Student-centered Computer Course Teaching reform

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Abstract. The traditional teaching mode of computer course is usually based on teachers and students passively accept knowledge. Although this mode plays an important role in knowledge inheritance, it has some limitations such as passive learning, emphasizing memory rather than understanding, lacking interactivity and hindering the nurturing of innovative capabilities, this paper zeroes in on student-centric pedagogical reforms in computer science education, critically examining the prevailing issues within contemporary computer course instruction, and discusses how to effectively transform the traditional teacher-led teaching mode, and construct a teaching system that pays more attention to students 'subjectivity, personalized learning and ability cultivation. This kind of teaching system can not only fundamentally reposition the key role and goal in the education process, put students in the central position of educational activities, not only should we prioritize and facilitate the holistic growth of every student, but also foster an environment where learners are motivated to actively engage in dialogue, pursue collaborative studies, and enhance their teamwork skills. This approach will more effectively hone students' abilities in critical analysis and innovation, empowering them to realize their full potential. Such an education lays the groundwork for young minds to meet and surmount the multifaceted challenges awaiting them in the future society.

Keywords: Computer course; Education and teaching reform; Be student-centered

1. Introduction

Amidst the relentless march of time and the swift advancements in information technology, coupled with evolving educational philosophies, the conventional paradigms of computer course instruction are increasingly struggling to align with the demands of nurturing talents required for the modern age. The "teacher-centered" teaching method in contemporary universities has many limitations, which not only transmits knowledge in one direction, limits the interaction between teachers and students, but also neglects the crucial aspects of comprehension and practical application, stifling students' creative impulses and dampening their spirit of inquiry. Such an environment hinders the creation of a vibrant classroom ambiance conducive to profound learning and meaningful exchanges [1]. It further falls short in nurturing the critical thinking and competencies demanded within the realm of computer science. The "student-centered" computer course focused in this paper is an important concept of modern teaching, which aims to improve students 'interest in learning and teaching results, and cultivate high-quality talents in the field of computer science.

The research on student-centered computer course teaching reform at home and abroad shows a booming trend. In recent years, domestic scholars have paid great attention to the student-centered undergraduate teaching reform, and educational researchers represented by Professor Zhao Juming have accumulated rich research results in this field [2]. The research not only explores deeply in theory, but also extensively explores how to implement this concept in computer courses in practice. For example, by introducing the mode of "learning by doing, learning by doing", and combining OBE concept and BOPPPS teaching mode, the university computer basic course is reformed. Numerous studies demonstrate the implementation of student-centered reform using specific curriculum cases, like the Principles of Computer Organization course. These initiatives typically receive funding from diverse teaching reform programs, such as those from the Higher Education Division of the Ministry of Education and local undergraduate university programs [3]. Research on "student-oriented" pedagogical approaches in undergraduate education commenced at an earlier stage abroad, amassing a wealth of refined frameworks and methodologies concerning instructional

techniques, curriculum architecture, and assessment systems. Particularly in the United States, continuous refinement and evolution of this concept within the realm of undergraduate teaching and learning reform have yielded valuable insights and practices that serve as an inspiration for educational systems globally [4]. In the context of the "Internet +" era, foreign studies pay particular attention to the role of technology in student-centered teaching reform, especially the integration application of modern information technology such as artificial intelligence, big data and virtual reality. Such explorations delve into not just the ways technology amplifies interactive teaching and personalizes the learning journey, but also investigate the potential of technology to democratize access to educational resources. This is particularly pertinent in underserved regions and specialized educational settings, where technology can bridge gaps and ensure equitable learning opportunities.

The research at home and abroad shows that the student-centered computer course teaching reform is moving from theoretical discussion to in-depth practice, and there's an escalating focus being placed on the integration and novel applications of technology. Although remarkable progress has been made, there are still challenges such as the transformation of teachers' roles, the development of teaching resources, and the reconstruction of evaluation system, which are also important directions for future research. At the same time, how to effectively implement these reform strategies under different cultural and educational backgrounds to promote global education equity and quality improvement is a common concern of the international education research community.

2. The theoretical basis of the concept of student-centered teaching

2.1 Constructivism. Constructivist learning theory originated from cognitive psychology, and its core claim is that learners actively construct knowledge based on personal prior knowledge and experience through interaction with the environment. The theory emphasizes knowledge building processes, situated learning, social interaction, and scaffolding instruction, in which learning is viewed as an active, creative process in which learners generate meaning through exploration, interpretation, reflection, and negotiation. Learning and the acquisition of knowledge unfold within specific contexts, necessitating a strong connection between educational content and real-world scenarios to augment its pertinence and applicability [5]. Moreover, learning is considered to be social. Engaging in dialogue and collaboration with peers enables learners to validate their hypotheses, refine their comprehension, and consequently enrich their learning experience. Educators, in their role as facilitators, are tasked with offering requisite assistance to aid students in accomplishing tasks that they are presently incapable of achieving on their own.

