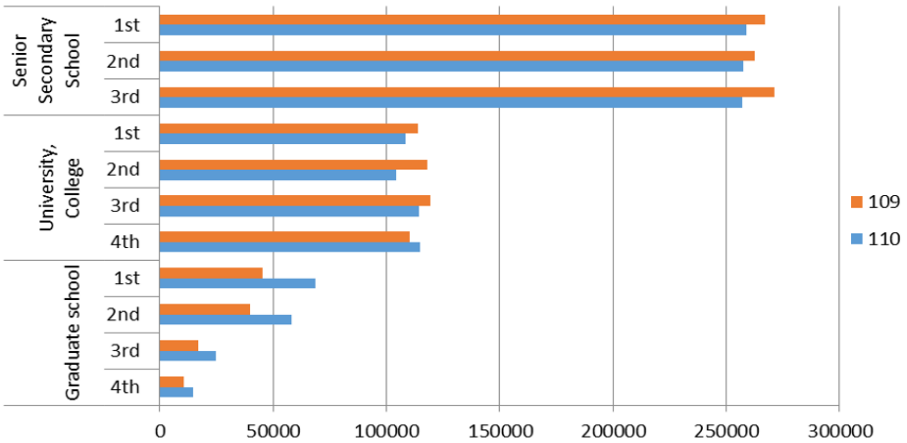

Figure 1. Number of students in Taiwan for 109-110 academic year (Department of Statistics of MOE, 2021a, 2022)

in fortifying the teaching vocation and cultivating education professionals.

However, under the repeated impact of the wave of low birth rates, higher education institutes in Taiwan have experienced shocks such as insufficient enrollment, student recruitment suspension, or school termination. In response to the trend of population change and reduction of students, the government promulgated the Act Governing the Closure of Private Educational Institutions at Senior Secondary or Higher Level issued by the Ministry of Education on May 11, 2022. List special counseling schools after school examinations, provide guidance, and establish a school exit mechanism to protect the rights of students to be taught and staff to work.

According to the Ministry of Education standard classification of education system and subject of the ROC (Department of Statistics of MOE, 2016), the number of students at all levels of schools in the 2020 to 2022 academic years announced by the Department of Statistics (DOS) of the Ministry of Education (MOE) (Department of Statistics of MOE, 2021a, 2022), the number of people with equivalent education is counted, as shown in **Figure 1**.

Compared with the number of students enrolled in two semesters, most courses have decreased, and only the graduate classes have not reduced but increased (Department of Statistics of MOE, 2021b). It can be seen that the proportion of students who choose to continue their studies after graduating from the university has grown. The educational focus of students at the master's level should be to cultivate professional talents that meet the needs of Taiwan's industrial development, strengthen the integration of learning and research, and emphasize teaching and research equally.

The ancients said: "know yourself and your enemy, and you will never be in danger in a hundred battles." To operate sustainably, Taiwan colleges and universities must understand the corresponding position of the school itself and schools of the exact nature. Through public information, such as Times higher education world university ranking, and literature Index databases to understand the academic research, research impact, internationalization, and knowledge transfer of various colleges and universities (Yemini & Sagie, 2016).

Thus, this study aims to analyze the trend of early childhood education published in the Web of Science (WoS) Database in Taiwan's colleges and universities from 2012 to 2022 and compare the research key areas of Taiwan to understand the academic position of Taiwan's education academics are relative to the current situation among international scholars. And provide clues and directions for related research, making the analysis database more valuable.

LITERATURE REVIEW

Text Mining for Internationalization of Education

First of all, rapid development of Internet technology makes knowledge exchange without borders. With advent of the global village, the digitization of global learning, and the increasing frequency of personnel mobility, higher education must adapt to era of knowledge economy and international academic

exchanges in age of knowledge management talent training (Altbach & Teichler, 2001; Chen et al., 2002).

In addition, due to the rapid growth of various digital academic databases, continuously creating and utilizing new knowledge and practical and integrated knowledge management is one of the challenges of the internationalization of higher education.

Higher knowledge education has both globalization and localization (Marginson, 2010) and has become a key determinant of economic growth and national security (Saravanan, 2020). Through international academic research, teachers and researchers in higher education can explore knowledge and applications in their professional fields, establish a global research system (Saravanan, 2020), improve teaching quality, and strengthen their institutions' knowledge value and brand image (Marinoni et al., 2019).

