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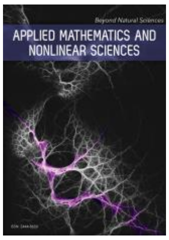

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The application of BOPPPS teaching model in online and offline hybrid Civics teaching in universities

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Abstract

This study examines the hybrid online-offline teaching of civics in colleges and universities, with a particular emphasis on the analysis of the BOPPPS teaching model. The study also evaluates and analyzes the civics application under the BOPPS teaching model using the ID3 decision tree algorithm and the information gain method as attribute selection criteria. By integrating BOPPS teaching and online and offline hybrid Civics teaching, an online, hybrid teaching model platform based on BOPPPS is constructed. The teaching impact of the BOPPS online and offline hybrid Civics education was confirmed when combined with the empirical data. According to the findings, 66% of students anticipate learning about civics online, and 77% anticipate learning about civics both online and offline. The standard deviation for traditional instruction is 5.7819; for "online resources + offline classroom teaching," it is 5.832; for BOPPPS teaching, it is 8.3988; and for BOPPPS teaching with online and offline integration, it is 6.0921. This study is helpful for fostering innovation and growth in both offline and online education at colleges and institutions. Hybrid civics education's evolution and innovation.

Keywords: ID3 decision algorithm; BOPPPS model; Information gain; Blended learning.
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1 Introduction

College student-teacher communication Civics classroom refers to the dialogue, communication, discussion, and sharing that takes place between teachers and students in a setting where civics instruction is being conducted. This dialogue is established within the context of college civics instruction [1-3]. However, since the new curriculum reform, teacher-student communication in college Civics classrooms generally has the phenomena of inadequate preparation for communication, narrow scope of communication, single way of communication, and weak awareness of communication, etc. To address these issues, it is crucial to increase the efficacy of teacher-student communication in college classrooms [4-6].

With the rapid development of information technology, online, hybrid teaching has received widespread attention in the education sector [7-9]. The term "online, hybrid teaching" refers to the full utilization of a variety of online teaching materials, teaching platforms, teaching tools, and support services to combine several teaching modes of online teaching. This is distinct from traditional online and offline hybrid teaching [10-12]. The growth of online teaching has produced a significant product known as online, hybrid teaching, which restructures the learning environment and eliminates the constraints of time and space in the classroom.

The literature [13] primarily examines the overall development and use of ideological and political education and invents a new university educational model based on advantageous psychological traits. The literature [14] constructed a set of information security curriculum systems by tapping into it. The integration of ideological and political, and curriculum contents was formed. In literature [15], the traditional teaching method of using a two-level structure and teaching process is reversed, and a flipped classroom is used in courses on political and ideological theory by designing algorithms, which offers some context for the academic research of colleges and universities. The literature [16] examined the impact of online and offline hybrid teaching methods by contrasting them with traditional teaching methods and came to the conclusion that the hybrid methods are very beneficial to students' reading abilities. The literature [17] argued that the New Coronary Pneumonia epidemic had affected the teaching schedule of many studies and that online and distance learning is necessary at a time of blockade and social distance of the New Coronary Pneumonia pandemic. The literature [18] explored the question of whether the policy preferences expressed by political participation are representative of all citizens through experiments and data.

In this article, the BOPPPS teaching paradigm is first examined, then it is assessed using the ID3 decision tree technique to see whether it is feasible. An online, hybrid teaching model platform based on the BOPPPS model is created via the combination of the BOPPPS model with online, hybrid teaching. Second, we examined how the BOPPPS teaching model was used in online and offline hybrid classes at colleges and universities, and we examined how the "online teaching + offline teaching" model was actually implemented in the classroom to confirm that it was effective. The learners' performance in the teaching practice is then analyzed using the ID3 algorithm, and the combined data is then utilized to confirm the teaching efficacy of the BOPPS online and offline blended Civics teaching. The best teaching strategy was chosen after comparing the teaching effects of BOPPPS online and offline teaching, "online resources + offline classroom teaching," BOPPPS teaching, and conventional teaching.