2.2 Connectivism. Connectivism, a theory introduced by George Siemens, emerges as a framework for learning in the digital age. It posits that in the milieu of overwhelming information and swift alterations, learning is achieved through the creation of links among nodes encompassing individuals, information repositories, ideas, and beyond [6]. This interconnected web facilitates the construction of knowledge and the adaptation to an ever-evolving informational landscape. Its main ideas include network thinking, information filtering and meaning construction, diversity and openness, and continuous learning. Under the tenets of connectivism, knowledge transforms from a static and fragmented collection of facts into a vibrant, networked node that is both fluid and extensively distributed. Learning is about forming, maintaining, and optimizing the connections between these nodes. Amidst the vast sea of information, learners are tasked with developing the skills to sift and appraise data. They accomplish this by channeling information through their personal networks, ultimately constructing a tailored knowledge framework that resonates with their individual learning objectives and informational needs. Learner learning should be diverse, covering different fields, perspectives and experiences, and promoting innovative and adaptive learning. In a knowledge society that is perpetually in flux, learning ought to be conceived as a lifelong endeavor. This ongoing process underscores the importance of perpetually linking to fresh information hubs and refreshing one’s personal knowledge networks to stay abreast with new developments and insights.

2.3 Comparison of Two Modes. Traditional teacher-centered and student-centered teaching modes are two completely different educational concepts and practices, and they have significant differences in educational objectives, teaching processes, teachers' roles, students' roles and evaluation systems, etc. The specific comparison is shown in Table 1.

Table 1 The comparison of two teaching models

Teaching mode	Teaching Objectives	Teaching process	Teacher's role and student's role	Evaluation system
Be teacher-centered	It focuses on the teaching of knowledge and the training of skills, and the teaching content and progress are often decided in advance by teachers or teaching materials, less consideration is given to the interests and needs of individual students.	It is mainly taught by teachers, students are mostly passive listeners, and the participation is relatively low, and the teaching method is relatively single.	The teacher controls the classroom, decides the learning content and progress, and the students follow the instructions of the teacher to learn.	Evaluation systems usually focus on summative evaluation, and performance is the main criterion for evaluation.
Be student-centered	Emphasizing the improvement of students 'comprehensive quality, teaching objectives tend to promote students 'all-round development, and encourage exploration, questioning and personalized learning paths.	Diverse teaching methods are adopted to encourage students to take the initiative to explore and solve problems.	Students take more responsibility in the learning process and can express opinions, ask questions and collaborate with each other.	The evaluation system is more diversified, including process evaluation, peer evaluation, self-evaluation and project presentation.

3. "Student-centered" Computer Curriculum Reform Strategy

Following the sustained and comprehensive rollout of the new curriculum reforms, and in tandem with the growing embrace of learner-centric educational philosophies, the imperative for reforming computer science curricula has emerged as both an unavoidable necessity and a pivotal mission [7]. Therefore, it is essential to formulate the "student-centered" computer curriculum reform strategy. The formulation of the strategy needs to start from the following four aspects.

3.1 Basic Computer Course. Computer-related courses play an important role in modern education and teaching, which involves many fields, such as computer system, program design, data management, network technology, information technology and computational thinking.

Primarily, the computer system delves into the architecture of hardware components and elucidates their operational mechanisms; Explain the basic concept, function and usage of operating system; Explain computer architecture and instruction sets, as well as the assembly principle of simple programming languages. Programming Master at least one programming language, such as Python, Java, C/C++, etc., learn basic syntax, data types, control structures, functions and other programming basics, and cultivate logical thinking and problem-solving skills by writing small

programs [8]. The domain of data management and database technology chiefly explores fundamental notions of the database management system, fostering an understanding of the relational database model. It equips learners with proficiency in SQL language, enabling them to adeptly perform operations such as data querying, insertion, deletion, and modification. Network technology includes network topology, network security foundation and network services and applications. Information Technology seeks to investigate the repercussions of computing technology on societal norms, legal frameworks, ethical standards, and the safeguarding of information security and privacy within the digital sphere of life. Computational thinking, on the other hand, cultivates the ability of abstract thinking, logical reasoning and system design, and is devoted to cultivating computational methods and strategies for solving practical problems.