Because of the development of the Internet, it has become more and more critical for school organizations to build international competitive advantages from knowledge (Al-Kurdi et al., 2018). Scholars can spread known knowledge and explore unknown parts through knowledge sharing. To effectively manage educational research as knowledge, scholars can read, analyze, and research related documents worldwide through bibliometrics in various electronic databases (Wang & Tseng, 2012).

Effective knowledge management provides a method for colleges and universities to keep their cultivation goals consistent with knowledge transfer (Al-Kurdi et al., 2018; Howell & Annansingh, 2013). The knowledge-sharing cycle and management bring progress and competitive advantages to higher education (Al-Kurdi et al., 2018, 2020). In higher education, knowledge exchange and knowledge transfer help others understand the organization's problems (Amayah Titi, 2013), discover new issues, and explore new knowledge.

From this, it can be seen that teachers in higher education institutions are the medium of knowledge transmission (Sadeghi Boroujerdi et al., 2019), and the application and research of teachers' knowledge in their professional fields are reflected in the academic papers published by teachers.

METHODOLOGY

The methodology employed in this study involves the utilization of the content analysis toolkit for academic research (CATAR), a specialized analytical instrument designed for examining scholarly literature possessing academic merit and conducting scientometric investigations. CATAR has been custom-developed to cater to the exigencies of the social sciences domain, addressing the need to bridge the disparity in the application of digital information within social science research. It offers researchers unencumbered access to its resources and obviates the need for extensive familiarization with intricate software operations (Tseng, 2011; Tseng & Lin, 2011). Streamlining the quantitative research procedures simultaneously affords researchers the opportunity to engage in a qualitative exploration of the knowledge structure contained in key documents in seminal literature.

The sequential progression of this research entails delineated stages encompassing the identification of target educational institutions, the systematic retrieval of pertinent documents, the computation of document similarity indices, and careful consideration of the constraints inherent in the research endeavor. The ensuing section expounds upon the intricate constituents of these sequential analysis stages. The ensuing discourse elaborates upon the meticulous procedural delineations inherent in the analysis, as follows:

Target University Retrieval

Through the standard classification query system of subject tables for colleges and universities, the subject classification is defined as the subject category related to the cultivation of early childhood education professionals. "Teacher education for preschool teachers" and "childcare and youth services" are established university-level education systems and target schools for early childhood education students from 2012-2022. Among them, nine colleges and universities that have suspended enrollment or are included in project counseling in 2022 are excluded, so the primary target schools of this study are 45.

Document Search and Download

This study selected the most academically influential Web of Science (2023) Database, which has complete citations, has the usability and richness required for bibliographic analysis data (Tseng & Lin, 2011; Yuan et al., 2019), and contains high-quality frequently used three citation indexes for academic evaluation, Science Citation Index Expanded (Web of Science), Social Sciences Citation Index (SSCI), Science Citation Index Expanded (SCI-Expanded) , Emerging Sources Citation Index (ESCI), and Arts & Humanities Citation Index (A & HCI) (Brika et al., 2022).

The primary purpose of this study is to explore the research development in early childhood education from 2012 to 2022. The documents in WoS Database will provide more than 40 items to transpose the downloaded document records into structured data (Yuan et al., 2019). In order to retrieve accurate information, precise keywords are required, which will be beneficial to context analysis.

Through WoS Database, the search is carried out by the intersection of all fields and children, and it is limited to the relevant records of papers published by the target

Table 1. Papers published on early childhood education in Taiwan from 2012 to 2022

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	*slp*
Number of publications	15	19	24	25	24	25	28	23	47	47	70	4.15

institution of this research in 2012-2022 and other conditions. The abbreviations and contents of the search items are, as follows:

Topic: Early childhood education or childhood education or child education or preschool education, or pre-school education,

PY: Year published, 2012-2022,

DT: Document types, article, and

Address: Author's affiliation, Taiwan.

In WoS Database, 2,937 records were retrieved that met the above search criteria. Since this research analyzes the colleges and universities institutions in Taiwan related to cultivating early childhood education professionals, colleges and universities, and hospitals that do not meet the above conditions are excluded, such as National Taiwan University, Chang Gung University, Kaohsiung Medical University, Kaohsiung Medical University, China Medical University, Taipei Medical University, I-Shou University, Chang Gung Memorial Hospital, and National Defense Medical Center.

Further, in WoS Database, the search criteria were limited to the target schools that meet the research purpose. 372 papers were obtained, and the target schools were reduced to 40. The relevant plain text files were downloaded on 5/14/2023 for data analysis content.

