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Analyzing Flipped Classroom Themes Trends in Computer Science Education (2007–2023) Using CiteSpace

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ABSTRACT

Flipped classroom (FC) overcomes many drawbacks of traditional teaching and has a wide range of applications in the field of (computer science) CS education. Systematically analyzing the research themes and keywords of the flipped classroom in CS teaching is of great significance in guiding the improvement of the teaching quality of the flipped classroom. In this study, we used CiteSpace to statistically analyze the data of 229 articles published in the core library of Web of Science from 2007 to July 18, 2023, and visualize author co-citation clustering, and keyword co-occurrence. The results of the study showed that (1) the statistical analysis indicated that the application of flipped classroom in CS education has entered a trough period; (2) based on the cluster of author co-citation network, three research themes of CS flipped implementation, online learning, and skill development were identified in this study. (3) Based on the co-occurrence of keywords, this study identified three research hotspots: integration strategies, flipping effectiveness, and challenges faced.

1. Introduction

Flipped classroom (FC), which utilizes technology to deliver learning materials and support students' online learning, is considered the most popular and dynamic approach [1-2]. It overcomes the limitations of traditional teacher-centered didactic teaching through student-centered activities and interactions between learners and teachers [3]. With the traditional face-to-face knowledge transfer shifted to out-of-class time, FC allows teachers to have more classroom time to observe and understand their students and identify deficiencies in their learning, thus helping them to fill knowledge gaps, correct misperceptions, and provide more timely guidance [4].The FC model has been widely used and recognized in different disciplines across the globe, and its popularity is still growing [5], and the current COVID-19 crisis poses a major challenge to schools, thus the importance of "flipped classroom" is increasing day by day[6].

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Computer science (CS) education refers to the art and science involved in learning and teaching computer science, including computation, algorithms, and computational thinking. Examples include pedagogy, curriculum design, and the science behind the pedagogical tools and techniques that educators use to support computer science teaching and learning [7]. There are still some debatable issues regarding the application of FC methods in computer science education. Several studies have shown that students' final grades in CS1 courses using the FC model improved compared to traditional teaching methods [8-9]. Under the FC model, students are more engaged, learn better, have more positive attitudes, and are more motivated to learn [10-12]. However, some practitioners have come to different conclusions. Findlay-Thompson and Mombourquette [13] found that there was no difference in achievement between students who studied in FC classrooms and those who studied in traditional classrooms. Towey [14], through the formation of study groups, the design of pair programming, course feedback, and class discussion way to implement FC teaching in a CS course, although some students' participation was high, there were problems such as attendance, decreased enthusiasm for learning, and interpersonal tension, which were mainly due to untimely feedback, differences in learning styles, overloaded learning, and students' insufficient pre-study, etc.

It can be seen from the literature that scholars do not share the same view on the practice of FC in CS courses, and it is necessary to make an objective and systematic summary of the research on the practice of FC in CS courses, and to clarify the research themes and hotspots in the field of FC in CS education, whereas most of the previous studies have been interpreted based on the content or application of a particular course [15-17]. In order to overcome the subjectivity of the study, this study investigated the application of FC in CS education by using the CiteSpace tool to conduct a bibliometric analysis of relevant articles published in the Web of Science core repository between 2007 and 2023, including four research questions:(1) What is the current state of research on FC in this field? (2) What are the research themes in FC in this area?(3) What are the research hotspots of FC in this field? It is hoped that this study can provide some academic references for subsequent research in this field and provide theoretical references for the effective implementation of FC in the field of CS education.

2. Materials and methods

2.1 Materials

2.1.1 Search policies

Publications in the Web of Science Core Collection were selected as the data source for this study. In order to obtain a wider range of potentially eligible articles, this study collected data on July 18, 2023 with the search formula: TS= ("Flip the classroom" OR "flipped class" OR "flipping" OR "inverted classroom" OR "flipped classroom") AND TS= ("Computer Science" OR "CS" OR "Information technology" OR "Programming" OR "Web Design" OR "Software Engineering" OR "Computer Education"), a total of 2885 documents were retrieved.

2.1.2 Inclusion and exclusion criteria

In order to analyze the hot topics and cutting-edge evolution of the literature related to FC in the field of CS education, the eligible articles are screened with the following inclusion and exclusion criteria (Table 1):

Table 1 Literature inclusion and exclusion criteria

Criteria	Indicators
Inclusion criteria	The full text of the article is published in English. Type of publication: article, review, peer-reviewed. Research focusing on FC pedagogy. Research on teaching and learning in CS education.
Exclusion criteria	The full text of the article is not published in English. Types of publications: books, chapters, papers, conference abstracts, reviews, protocols, research outlines, government publications, posters, editorial materials, duplicates, not peer-reviewed. FC is mentioned but were not the focus of the intervention. Study was not related to the CS education. Inadequate description of student performance or learning activities.

2.1.3Data extraction

Data extraction was implemented according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 statement [18]. Firstly, an automated tool was used to screen for eligible records. The screening format is as follows:

(1) Publication Years = "2007-2023" (index date from 2007 to 01-01 to 2023-07-25).[The term "flipped classroom" originated in 2007 [19].

(2) Document type = "Article" or "Review" or “Proceeding Paper”.

(3) Language = "English".

Secondly, the titles and abstracts of the literature were screened according to the inclusion/exclusion criteria and the full text of the shortlisted literature was downloaded. Thirdly, the downloaded literature was reviewed in full text, irrelevant studies were excluded, and their applicability was assessed by all authors until a consensus was reached. Finally, 229 articles were finalized for this study.