3.2 Scientifically Optimize the Course Content. To reform the education of computer course, it is necessary to abandon the shortcomings of traditional teaching, scientifically optimize the course content, and reform the course basis. Firstly, the course should keep up with the development trend of technology and update the course content regularly to ensure that it is in sync with the latest technologies, tools and applications in the computer industry, such as cloud computing, big data, artificial intelligence, blockchain, etc. Equal emphasis should be placed on nurturing computational thinking. This can be achieved by integrating the development of computational thinking skills into the curriculum design, utilizing practical exercises like problem-solving, algorithm formulation, and logical deduction to reinforce these abilities. More to the combination of theory and practice, increase practical operation and project-driven teaching content, so that students through practical programming projects, case analysis, through practical engagements such as laboratory exercises and other hands-on methods, students are encouraged to apply theoretical knowledge to address real-world issues, thereby enhancing the efficacy of their learning experiences. Continuous scientific refinement of the course material ensures superior alignment with the educational requisites of the digital era. This approach cultivates versatile talents equipped with a robust theoretical foundation and the agility to keep pace with the swift technological advancements.

3.3 Innovation of Curriculum Design and Teaching Methods. Computer course instruction can undergo transformative changes in both curriculum design and pedagogical strategies, with potential avenues for innovation spanning across a multitude of dimensions. For example, the role of teachers is changed from a lecturer to a guide and collaborator to achieve "student-centered". Teachers are no longer simple knowledge transmitters, but designers and guides of learning activities. By asking questions, inspiring thinking, organizing discussions and other ways, students' curiosity and desire to explore are stimulated, students are encouraged to cooperate in groups, and teachers participate as part of the team. Supplying essential resources and guidance fosters an environment of student interaction and mutual support, enabling collective problem-solving endeavors. Flexible course organization can also be used to split the course content into modules, each focusing on a specific topic or skill. The modules were independent and composable, which was convenient for students to plan personalized learning paths according to their own foundation and interests. Or the traditional classroom teaching is moved to the outside class through the form of video and online reading materials, and the classroom time is mainly used for discussion, question answering, collaborative learning and practical operation, which can enhance students 'active learning ability and classroom interaction efficiency. It can also set up a formative assessment and feedback mechanism, utilizing methods like quizzes, homework feedback, and project progress checks [9], focusing on students' performance and progress in the learning process, rather than relying only on the final exam. Leveraging digital learning platforms and educational aids can offer prompt feedback to students, aiding them in timely adjustments to their learning tactics. Encouraging peer assessment amongst students promotes a culture of reciprocal learning and enhanced comprehension.

For example, the classic BOPPPS teaching mode can be adopted, which is a new teaching mode oriented to educational objectives and centered on students, including six teaching links: Course introduction, learning objectives, pre-assessment, participatory learning, post-assessment and

summary, as shown in Fig. 1, this teaching mode emphasizes students' all-round participatory learning rather than just listening to lectures. Teachers can promptly acquire feedback from students, enabling them to make necessary adjustments to upcoming teaching activities, thereby facilitating the successful attainment of educational objectives.

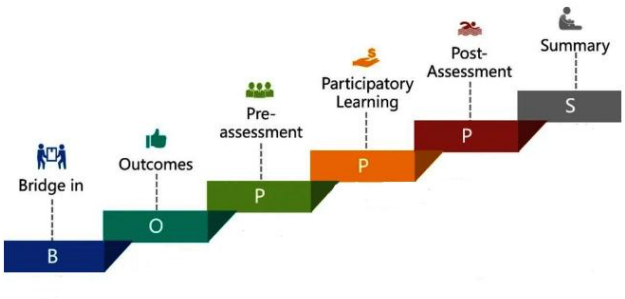

Figure 1. Teaching mode of BOPPPS

3.4 Improve Teachers' Comprehensive Quality. The "student-centered" teaching mode puts forward higher requirements for teachers 'professional ability and comprehensive quality. To foster a more proactive learning environment for students, teachers are required to possess a wealth of teaching expertise and refined pedagogical skills. They must remain committed to renewing their educational approaches and ideologies continually, alongside striving for the enhancement of their own teaching proficiency. Throughout the instructional process, teachers should proactively engage with students, motivating them to think autonomously and pose inquiries. It's vital to cultivate a convivial and laid-back learning ambiance where students feel empowered to take the lead in classroom discussions. Moreover, teachers should be diligent in learning and refreshing their knowledge of teaching theories, techniques, and methodologies [10]. A commitment to enhancing one’s teaching proficiency and innovative mindset is crucial. This allows for the effective advancement and practical implementation of the "student-centered" educational philosophy, fostering a learning environment that truly places students at its core.