Research Limitations

This research sample exclusively delves into the corpus of WoS Database. The focal point of investigation encompasses colleges and universities in Taiwan that nurture students specializing in early childhood education. Specifically, this study centers on international journal publications spanning 2012 to 2022, after Taiwan integrated kindergartens and nursery schools. Consequently, research entities falling beyond the purview of the designated target institutions, as well as international journals lying outside the predefined temporal scope, wherein the research titles, abstracts, and keywords do not allude to early childhood education, childhood education, child education, preschool education, or preschool education, are precluded from inclusion within the ambit of analysis. The delineation mentioned above stands as a circumscription inherent to this study.

Calculate Document Similarity

In order to understand the knowledge structure of the documents to be analyzed, this step is to establish a similar relationship between the two papers (Karakus et al., 2019; Tseng & Lin, 2011). There are three standard document association calculation methods: co-citation (co-citation), bibliographic pair (bibliographic) coupling) and co-word (co-word) (Zhang et al., 2018), showing that the two articles have a co-citation relationship. If the two articles jointly cite more bibliographic data or the abstract uses more of the same vocabulary, the similarity between the two articles is higher.

CATAR tool program developed by Professor Tseng (Tseng & Lin, 2011) normalizes the dice coefficient by using the above three methods to normalize the similarity of files (the score value from zero to one), and the formula is, as follows:

$$Sim(X, Y) = 2x|S(X) \cap S(Y)| / (|S(X)| + |S(Y)|) \quad (1)$$

RESULTS AND DISCUSSION

The research scope is WoS Database, and the research field is education & educational research, the higher education schools that cultivate early childhood education professionals in Taiwan from 2012 to 2022. The data retrieval and download date are 2023/5/14. Among the downloaded data that meet the search conditions, 40 target schools and 372 documents were analyzed for content.

Overview Analysis

After CATAR analysis and classification, 347 documents can be analyzed. As for Taiwan's research publication status on early childhood education, more papers will be published in 2020-2022. In 2022, WoS Database published the highest energy, with 70 articles. Said that Taiwan's schools that train early childhood education professionals have continued to pay attention to research issues related to early childhood education. The details are shown in **Table 1**.

From the data downloaded above, it can be found that between 2012 and 2022, there were 15 public and private Colleges and Universities in WoS Database, and the education & educational research field has more than 10 articles. Among them, nine are national, and six are private. The description is, as follows in **Figure 2**.

According to the results of the sloping trend of the retrieved literature of colleges and universities, the top-10 colleges and universities among which No. 1 National Taiwan Normal University (*slp*=0.89) is the most eye-catching, and No. 2 is Chaoyang University of Technology (*slp*=0.5), No. 3 is National Chengchi University (*slp*=0.39), and No. 4 is National Tsing Hua University (*slp*=0.38). The Chaoyang University of Technology is the slowest to enter the sloping trend. It has only been included in WoS since 2018, and it is the first private technology university, as shown in **Table 2**.