2 Construction of a hybrid teaching model based on BOPPPS

2.1 BOPPPS Teaching Model

2.1.1 BOPPPS teaching model

In order to condense classroom material into 15-minute modules, Douglas Kerr of the University of Vancouver developed the BOPPPS model of Canadian teacher skills training in 1976, and each module must be carried forward and downward so that trainees can review and improve the teaching process through the module's short, high-intensity and efficient exercises to ensure the achievement of teaching objectives. The BOPPPS approach accomplishes the ideal fusion of teaching theory and practice by placing a strong emphasis on quick feedback of teaching results to permit timely modification of teaching activities. The BOPPPS model splits the teaching process into six phases. Table 1 shows the main material of the BOPPS teaching model. The key stage of the BOPPPS model is participatory learning, and the effects of this stage will directly impact the learners' ultimate learning outcomes.

Table 1. Basic content of BOPPS teaching model

Serial number	Element name	Teaching task	Teaching strategy
1	Import	Arouse curiosity and attract attention	Problem-oriented, case study, etc
2	Target	Set goals and indicate the direction of learning	The degree of knowledge
3	Pretest	Understanding student foundation	Questions, tests, questionnaires, etc
4	Participatory learning	Encourage students to actively participate in the teaching process	Role play, group cooperation, etc
5	Post-test	Test learning effect	Exercise test
6	Summarize	Summarize teaching content	Comb the content

The six basic elements above change order according to the needs of the curriculum and are linked to each other to form a complete, effective, and efficient classroom. In certain instances, the BOPPPS teaching paradigm is combined with the flipped classroom to create a teaching strategy. There are also studies that apply the BOPPPS model to the flipped classroom as a practical study to fully utilize the advantages of both in order to achieve optimal teaching and learning [19-20].

2.1.2 Decision tree algorithm and information gain

In 1928, Hartley provided the first numerical measure of information:

$$I = \log_2 S^n = n \log_2 S \tag{1}$$

Drawing on and incorporating Hartley's ideas, Shannon proposed and developed information theory in 1948. The important concepts he proposed are:

1) The amount of self-information

Suppose $X_1, X_2, \ldots, X_n$ is the signal sent by the source. Before receiving X_i, the recipient's uncertainty about sending X_i is defined as the self-information of the message symbol $I(X_i)$. $I(X_i) = -\log P(X_i)$.

Where $P\left(X_i\right)$ is the probability that the source is sent. If the base is 2, the resulting unit of information is bit. If the base is e, the resulting unit of information is not.

2) Information entropy

The quantity of self-information represents symbol uncertainty, and information may be used to gauge source uncertainty overall. The definition is as follows:

$$\begin{aligned} H(X) &= P\left(X_1\right)I\left(X_1\right)+P\left(X_2\right)I\left(X_2\right)+\ldots+P\left(X_n\right)I\left(X_n\right) \\ &= -\sum_{i=1}^{n} P\left(X_i\right)\cdot\log P\left(X_i\right) \end{aligned} \tag{2}$$

3) Conditional entropy

Conditional entropy $H(X/Y)$ is used to calculate the amount of source X uncertainty that persists after the recipient gets random variable Y when source X and random variable Y are not completely independent of one another. Let X correspond to the source symbol X_i, Y correspond to the source symbol $Y_j (j=1,2,\ldots,m), P\left(X_i/Y_j\right)$ be the conditional probability that X is X_i when Y is Y_j, then we have:

$$H(X/Y) = -\sum_{i=1}^{n}\sum_{j=1}^{m} P\left(X_iY_j\right)\cdot\log P\left(X_i/Y_j\right) \tag{3}$$

The conditional entropy is smaller than the information entropy, which means that the average uncertainty about the input symbol X is reduced after receiving all symbols of the symbol set Y. This means that some uncertainty about the sender is always removed after the message has been delivered, and thus some information is gained.