4. The Challenges and Countermeasures of Implementing Student-centered Teaching

Transitioning computer course instruction to a student-centric approach will inevitably entail a departure from conventional teaching methods, presenting a plethora of challenges along the way. Therefore, devising appropriate strategies becomes imperative to navigate these obstacles effectively while capitalizing on the opportunities that arise from such transformative educational reforms.

4.1 School Culture and the Need for Management Support. Traditional education systems often emphasize teacher-centered and standardized testing, school culture may not be adapted to student-centered teaching models, and management may have insufficient understanding and support for new teaching methods. To deal with such challenges, it needs the promotion of senior leaders. School leaders bear the responsibility of defining the reform's trajectory clearly. Through policy endorsement and judicious resource distribution, they play a pivotal role in cultivating an environment conducive to the success of reform initiatives. Schools need to carry out cultural construction, establish a school culture that encourages innovation, respects differences, attaches importance to students' individual development, and promotes the common growth of teachers and students. Regularly conducting workshops and seminars can also significantly enhance the comprehension and acceptance of the student-centered teaching philosophy among faculty members, administrative staff, and students alike.

4.2 Teacher Professional Development and Ability Improvement. Teachers might possess insufficient skills or experience in executing student-focused teaching methodologies. This includes the ability to craft interactive lesson plans, leverage information technology effectively, and deliver tailored instruction that caters to individual learning needs [11]. In this regard, the school can carry

out professional training and organize regular professional development training, including instructional design, technical tools application, learning assessment methods, etc. Establish a teacher learning community, encourage teachers to share experience, cooperate in lesson preparation, and solve teaching problems together. Teachers are prompted to engage in reflective practice regarding their teaching methods, with a view to enhancing their instructional capabilities.

4.3 Participation and Understanding of Parents and Society. Parents and society may not be familiar with the student-centered teaching model and fear that teaching quality will decline or not meet traditional educational expectations. In this regard, schools can hold parent-teacher conferences to explain the benefits of student-centered teaching, show successful cases, and promote parents' understanding and support. Institute a collaborative home-schools communication protocol, welcoming parental involvement in institutional events, and collectively contributing to the development and oversight of students' academic plans. Partnering with community entities such as corporations, libraries, and science centers can furnish students with augmented experiential learning opportunities. Simultaneously, this partnership elevates public cognizance and endorsement of the innovative pedagogical model being implemented.

4.4 Resource Allocation and Technical Support. The implementation of student-centered teaching requires sufficient hardware facilities, software resources and technical support, but schools may face funding constraints or technical updates lag. Addressing this requires a concerted effort from both societal bodies and educational institutions, prioritizing the investment in requisite technology and equipment for facilitating teaching reforms. Institutions may explore efforts to secure government grants, corporate contributions, and social sponsorships as part of a diversified funding strategy to augment resource pools.

To sum up, the implementation of student-centered computer course teaching reform is a system engineering, which needs the joint efforts and continuous support of school management, teachers, families and society. Through comprehensive actions, it can address challenges and enhance teaching quality and students' learning effectiveness significantly.

5. Summary

This paper focuses on the teaching reform of computer courses. In view of the limitations of passive learning, ignoring innovation ability and practical application in traditional teaching mode, a series of student-centered reform strategies are proposed. The essence of the reform lies in transforming the educational ideology, placing students at the epicenter of educational pursuits. It underscores individualized learning, skill enhancement, and the augmentation of overall competencies. Through refining instructional content, revamping pedagogical approaches, and upgrading educators' competencies in alignment with the novel teaching paradigm, there's a resultant enhancement in students' capacity for autonomous learning, so that students are no longer limited to passively receiving knowledge, which can not only reshape the relationship between teaching and learning, but also promote the development of the education system to a more flexible, efficient and fair direction.

Prospecting ahead, the student-centered pedagogical reform in computer courses is poised to advance further, inevitably encountering a myriad of challenges enroute. To address these impending issues, a diverse array of strategies will be indispensable to navigate through them effectively. As technology perpetually advances and educational ideologies progressively evolve, computer education is destined to amalgamate cutting-edge innovations like artificial intelligence and big data analytics even more seamlessly. This integration promises to usher in a new era of hyper-personalized and technologically sophisticated instruction. The student-centered teaching reform in computer courses represents an ongoing evolutionary process, which needs the joint efforts of educators, administrators, parents and all walks of life in order to cultivate compound talents who not only have a deep theoretical foundation, but also can constantly adapt and innovate in the rapidly changing information age. Through persistent exploration and practical application, education will more effectively cater to the holistic development of students. It will groom a

workforce of highly competitive computer professionals, making significant contributions to societal advancement.

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