2.2Analysis method and procedure

This study maps and analyzes the literature using CiteSpace, a Java application developed by Chaomei Chen's team, where node size, network connectivity, and keyword co-occurrence properties clearly show the current status and trends of research in the field[20]. It can scientifically measure and visualize the literature collections in the field of natural and social sciences, explore the critical paths of disciplinary evolution, and analyze disciplinary themes and trends[21].This study used CiteSpace version 6.2.R3 (64-bit) for the following analysis:

i.Statistical analysis: Includes temporal distribution and categorization of publications related to the flipped classroom in CS education.

ii. Author co-citation and clustering analyses: reflecting the knowledge base and research themes of flipped classroom research in CS.

iii. Keywords Co-occurrence: The keyword co-occurrence network can reveal the potential hotspots and trends of future flipped classroom research in CS education.

iv. Construction of a comprehensive knowledge framework: it can help scholars quickly understand the comprehensive knowledge and logical structure of FC in CS education from multiple perspectives.

3.Results

3.1 Statistical Analysis

The number of papers and their variations represent differences in the amount of research and attention given to the field [21]. Figure 1 shows the published papers related to flipped classroom in CS education during the 17-year period from 2007-2023.

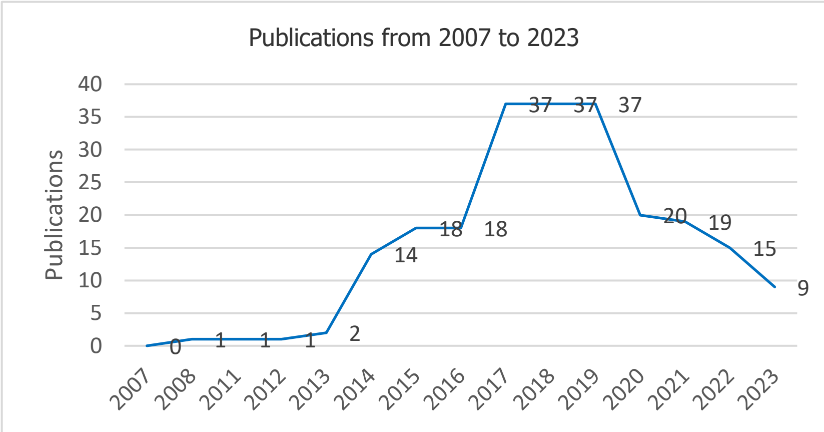

Fig. 1. Published papers applying the flipped classroom in CS education from 2007 to 2023

The Hype Cycle traces the evolution of technological innovations in five successive phases, including Technology Trigger, Peak of Inflated Expectations, Trough of Disillusionment, Slope of Enlightenment, and Plateau of Productivity [22]. According to Hype Cycle, combined with the number of published papers in Figure 1, FC in CS education is currently in Trough of Disillusionment. its development path is roughly:

i. Technology Trigger (2008-2014)

Although the term FC originated in 2007, the earliest 1 paper in the field of CS education was published in 2008, followed by 1 paper each in 2011-2013 and 2 in 2013. Researchers in the field of CS education began focusing on the FC in 2014, and the number of articles published increased to 14.

ii. Peak of Inflated Expectations (2015-2020)

In 2015, this teaching method was widely recognized in the field of CS education, and teachers of related courses implemented the FC in their CS courses. The number of publications was 18 in 2015-2016, respectively, and the number of publications increased to 37 in 2017-2019, however, in 2020, the number of publications decreased to 20.

iii. Trough of Disillusionment (2021-Current)

By 2021, the number of postings is decreasing year by year, indicating that researchers in the field of CS education are experiencing a sober reflection on the scope and limitations of the role of the FC after experiencing the previous stages of the FC time. Some scholars believe that there is not enough evidence to prove that the FC is definitely better than the traditional classroom, and the challenges of FC such as the resistance of teachers, students, and parents, time-consuming and labor-intensive [23], and the difficulty of developing high-quality instructional videos have also hindered the application of FC in the CS field to a certain extent. Therefore, researchers in the field of CS education need to actively optimize FC to get it out of the trough and into the recovery and maturity period as soon as possible, so that FC methodology can play a maximum effect in the field of CS education.

3.2 Knowledge Structure Map

A total of 33 knowledge clusters were generated in this study (Figure 2). According to Figure 2, the modularity Q-value was 0.7948 and the average silhouette value was 0.9058, which indicates that the FC research mapping in the field of CS education underwent a high-quality cluster analysis. The results of the cluster analysis of the authors' co-citations show that Lage, Bergmann, Bishop, O'FLAHERTY, and Mason are at the center of the co-citation network, and the other researchers use these scholars as a pivot point to extend outward. By combing the representative literature of the main researchers on the nodes, it can be summarized that FC research in computer science education focuses on three main themes: flipped implementation, online learning, and skill development.