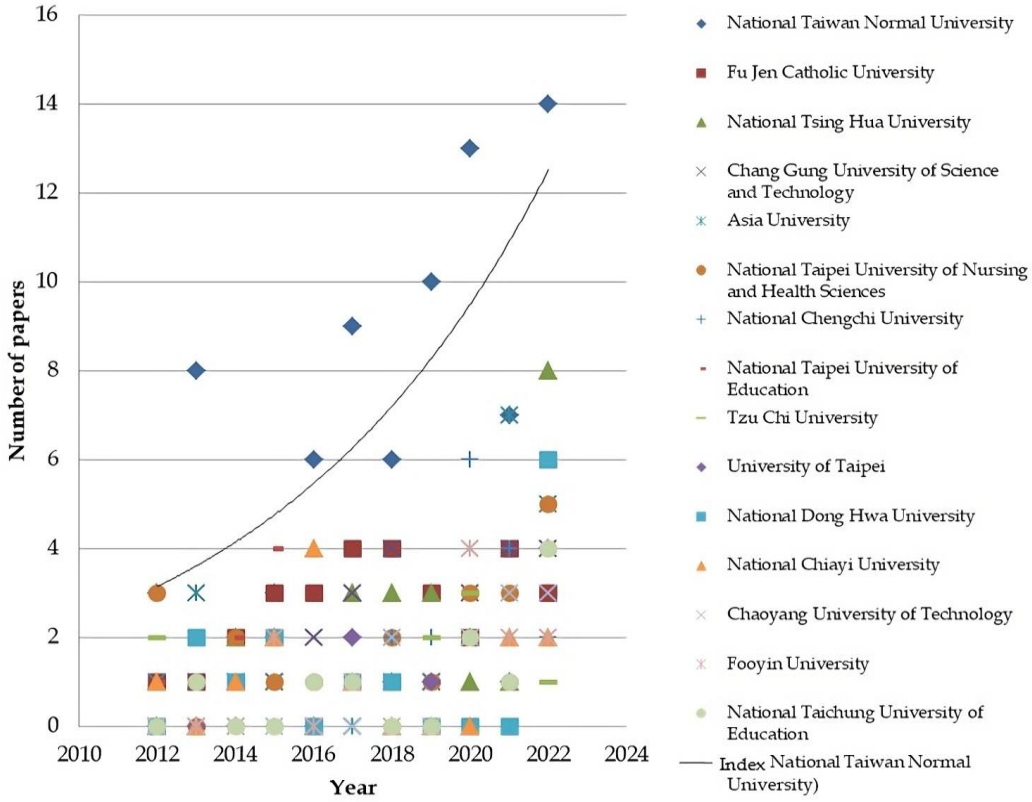

Figure 2. Publishing trends at colleges & universities analyzed in this study from 2012 to 2022 (Source: Authors' own elaboration)

Table 2. Top-10 schools in Taiwan's early childhood education paper publication with the most slope trend

No	Colleges & universities	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	*slp*
1	National Taiwan Normal University	3	8	2	3	6	9	6	10	13	7	14	0.89
2	Chaoyang University of Technology	0	0	0	0	0	0	2	0	2	3	3	0.50
3	National Chengchi University	0	1	1	0	1	1	2	2	6	4	2	0.39
4	National Tsing Hua University	0	0	2	2	0	3	3	3	1	1	8	0.38
5	Asia University	1	3	1	1	0	0	1	1	2	7	5	0.36
6	Chang Gung University of Science & Technology	0	1	1	1	2	3	4	1	3	4	4	0.34
7	National Taichung University of Education	0	1	0	0	1	1	0	0	2	1	4	0.24
8	National Taipei University of Nursing & Health Sciences	3	0	2	1	1	1	2	1	3	3	5	0.24
9	Fooyin University	0	0	0	2	0	1	0	0	4	2	2	0.24
10	University of Taipei	0	0	0	2	0	2	1	1	2	1	4	0.23

Among the 10 colleges and universities in **Table 2**, nine of them have kindergartens attached to them. Therefore, this research infers that for educational schools related to the cultivation of early childhood education professionals, when there are kindergartens that provide future education and protection service personnel as practice sites, in addition to allowing future preschool education. It is to observe and practice the knowledge of early childhood education. At the same time, the big and small events in kindergartens can also provide research topics for teachers at colleges and universities.

According to the number of publications and citations of colleges and universities data, the average number of citations of published documents is calculated, and the results are listed in **Table 3**. In the knowledge transfer of early childhood education, it is worth noting that the National Taipei University of Education received an average of 11.26 citations, the highest in this study. Followed by Tzu Chi University, National Taiwan Normal University, Fooyin University, and National Taipei University of Nursing and Health Sciences, has good academic influence.

Breakdown Analysis

Breakdown analysis is to classify and identify themes according to the similarity of the analysis files (Tseng, 2011). This study uses CATAR to extract the conceptual themes in the documents and classify them into clusters, revealing early childhood education research in Taiwan from 2012 to 2022. The bibliographic pairs are used to obtain similar documents and gather them into five

Table 3. Top-10 schools with the most academic impact

IU	NC	TC	CPP	CPP's ranking
National Taiwan Normal University	81	912	11.26	3
Fu Jen Catholic University	30	178	5.93	8
Chang Gung University of Science & Technology	24	140	5.83	9
National Taipei University of Nursing & Health Sciences	22	221	10.05	5
Asia University	22	132	6.00	7
National Chengchi University	20	121	6.05	6
National Taipei University of Education	14	231	16.50	1
Tzu Chi University	14	185	13.21	2
National Chiayi University	13	73	5.62	10
Fooyin University	11	114	10.36	4

clusters, 11 items, and the co-occurrence words are four clusters, 14 items.