4) Average mutual information quantity

$H(X)$ represents the average uncertainty about the symbol set X before receiving the symbol set Y, and $H(X/Y)$ represents the average uncertainty about the input symbol X after receiving all symbols of the symbol set Y. The average reciprocal information between is then determined by $I(X,Y)$, representing the amount of information about X obtained after receiving the symbol set Y.

$$I(X,Y) = H(X) - H(X/Y) \tag{4}$$

In algorithm (1), at the beginning of learning, there is only an empty decision tree, and it is not known how to classify the instances according to the attributes. All we have to do is to select the feature attributes that have the best classification samples according to the individual instances in the training sample set. It is helpful to assume that the training sample set is X, includes $|X|$ data samples, and that the category characteristics can take n various values, each of which corresponds to n different categories $C_i (i=1,2,\ldots,n)$. This is in keeping with the notion of information theory. The likelihood that any data object falls within the category C_i is expressed as $P\left(C_i\right)$, which may be calculated as $C_i/|X|$. The quantity of data needed to classify a data object is then:

$$H(X,C) = -\sum_{i=1}^{n} P(C_i) \cdot \log P(C_i) \tag{5}$$

The decision tree learning process is the gradual reduction of the uncertainty of the division using a decision tree. If the test attribute A is selected for testing and A takes v different values $\{\alpha_1, \alpha_2, \ldots, \alpha_v\}$. Then the conditional entropy for dividing the current sample set using a specific value α_j of the attribute A is:

$$\begin{aligned} H(X/A) &= -\sum_{i}^{n} \sum_{i}^{v} P\left(C_i, A = \alpha_j\right) \cdot \log P\left(C_i / A = \alpha_j\right) \\ &= -\sum_{i}^{n} \sum_{i}^{v} P\left(A = \alpha_j\right) \cdot P\left(C_i / A = \alpha_j\right) \cdot \log P\left(C_i / A = \alpha_j\right) \\ &= -\sum_{i} \left[P\left(A = \alpha_j\right) \cdot \sum_{i}^{n} P\left(C_i / A = \alpha_j\right) \cdot \log P\left(C_i / A = \alpha_j\right) \right] \end{aligned} \tag{6}$$

From the definition of mutual information in (4), it can be calculated that the amount of information provided by attribute A for classification $I(X, A)$ is:

$$I(X, A) = H(X) - H(X/A) \tag{7}$$

The uncertainty for the classification following the selection of test attribute A decreases as the information offered by A for the classification increases, as shown by the smaller value of Eq. (6) and the bigger value of Eq. (7). The ID3 algorithm will choose the attribute that increases $I(X, A)$ by the most as the test attribute, and it will call $I(X, A)$ the quantity of information provided by the test attribute A for the classification or the information gained from attribute A.

2.1.3 Analysis of ID3 algorithm for teaching BOPPS

Every level of the decision tree should use an information acquisition strategy to choose attributes to determine which attribute to utilize when generating each node. The ID3 algorithm is a popular decision tree learning methodology. As a result, the test attribute for the current node may be chosen based on the attribute with the maximum information gain, requiring the least amount of information to classify the subset of training samples generated by attribute division.

Each item in the ID3 algorithm classification issue is characterized by a number of characteristics, each of which is constrained to values that are mutually exclusive in a discrete set. Let $E = F_1 \times F_2 \times \ldots \times F_n$ be a n-dimensional infinite vector space, where F_i is an infinite set of discrete symbols. The elements $e = \langle V_1, V_2, \ldots V_n \rangle$ in E are called examples of the sample space, where $V_j \in F_i, (j = 1, 2, \ldots n)$. For simplicity, it is assumed that the sample examples have only two classes in the real world, and in this two-category induction task, the entities of PE and NE are called the positive and negative examples of the concept, respectively. According to the fundamental principle of decision trees, the size of the collection of positive and negative instances in the vector space E is P and N, respectively. The ID3 algorithm is based on the following two hypotheses:

1) The likelihood that any sample set will be correctly classified by a decision tree on the vector space E is the same as the likelihood that E contains both positive and negative instances.