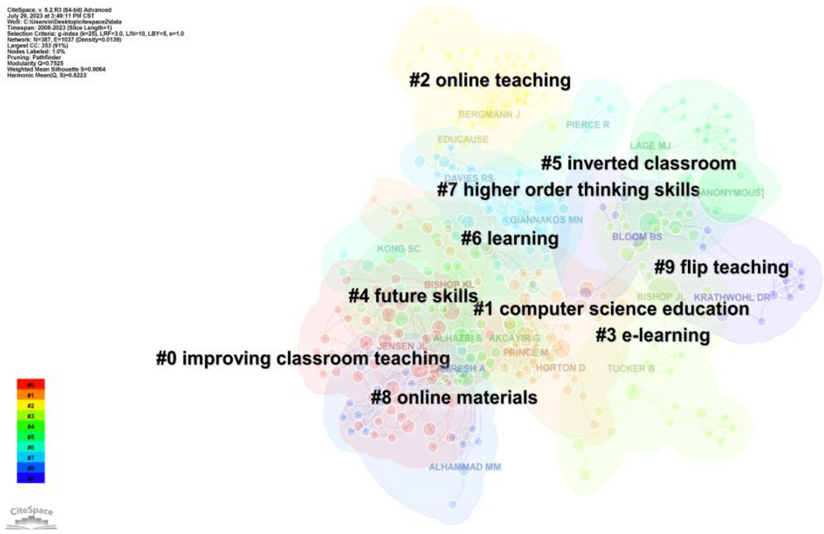

Fig. 2. Cluster of author Co-citation network

3.2.1 Flipped Implementation

This is represented in the figure as clusters 0, 1, 5, 6 and 9. Research in this area focuses on pre-course preparation and implementation of classroom activities. Preclassroom learning is very important for successful implementation of FC. According to Pattanaphanchai [24], the main challenge in implementing FC in a computer science course is to ensure student engagement with preclassroom materials. Pre-classroom activities for FC are aligned with Bloom's lower-order thinking skills (memorization, comprehension), and are implemented mainly in the form of videos and readings [25]. Meanwhile, when students encounter some difficulties in understanding and applying the concepts in preclass learning, teachers should give timely feedback and build necessary scaffolds for students to solve the problems in terms of student engagement, learning and interaction. Classroom activities tend to be brief, highly structured, and teacher-driven, with a focus on developing higher-order levels of thinking (applying, analyzing, evaluating, and creating) [25], being able to apply what they have learned to solve higher-level or real-world problems with the support of the teacher and their peers, and integrating their new knowledge into real-world contexts [26].

Zhao *et al.* [27] showed that technology-assisted learning materials help to clarify abstract concepts, thus enabling students to overcome difficulties in the learning process. Some technological tools can be used to support better classroom activities. Such as Padlet, Kahoot and Cirrus [28]. The FC model emphasizes the learning process rather than the learning outcome; therefore, assessment of course learning should include both summative and formative assessment [29], incorporating students' learning outside the classroom, and the quality of classroom interactions should be reflected in the overall grade.

3.2.2 Online Learning

This is represented as # 2 and #3 in the figure. Research in this area focuses on online learning materials, activities and platforms. #2 research is represented by Bergmann, who argues that free online video resources make it easy for readers to find high-quality videos, e.g. Massive Open Online Courses (MOOCs) established around the world can be used as ready-to-use resources [30]. #3 "Online Learning" is represented by Bishop, who sees the tasks of online learning as primarily asynchronous video lectures and practice problems. Online learning materials, activities need to be managed by instructors using a variety of technologies or online platforms. LMS is the most commonly used online platform, Moodle, MOOC platforms, Blackboard and Schoology are widely used to store syllabus, instructional videos, post course announcements, provide online discussions, quizzes and support electronic assignment submissions [31].LMS use should be learner-centered, capable of capturing formative data about instructor-learner interactions in real time, guiding students through a series of online activities, tracking student logins and their online learning activities, and incorporating a great deal of interactivity into the overall online experience [32].

With the development of artificial intelligence and big data technologies, learning management systems can enable personalized learning, assessment and grading, educational games and simulations [33], analyze data on student performance, preferences, and other factors, customize learning paths for learners, and provide targeted support and feedback [34], which in turn can increase student motivation and engagement and improve learning outcomes [35]. Moodle and Khan Academy have integrated the Chat GPT plugin [36], which may provide a solution to escape the dilemmas faced by FC, such as overburdened teachers and untimely feedback.

3.2.3 Skill Development

This is represented in the diagram as #4, #7. The research in this field focuses on the development of future skills and higher-order thinking skills. # 4, Future Skills, is represented by Akçayır. Akçayır *et al.* [37] conducted a large-scale literature review on FC and showed that the FC model improves students' critical thinking, socialization, and problem-solving skills. One of the specific learning outcomes of a CS program is to develop independent problem-solving skills, and students' ability to solve problems through hands-on engage in deep learning, which can be a very rewarding experience for both students and teachers in CS education [38]. # 7,"higher order thinking skills" is represented by Davis, who argues that effective FC classroom time should be used to help students master particularly challenging concepts or to help students engage in higher-order critical thinking and problem solving[39]. Liu *et al.*[40] showed that students who participated in a flipped information technology course had significantly better higher-order thinking skills than those who learned in a traditional classroom setting. Wilson [41] applied the FC model to an object-oriented programming class, designing learning activities such as problem and inquiry-based learning, collaborative programming, peer review, and discussion. The results of the study showed that these activities were an effective way to help students develop higher-order skills such as creativity, problem solving, and communication.

3.3 Keyword Analysis

Figure 3 shows the research hotspots of FC in CS education, which includes three main categories of keywords: integration strategies, challenges, and effects. In addition, "software engineering" and "computer programming" are also included, indicating that FC practices in CS education are mainly focused on these two courses.

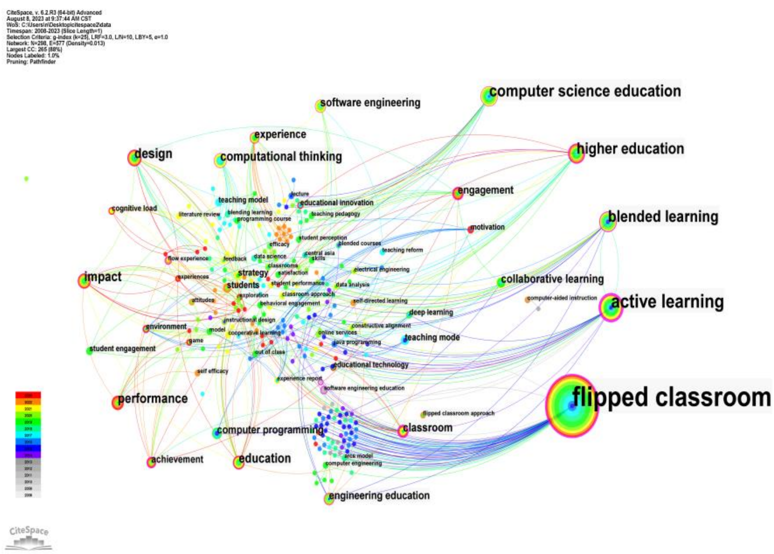

Fig. 3. Keywords Co-occurrence

3.3.1 Integration Strategies

Keywords related to integration strategies include "active learning", "blended learning", "design", "collaborative learning", "strategy", and "environment". These studies focus on integrating learning strategies such as active learning, collaborative learning, and problem solving into the design of FC.