Bibliographic Pair Analysis

After bibliographic analysis by CATAR, four strata were obtained. Abandonment level 2 has a more complicated classification of 15 clusters and 30 items, or more general level 4 has a classification of three clusters and five items. According to the research and comparison needs, choose the third level with five clusters and 11 items. And because the 5th cluster is not related to early childhood education because of its research object and content, it will not be discussed. The serial number, number of papers, similarity coefficients, and concept descriptors of four clusters are, as follows:

1. 6: 25 Docs: 0.011060 (learn, augment, reality, student, and game-based),
2. 3: 18 Docs: 0.013636 (executive, kindergarten, science, effect, and function),
3. 2: 11 Docs: 0.015504 (Taiwan, health-promoting, primary, eye, and care), and
4. 7: 10 Docs: 0.010695 (health literacy, responsive, culturally responsive, teach, and pregnant).

From the key documents of the bibliographic pair, four bibliographic pair clusters are classified, according to the classification subject concept, research topics, and other information. Four clusters are named, as follows:

1. the relationship between game education and enhanced student learning,
2. ECEC curriculum framework (Taiwan),
3. vision care for children in Taiwan, and
4. family health literacy and culturally responsive teaching with new Taiwanese children.

Co-Occurrence Word Analysis

Through the analysis of co-occurrence words by CATAR, five strata were obtained. According to the needs of research comparison, the more complicated stratum 3 (14 clusters, 46 items) or the vaguer stratum 4 (two clusters, 14 items) were discarded. Finally, four clusters were obtained, and the serial number, similarity coefficients, and concept descriptors are as follows:

1. 54: 256 Docs: 0.1564 (family, health, effect, behavior, and mother),
2. 45: 37 Docs: 0.1957 (skill, learn, STEAM, game, and think),
3. 56: 36 Docs: 0.1532 (interaction, learn, student, regard, and review), and
4. 42: 22 Docs: 0.2091 (teacher, preservice, evaluation, in-service, and special).

From key documents of co-occurrence words, four co-occurrence word clusters are classified, according to the classification theme concepts, research topics, and other information. Four clusters are named, as follows:

1. the impact of healthy family life on the development of young children,
2. ECEC curriculum framework (Taiwan),
3. emotional interaction and learning, and
4. pre-service and in-service teacher training.

Cluster Naming Correspondence Analysis

Based on analysis and naming of Taiwan preschool education bibliography and co-occurrence word theme, cluster naming and meaning correspondence have similarities and differences, and results are listed in **Figure 3** and **Table 4**.

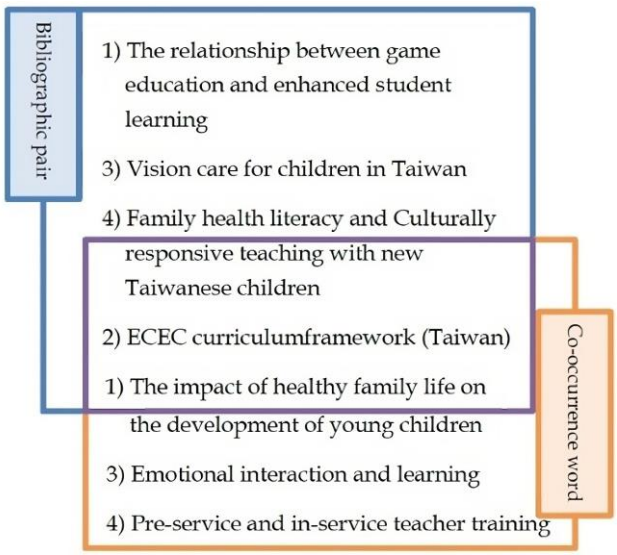

Figure 3. Early childhood education cluster naming similarity map (Source: Authors' own elaboration)

Table 4. Early childhood education cluster naming comparison table

Bibliographic pair	Co-occurrence word
Relationship between game education & enhanced student learning	Impact of healthy family life on development of young children
ECEC curriculum framework (Taiwan)	ECEC curriculum framework (Taiwan)
Vision care for children in Taiwan	Emotional interaction & learning
Family health literacy & culturally responsive teaching with new Taiwanese children	Pre- & in-service teacher training

Note. Solid line indicates the same & dotted line indicates similarity

The same

Bibliographic pair cluster 2 and co-occurrence word cluster 2 have the same research direction, and both are "ECEC curriculum framework (Taiwan)".