According to Ridzuan *et al.* [1], the FC model implements active learning strategies through a hybrid structure of face-to-face classroom and online environments. Practitioners in the field of CS education have designed a series of active learning activities such as discussion, collaboration, and interactive communication to effectively implement FC in a computer programming course with good results [42]. Since there is enough time for training in FC, incorporating collaborative learning strategies not only improves students' academic performance, but also enhances their self-confidence in computer programming [43]. In addition to this, FC incorporates problem-based [44], project-based [45], and gamification [46] strategies.

In addition to performing strategy integration, practitioners may consider using other interactive technologies such as eye-tracking and brain-computer interaction technologies in FC to investigate the development of this process model and its impact on learning outcomes in CS courses [16].

3.3.2 The Effectiveness of flipped classroom

The keywords related to the effect of flipped classroom are "computational thinking", "participation", "experience", "achievement", "influence" and "motivation". Cultivating students' computational thinking ability is one of the important topics in the research on teaching and learning in computer courses, and researchers' teaching practices have proved the positive impact of FC on "computational thinking" ability [47-48]. In addition, a study by Lai *et al.*[49] further identified flow experience as a significant predictor of computational thinking skills in programming courses.

Numerous studies have pointed out that in CS education, student engagement is higher in FC courses that incorporate FC models into Facebook virtual learning communities [50], games [51], and AI personalized recommendation elements [52]. The study by Yılmaz *et al.* [50] further pointed out that a sense of socialization, a sense of community, and satisfaction are also significant predictors of student engagement. FC is a method to improve academic performance in computer science courses [10], and some researchers have further explored the effects of other factors in FC on performance, such as cognitive flexibility, problem-solving skills, and flipped learning readiness [53]; student choice [9]; knowledge management and inquiry-based instructional strategies [54]; learning experiences [55]; and collaboration [56]. In addition, FC provides more opportunities for communication [57] or combines SPOC with FC activities implemented in the classroom [58], thus increasing motivation (motivation) to take CS courses.

Most of these studies have demonstrated that FC has multiple effects on students, such as self-regulation [59], self-efficacy [9,60], self-directed learning [11], and deep learning [61].

3.3.3 The Challenges of flipped classroom

Keywords related to challenge include "cognitive load", "computer anxiety", "anxiety", "challenge", "bias", and "challenge". Students face a high cognitive load during the learning process of programming courses [62]. Meanwhile, textual programming language environments (e.g., C, python, etc.) have complex programming features that make it difficult to reduce the cognitive load [63]. In the field of FC, practitioners have mainly reduced students' cognitive load while taking CS courses by combining other teaching strategies with FC, such as the use of scaffolding [64], concept mapping [65], and TL (team learning) interventions [66]. Anxiety is another challenge in implementing FC in the field of CS education, mainly computer anxiety and social anxiety, and studies have shown that adequate online learning preparation before class and peer support groups can reduce computer anxiety faced by students during the application of the FC model and improve academic performance [60]. Meanwhile, students must demonstrate a greater sense of responsibility to control and monitor their own learning in order to make pre-course online learning more meaningful [67]. Social anxiety is one of the main challenges faced during online learning, and Polat *et al.*'s [68] study of flipped information technology (IT) courses showed that self-efficacy had a positive effect on social anxiety. The greater the students' skills and ability to interact with the instructor and peers, the less social anxiety they experienced in the course.

In addition to "cognitive load" and "anxiety," implementation of FC in CS education has faced challenges such as high teacher and student load, decreased student attendance, difficulty maintaining motivation, and resistance to new formats [15,17].

4. Conclusions and Recommendations

The analysis results of this study show that researchers in the field of CS education have done a lot of practice on the implementation process, effects, and challenges of FC, so it is necessary to construct a comprehensive knowledge framework (as shown in Fig. 4) to give readers a clearer understanding of this field. In this study, a comprehensive planning of FC research in the field of CS education was conducted from the statistics of publication information, collaboration information, author co-citation information keyword co-occurrence information as follows:

i.Statistical information shows the current status of FC papers published in the field of CS education. ii. From the number of papers published annually from 2008 to July 2023, the duration of research development is divided into three phases: the technology germination phase (2008-2014), the rapid development phase (2015-2020), and the bubble phase (2021-present). With the increasing popularity of Internet technology, coupled with the publication by Bergman and Sams [69] working on FC and media publicity, research on FC gradually increased after 2012 , and researchers in the field of CS education gradually seized this opportunity to actively promote and apply it, although the number of papers published in the first decade showed a fluctuating upward trend, and a number of influential journals also published a large number of papers in this field. However, confined to the implementation of FC is also facing some challenges, the data in recent years showed a downward trend, and the current application of FC has entered a trough period. This urgently requires researchers in the field of computer education to actively promote the application of FC in CS education, and to strengthen cooperation, pay attention to teachers' and students' willingness to use, and utilize the advantages of FC with the help of information technologies such as artificial intelligence, virtual reality, data mining, etc., to further explore new forms of FC application in CS education.

ii.The authors' co-citation clustering suggests that the implementation of FC in CS teaching is divided into two phases, pre-course and in-course, where student participation is ensured during the online learning process before the course, and student interaction and student competence development are emphasized during the course.

iii. Keyword co-occurrence helps to understand valuable topics. A new research trend may be to combine FC with other instructional strategies (e.g., collaboration, active learning, problem solving, etc.) to overcome challenges (e.g., cognitive load, computer anxiety, etc.) and to focus on the effects of the internal mechanisms of FC (engagement, experience, motivation, etc.) on the instructional outcomes (grades, computational thinking, self-regulation skills, self-efficacy).

iv. The authors' co-citation clustering information and keyword co-occurrence information allow readers to understand the research topics and hotspots of FC in CS.By sorting out the implementation process of FC in CS courses, including integrating other teaching strategies, designing pre- and in-class activities, and overcoming difficulties in order to achieve appropriate learning outcomes.

v.

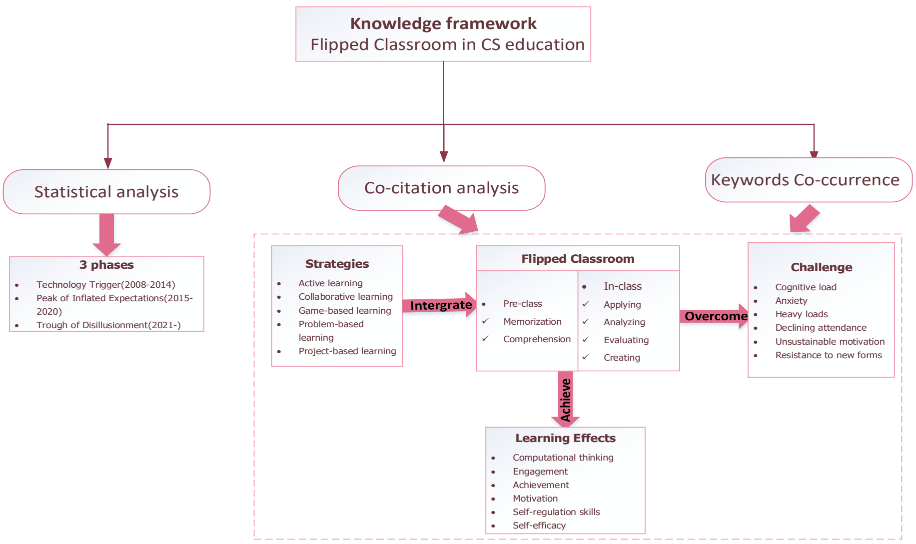

Fig. 4. Knowledge framework of Flipped Classroom in CS education

This study analyzed WoS publications on flipped classrooms in CS education using CiteSpace. The findings reveal the research themes and research hotspots of FC in CS education through visualized author co-citation clustering and keyword co-occurrence, which helps scholars to have a dynamic and comprehensive understanding of this research area. Although we examined the research progress of FC in CS education from multiple perspectives and constructed a comprehensive knowledge framework, some of the excluded data may affect the analysis results because only English publications in the WoS core database before July 18, 2023 were selected. In the future, we will expand the database and extend the time period to further explore studies in other languages to characterize FC in CS education in more detail. More and more scholars are contributing to the use of FC in CS education by integrating new strategies and introducing new technologies.

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References

[1] Ridzuan, Raihana, Wan Nur Asyura Wan Adnan, Zarita Zakaria, Nur Izzati Mohd Noh, and Fazilah Abd Manan. "Perception of Biology Students to Flipped Classroom Approach in Biological Control and Environment Conservation." *International Journal of Advanced Research in Future Ready Learning and Education* 27, no. 1 (2022): 9–15.

[2] Ozdamli, Fezile, and Gulsum Asiksoy. "Flipped Classroom Approach." *World Journal on Educational Technology: Current Issues* 8, no. 2 (2016): 98–105. https://doi.org/10.18844/wjet.v8i2.640.

[3] Low, Min Chi, Chen Kang Lee, Manjit Singh Sidhu, Seng Poh Lim, Zaimah Hasan, and Seng Chee Lim. "Blended Learning to Enhanced Engineering Education Using Flipped Classroom Approach: An Overview." *electronic Journal of Computer Science and Information Technology* 7, no. 1 (2021). https://doi.org/10.52650/ejcsit.v7i1.111.

[4] Berrett, Dan. "How 'flipping'the classroom can improve the traditional lecture." The chronicle of higher education 12, no. 19 (2012): 1-3.

[5] Malik, Khalid Mahmood, and Meina Zhu. "Do Project-Based Learning, Hands-on Activities, and Flipped Teaching Enhance Student's Learning of Introductory Theoretical Computing Classes?" *Education and Information Technologies* 28, no. 3 (2022): 3581–3604. https://doi.org/10.1007/s10639-022-11350-8.

[6] Nor, Siti Rohani Mohd, Adina Najwa Kamarudin, and Nurul Aini Jaafar. "Comparison on the Student's Performances during Physical and Online Learning in Financial Mathematics Course." *International Journal of Advanced Research in Future Ready Learning and Education* 28, no. 1 (2022): 1–8.

[7] Agbo, Friday Joseph, Ismaila Temitayo Sanusi, Solomon Sunday Oyelere, and Jarkko Suhonen. "Application of Virtual Reality in Computer Science Education: A Systemic Review Based on Bibliometric and Content Analysis Methods." *Education Sciences* 11, no. 3 (2021): 142. https://doi.org/10.3390/educsci11030142.

[8] Horton, Diane, Michelle Craig, Jennifer Campbell, Paul Gries, and Daniel Zingaro. "Comparing outcomes in inverted and traditional CS1." In *Proceedings of the 2014 conference on Innovation & technology in computer science education*, pp. 261-266. 2014.https://doi.org/10.1145/2591708.2591752.