The similar

The bibliographic pair cluster 4 and the co-occurrence word cluster 1 have similar research topics, both of which discuss related research such as "family health literacy and life".

It can be understood from **Figure 3** that the analysis samples of this study can be roughly divided into seven categories through the analysis of CATAR. From the cross-comparison of the titles, keywords, and abstracts of key documents in each cluster, it can be found that the co-occurrence words Analysis and classification, closer to key documents than bibliographic pairs.

The possible reason for this result is that scholars probably have habitual personal references to academic materials, and relative bibliographical pairs of materials will be more similar, but descriptive conclusions in academic materials are also diverse, and most scholars only extract a small amount from them. part of the knowledge transfer.

CONCLUSIONS

Taiwan's research on early childhood education between 2012 and 2022 focuses on the following:

1. child health and development,
2. ECEC curriculum framework (Taiwan), and
3. pre-service and in-service preschool educator training.

The research focus of Taiwanese scholars proposed in this study is similar to the research results of Pham et al. (2023). International scholars are most interested in education research in cultivating and training in-service teachers and professional knowledge and acumen of curriculum and teaching content.

It can be seen in the research hotspots of early childhood education in Taiwan from 2012 to 2022, focusing on children's health, preschool curriculum design, and professional knowledge and acumen. In other words, to train future education and protection service personnel, Taiwan's colleges and universities teachers continue to integrate early childhood education-related research into the six primary areas, body movements, health, cognition, language, society, emotions, and aesthetics.

Moreover, situated within an epoch characterized by the swift dissemination of information, educators responsible for training preschool teachers must base their teaching abilities on academic research literacy. This approach necessitates their proactive engagement with the multifarious challenges of dynamic societal transformations. Throughout their teaching careers, educators should not only engage an avenue toward this objective materializes through the persistent dissemination of scholarly contributions within international journals. But also endeavor serves as a mechanism through which educators can refine and augment their inherent capacity for self-directed learning, consequently refining their pedagogical competencies and skill sets, thereby fostering the cultivation of heightened academic and professional competence amongst educators in the field of early childhood education (Zhang et al., 2018). This concerted effort thereby garners strengthened international credibility for early childhood education professionals.

In the future, it is still worthwhile to continue to explore early childhood education and share knowledge with international early childhood education so that educators can cultivate thoughtful and well-informed senior education professionals in the process of training teachers' talent process (Menter & Flores, 2021). Because of its ability to lead academic research, higher education needs to continue to pay attention to changes in the world, policies, and early childhood education practices and explore the positioning of higher education. With the dynamic process of adjustment and exploring single or interdisciplinary academic knowledge, establish a better research and teaching team, form a virtuous cycle, and connect research, teaching, and educational practice in cultivating early childhood education professionals, as shown in **Figure 4**.

The scholarly and vocational accomplishments achieved by Taiwanese institutions of higher education within the domain of early childhood education wield a direct influence over the enhancement of extant practices within Taiwan's early childhood education landscape. Substantive guidance is afforded by identifying and elucidating the focus of the research concentration,

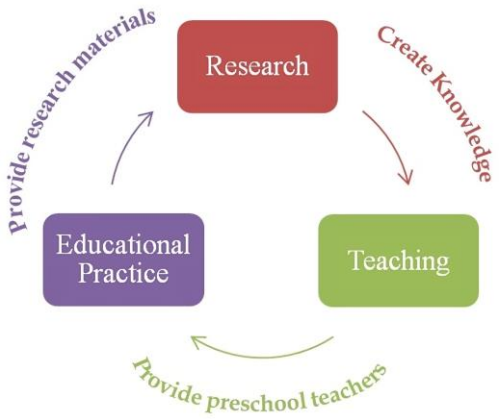

Figure 4. High-quality research, teaching, & teaching practice cycle diagram (Source: Authors' own elaboration)

including children's health, preschool curriculum design, and the professional competence, knowledge, and educators of preschool educators. This guidance, in turn, holds the potential to fortify the preparatory training of prospective early childhood educators, enhance the precision and instructional caliber of educational and safeguarding curricula, and engender an enhanced pedagogical encounter.

The outcomes of this investigation extend beyond a mere deepening of the academic discourse; they spread their influence directly upon practical pedagogical implementation. This symbiotic interplay between scholarly pursuits and pragmatic application catalyzes a prospective, forward-thinking, and adaptable model of early childhood instruction.

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Declaration of interest: No conflict of interest is declared by authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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