[9] Schwarzenberg, Pablo, and Jaime Navón. "Supporting goal setting in flipped classes." *Interactive learning environments* 28, no. 6 (2020): https://doi.org/671-684.10.1080/10494820.2019.1707691

[10] Etemi, Blerta Prevalla, and Huseyin Uzunboylu. "The effects of flipped learning method on students' perception and learning of java programming." *International Journal of Engineering Education* 36, no. 4 (2020): 1372-1382.https://doi.org/10.37200/ijpr/v24i5/pr2020251

[11] Bui, Thi Thuy Hang, Amrita Kaur, and Tran Van Hung. "A flipped classroom to personalise learning for engineering students." *International Journal of Learning Technology* 17, no. 2 (2022): 97-114.https://doi.org/10.1504/ijlt.2022.125082

[12] Chiu, Po-Sheng, Hua-Xu Zhong, and Chin-Feng Lai. "Investigating the effects of a programming course using flipped learning." *Innovations in Education and Teaching International* 60, no. 4 (2023): 578-590.https://doi.org/10.1080/14703297.2022.2080097

[13] Findlay-Thompson, Sandi, and Peter Mombourquette. "Evaluation of a flipped classroom in an undergraduate business course." *Business education & accreditation* 6, no. 1 (2014): 63-

71.https://doi.org/10.1080/10691898.2017.1381056

[14] Towey, Dave. "Lessons from a failed flipped classroom: The hacked computer science teacher." In *2015 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*, pp. 11-15. IEEE, 2015.https://doi.org/10.1109/tale.2015.7386008

[15] Bakheet, Eman Madani, and Andrew M. Gravell. "Significant Factors Influencing Computer Science Instructor's Behavioral Intentions to Adopt the Flipped Classroom: A Global Quantitative Study." In *2021 10th International Conference on Educational and Information Technology (ICEIT)*, pp. 150-155. IEEE, 2021.https://doi.org/10.1109/iceit51700.2021.9375590

[16] Hendrik, Hendrik, and Almed Hamzah. "Flipped classroom in programming course: A systematic literature review." *International Journal of Emerging Technologies in Learning (iJET)* 16, no. 2 (2021): 220-236.https://doi.org/10.3991/ijet.v16i02.15229

[17] Veras, Nécio L., Lincoln S. Rocha, and Windson Viana. "Flipped classroom in software engineering: A systematic mapping study." In *Proceedings of the XXXIV Brazilian Symposium on Software Engineering*, pp. 720-729. 2020.https://doi.org/10.1145/3422392.3422490

[18] Page, Matthew J., Joanne E. McKenzie, Patrick M. Bossuyt, Isabelle Boutron, Tammy C. Hoffmann, Cynthia D. Mulrow, Larissa Shamseer et al. "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews." *International journal of surgery* 88 (2021): 105906.https://doi.org/10.1016/j.jval.2020.04.1154

[19] Lin, Hui-Chen, and Gwo-Jen Hwang. "Research trends of flipped classroom studies for medical courses: A review of journal publications from 2008 to 2017 based on the technology-enhanced learning model." *Interactive Learning Environments* 27, no. 8 (2019): 1011-1027.https://doi.org/10.1080/10494820.2018.1467462

[20] Wang, Duomin, Yubin Huangfu, Zuoji Dong, and Yiqi Dong. "Research hotspots and evolution trends of carbon neutrality—visual analysis of bibliometrics based on CiteSpace." *Sustainability* 14, no. 3 (2022): 1078.https://doi.org/10.3390/su14031078

[21] Sun, Liyan, Li Yang, Xue Wang, Junqi Zhu, and Xuesen Zhang. "Hot topics and frontier evolution in college flipped classrooms based on mapping knowledge domains." *Frontiers in Public Health* 10 (2022): 950106.https://doi.org/10.3389/fpubh.2022.950106

[22] Linden, Alexander, and Jackie Fenn. "Understanding Gartner's hype cycles." *Strategic Analysis Report Nº R-20-1971. Gartner, Inc* 88 (2003): 1423.https://doi.org/10.11114/jets.v2i1.228

[23] Maher, Mary Lou, Celine Latulipe, Heather Lipford, and Audrey Rorrer. "Flipped classroom strategies for CS education." In *Proceedings of the 46th ACM Technical Symposium on Computer Science Education*, pp. 218-223. 2015.https://doi.org/10.1145/2676723.2677252

[24] Pattanaphanchai, Jarutas. "An investigation of students' learning achievement and perception using flipped classroom in an introductory programming course: A case study of Thailand higher education." *Journal of University Teaching & Learning Practice* 16, no. 5 (2019): 4.https://doi.org/0.53761/1.16.5.4

[25] Başaran, Seren. "INVESTIGATING UNIVERSITY STUDENTS'VIEWS ON FLIPPED CLASSROOM APPROACH." In *INTED2019 Proceedings*, pp. 8050-8059. IATED, 2019.https://doi.org/10.21125/inted.2019.1998

[26] Amira, Teimzit, Mahnane Lamia, and Mohamed Hafidi. "Implementation and evaluation of flipped algorithmic class." *International Journal of Information and Communication Technology Education (IJICTE)* 15, no. 1 (2019): 1-12.https://doi.org/10.4018/ijicte.2019010101

[27] Zhao, Dan, A. Chis, G. M. Muntean, and C. H. Muntean. "A large-scale pilot study on game-based learning and blended learning methodologies in undergraduate programming courses." In *Edulearn18 Proceedings*, pp. 3716-3724. IATED, 2018.https://doi.org/10.21125/edulearn.2018.0948

[28] Dianati, Seb, Mai Nguyen, Phung Dao, Noriko Iwashita, and Claudia Vasquez."Student Perceptions of Technological Tools for Flipped Instruction: The Case of Padlet, Kahoot! And Cirrus." Journal of University Teaching and Learning Practice 17, no.5 (2020): 52- -66.https://doi.org/10.53761/1.17.5.4.

[29] Sun, Jerry Chih-Yuan, and Yu-Ting Wu. "Analysis of learning achievement and teacher–student interactions in flipped and conventional classrooms." *International Review of Research in Open and Distributed Learning* 17, no. 1 (2016): 79-99.https://doi.org/10.19173/irrodl.v17i1.2116

[30] Umar, Norazah, Nurhafizah Ahmad, Jamal Othman, and Rozita Kadar. "Investigating Students' Acceptance of e-Learning Effectiveness: A Case Study in Higher Education." *Journal of Advanced Research in Computing and Applications*, 2023, 1–10.

[31] Draskovic, Drazen, Marko Misic, and Zarko Stanisavljevic. "Transition from Traditional to LMS Supported Examining: A Case Study in Computer Engineering." *Computer Applications in Engineering Education* 24, no. 5 (September 2016): 775–86. https://doi.org/10.1002/cae.21750.

[32] Zainuddin, Zamzami, and Corinne Jacqueline Perera. "Supporting students' self-directed learning in the flipped classroom through the LMS TES BlendSpace." *On the Horizon* 26, no. 4 (2018): 281-290.https://doi.org/10.1108/oth-04-2017-0016

[33] Kothari, Garima, and B. L. Verma. "AI-Implanted E-Learning 4.0: A New Paradigm in Higher Education." *Impact of Artificial Intelligence on Organizational Transformation* (2022): 305-325.https://doi.org/10.1002/9781119710301.ch18

[34] Tapalova, Olga, and Nadezhda Zhiyenbayeva. "Artificial Intelligence in Education: AIEd for Personalised Learning Pathways." *Electronic Journal of e-Learning* 20, no. 5 (2022): 639-653.https://doi.org/10.34190/ejel.20.5.2597

[35] Jaafar, Nurulaini, Siti Rohani Mohd Nor, Siti Mariam Norrulashikin, Nur Arina Bazilah Kamisan, and Ahmad Qushairi Mohamad. "Increase Students' Understanding of Mathematics Learning Using the Technology-Based Learning." *International Journal of Advanced Research in Future Ready Learning and Education* 28, no. 1 (2022): 24–29.

[36] FIRAT, Mehmet. "Integrating AI applications into learning management systems to enhance e-learning." *Instructional Technology and Lifelong Learning* 4, no. 1 (2023): 1-14.https://doi.org/10.52911/itall.1244453

[37] Akçayır, Gökçe, and Murat Akçayır. "The flipped classroom: A review of its advantages and challenges." *Computers & Education* 126 (2018): 334-345.https://doi.org/10.1016/j.compedu.2018.07.021

[38] Hettiarachchi, E. "ENHANCING THE UNDERGRADUATE LEARNING EXPERIENCE BY TAKING A LEAP INTO ACTIVE LEARNING." In *INTED2019 Proceedings*, pp. 1666-1676. IATED, 2019.https://doi.org/10.21125/inted.2019.0487

[39] Davies, Randall S., Douglas L. Dean, and Nick Ball. "Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course." *Educational Technology Research and Development* 61 (2013): 563-580.https://doi.org/10.1007/s11423-013-9305-6

[40] Liu, Dongping, and Hai Zhang. "Improving students' higher order thinking skills and achievement using WeChat based flipped classroom in higher education." *Education and Information Technologies* 27, no. 5 (2022): 7281-7302.https://doi.org/10.1007/s10639-022-10922-y

[41] Wilson, Shane. "LESSONS LEARNED FROM FLIPPING A LARGE-SCALE PROGRAMMING COURSE." *ICERI Proceedings*, November 2018. https://doi.org/10.21125/iceri.2018.1805.

[42] Lucho, Stuardo, Gumercindo Bartra Gardini, and José María Espinoza Bueno. "Teaching web development courses using flipped classroom and Discord: a two-year experience in the Peruvian context during the COVID-19 pandemic." In *2023 IEEE World Engineering Education Conference (EDUNINE)*, pp. 01-06. IEEE, 2023.https://doi.org/10.1109/edunine57531.2023.10102865

[43] Hayashi, Yasuhiro, Ken-Ichi Fukamachi, and Hiroshi Komatsugawa. "Collaborative learning in computer programming courses that adopted the flipped classroom." In *2015 International Conference on Learning and Teaching in Computing and Engineering*, pp. 209-212. IEEE, 2015.https://doi.org/10.1109/latice.2015.43

[44] Hsu, Wen-Chun, and Hao-Chiang Koong Lin. "Impact of applying WebGL technology to develop a web digital game-based learning system for computer programming course in flipped classroom." In *2016 International Conference on Educational Innovation through Technology (EITT)*, pp. 64-69. IEEE, 2016.https://doi.org/10.1109/eitt.2016.20

[45] Anuar Mohd Yusof, Radhya Yusri, and Azlin Sharina. "A Proposed Integration Model of Project Based Learning and Simulation to Improve the Learning Quality". *International Journal of Advanced Research in Future Ready Learning and Education* 34, no. 1 (2024): 63-76. https://www.akademiabaru.com/submit/index.php/frle/article/view/5309.

[46] Amilah,Anis. "The Usability of Mobile Experiment Application in Science Subject for Secondary Student." Advanced Research in Computing and Applications 16, no. 1 (2019): 34–41.

[47] Fang, Ai-Dong, Guo-Long Chen, Zhi-Rang Cai, Lin Cui, and Lein Harn. "Research on Blending Learning Flipped Class Model in Colleges and Universities Based on Computational Thinking—"Database Principles" for Example." *Eurasia Journal of Mathematics, Science and Technology Education* 13, no. 8 (2017): 5747-5755.https://doi.org/10.12973/eurasia.2017.01024a

[48] Senske, Nick. "Evaluation and impact of a required computational thinking course for architecture students." In *Proceedings of the 2017 ACM SIGCSE Technical Symposium on computer science education*, pp. 525-530. 2017.https://doi.org/10.1145/3017680.3017750

[49] Lai, Chin-Feng, Hua-Xu Zhong, and Po-Sheng Chiu. "Investigating the impact of a flipped programming course using the DT-CDIO approach." *Computers & Education* 173 (2021): 104287.https://doi.org/10.1016/j.compedu.2021.104287

[50] Yılmaz, Fatma Gizem Karaoğlan, and Ramazan Yılmaz. "Exploring the role of sociability, sense of community and course satisfaction on students' engagement in flipped classroom supported by facebook groups." *Journal of computers in education* 10, no. 1 (2023): 135-162.https://doi.org/10.1007/s40692-022-00226-y

[51] Huang, Biyun, Khe Foon Hew, and Chung Kwan Lo. "Investigating the effects of gamification-enhanced flipped learning on undergraduate students' behavioral and cognitive engagement." *Interactive Learning Environments* 27, no. 8 (2019): 1106-1126.https://doi.org/10.1080/10494820.2018.1495653

[52] Huang, Anna YQ, Owen HT Lu, and Stephen JH Yang. "Effects of artificial Intelligence–Enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom." *Computers & Education* 194 (2023): 104684.https://doi.org/10.1016/j.compedu.2022.104684

[53] Durak, Hatice Yildiz. "Modeling different variables in learning basic concepts of programming in flipped classrooms." *Journal of Educational Computing Research* 58, no. 1 (2020): 160-199.https://doi.org/10.1177/0735633119827956
[54] Thongkoo, Krittawaya, Patcharin Panjaburee, and Kannika Daungcharone. "Integrating Inquiry Learning and Knowledge Management into a Flipped Classroom to Improve Students' Web Programming Performance in Higher Education." *Knowledge Management & E-Learning* 11, no. 3 (2019): 304-324.https://doi.org/10.34105/j.kmel.2019.11.016
[55] Schwarzenberg, Pablo, Jaime Navon, Miguel Nussbaum, Mar Pérez-Sanagustín, and Daniela Caballero. "Learning experience assessment of flipped courses." *Journal of Computing in Higher Education* 30 (2018): 237-258.https://doi.org/10.1007/s12528-017-9159-8
[56] Hwang, Wu-Yuin, Rio Nurtantyana, and Uun Hariyanti. "Collaboration and interaction with smart mechanisms in flipped classrooms." *Data Technologies and Applications* (2023).https://doi.org/10.1108/dta-04-2022-0171
[57] Halabi, Osama, Saleh Alhazbi, and Samir Abou El-Seoud. "Students perceptions in a flipped computer programming course." In *The Challenges of the Digital Transformation in Education: Proceedings of the 21st International Conference on Interactive Collaborative Learning (ICL2018)-Volume 2*, pp. 76-85. Springer International Publishing, 2019.https://doi.org/10.5220/0006794203030308
[58] Alario-Hoyos, Carlos, Iria Estévez-Ayres, Carlos Delgado Kloos, and Julio Villena-Román. "From MOOCs to SPOCs… and from SPOCs to flipped classroom." In *Data Driven Approaches in Digital Education: 12th European Conference on Technology Enhanced Learning, EC-TEL 2017, Tallinn, Estonia, September 12–15, 2017, Proceedings 12*, pp. 347-354. Springer International Publishing, 2017.https://doi.org/10.1007/978-3-319-66610-5_25
[59] Karaoğlan Yılmaz, Fatma Gizem, Yusuf Ziya Olpak, and Ramazan Yılmaz. "The effect of the metacognitive support via pedagogical agent on self-regulation skills." *Journal of Educational Computing Research* 56, no. 2 (2018): 159-180.https://doi.org/10.1177/0735633117707696
[60] Yildiz Durak, Hatice. "Flipped classroom model applications in computing courses: Peer-assisted groups, collaborative group and individual learning." *Computer Applications in Engineering Education* 30, no. 3 (2022): 803-820.https://doi.org/10.1002/cae.22487
[61] SHIa, Xi, Li XIAO, and Duo CHEN. "The Application of Deep Learning Field Construction Based on the Integration of Online Course and Flipped Classroom."https://doi.org/10.12783/dtssehs/mess2017/12210
[62] Eusoff, Rosnizam, Syahanim Mohd Salleh, and Abdullah Mohd Zin. "Implementing Flipped Classroom Strategy in Learning Programming." *International Journal of Advanced Computer Science and Applications* 12, no. 10 (2021).https://doi.org/10.14569/ijacsa.2021.0121066
[63] Zhong, Hua-Xu, Po-Sheng Chiu, and Chin-Feng Lai. "Effects of the use of CDIO engineering design in a flipped programming course on flow experience, cognitive load." *Sustainability* 13, no. 3 (2021): 1381.https://doi.org/10.3390/su13031381
[64] Midun, Hendrikus, Oswaldus Bule, and Widdy HF Rorimpandey. "The effect of scaffolding on assignment quality and procedural learning achievement." *Journal of Educational, Cultural and Psychological Studies (ECPS Journal)* 22 (2020): 143-157.https://doi.org/10.7358/ecps-2020-022-midu
[65] Kuo, Yu-Chen, Yu-Hsuan Lin, Tao-Hua Wang, Hao-Chiang Koong Lin, Ju-I. Chen, and Yueh-Min Huang. "Student learning effect using flipped classroom with WPSA learning mode-An Example of Programming Design Course." *Innovations in Education and Teaching International* (2022): 1-12.https://doi.org/10.1080/14703297.2022.2086150
[66] Cheng, Yih-Ping, Pei-Di Shen, Min-Ling Hung, Chia-Wen Tsai, Chih-Hsien Lin, and Lynne Cheng Hsu. "Applying online content-based knowledge awareness and team learning to develop students' programming skills, reduce their anxiety, and regulate cognitive load in a cloud classroom." *Universal Access in the Information Society* (2021): 1-16.https://doi.org/10.1007/s10209-020-00789-6
[67] Norhaslinda Hassan, Min Hui Leow, Fenny Thresia, and Lu Qiaoqiao. "Exploring Self-Directed Learning Readiness Among Undergraduates in ESL Classrooms". *International Journal of Advanced Research in Future Ready Learning and Education* 34, no. 1 (2024): 53-62. https://www.akademiabaru.com/submit/index.php/frle/article/view/5311.
[68] Polat, Elif, Sinan Hopcan, and Tuğba Kamalı Arslantaş. "The association between flipped learning readiness, engagement, social anxiety, and achievement in online flipped classrooms: a structural equational modeling." *Education and Information Technologies* 27, no. 8 (2022): 11781-11806.https://doi.org/10.1007/s10639-022-11083-8
[69] Bergmann, Jonathan, and Aaron Sams. *Flip your classroom: Reach every student in every class every day. International society for technology in education*, 2012.