2) Equation (5) states that the information entropy necessary for a decision tree to correctly classify a sample set is:

$$I(P,N)=-\frac{P}{P+N}\log\frac{P}{P+N}-\frac{N}{P+N}\log\frac{N}{P+N} \tag{8}$$

If the attribute A is chosen as the heel of the decision tree and A takes V different values $\{A_1,A_2,\ldots,A_v\}$, using the attribute A can divide E into V subsets $\{E_1,E_2,\ldots E_v\}$, which E_i contains sample data for attribute A taking A_i values in E. Assuming that E_i contains p_i positive and n_i negative examples, the desired information required for the subset E_i is $I\left(p_i,n_i\right)$ and the desired entropy required for the attribute A to be the root is

$$E(A)=\sum_{i}^{v}\frac{p_i+n_i}{P+N}\cdot I\left(p_i,n_i\right) \tag{9}$$

Among them $I\left(p_i,n_i\right)=-\frac{p_i}{p_i+n_i}\log\frac{p_i}{p_i+n_i}-\frac{n_i}{p_i+n_i}\log\frac{n_i}{p_i+n_i}$

According to Equation (7), the information gain with A as the root is

$$Gain(A)=I(P,N)-E(A) \tag{10}$$

The ID3 algorithm selects $Gain(A)$ the largest attribute A^* as the root node, and recursively invokes the above procedure for V subsets E_i of E corresponding to different values of A^* to generate subnodes $B_1,B_2,\ldots,B_v$ of A^*.

The ID3 algorithm's fundamental idea is based on a two-class issue, but it may be simply expanded to handle situations with many classes. Let there be C classes of samples in the sample set S, and the number of samples in each class is $P_i(i=1,2,\ldots,C)$. If the attribute A is used as the root of the decision tree, A with V values $A_1,A_2,\ldots,A_v$, it divides E into V subsets $E_1,E_2,\ldots E_v$. If includes has $P_{ij}(j=1,2,\ldots,C)$ samples of class j, then the entropy, or information content, of the subset E_i is as follows:

$$H\left(E_i\right)=-\sum_{j=1}^{c}\frac{P_{ij}}{\left|E_i\right|}\log\frac{P_{ij}}{\left|E_i\right|} \tag{11}$$

After classification with A as the root, the information entropy is as follows:

$$H(E/A)=\sum_{i=1}^{v}\frac{\left|E_i\right|}{|E|}\cdot H\left(E_i\right) \tag{12}$$

The information gain is maximized by choosing the attribute A^* that minimizes $H(E/A)$.

The training set can be classified properly by more than one decision tree, and the ID3 method produces the decision tree with the fewest nodes. The ID3 algorithm is a more accurate and reasonable algorithm to evaluate the BOPPS teaching model.

2.2 Integration of BOPPS teaching and online and offline hybrid Civics teaching

2.2.1 Integration of BOPPPS model with online hybrid teaching

A reasonable integration of the BOPPPS model with online, hybrid teaching will have to follow certain integration principles, that is, considering the three elements of teaching, including teachers, students, and teaching environment, which must achieve three elements. The first is to facilitate teachers' teaching, which mainly includes teachers' ability to grasp learners' learning status instantly, carry out rich teaching activities using platform functions, and store and manage teaching resources. The second goal is to make learning easier for students, which primarily entails making it convenient for them to acquire and access information, engage in instructional activities, and carry out evaluations. The third is to be precisely matched to the educational environment; first, it can track and manage students' learning; second, it offers features like testing and assignment correction; and third, it can be used in a variety of ways. It may help instructors finish their job more quickly and be less burdensome, and third, it can support a variety of teaching tools, allowing teachers to conduct engaging lessons and enhance student learning simultaneously. The aforementioned three factors indicate that the BOPPPS model is reasonably integrated with online, hybrid teaching, and Figure 1 depicts the complete teaching model flow.

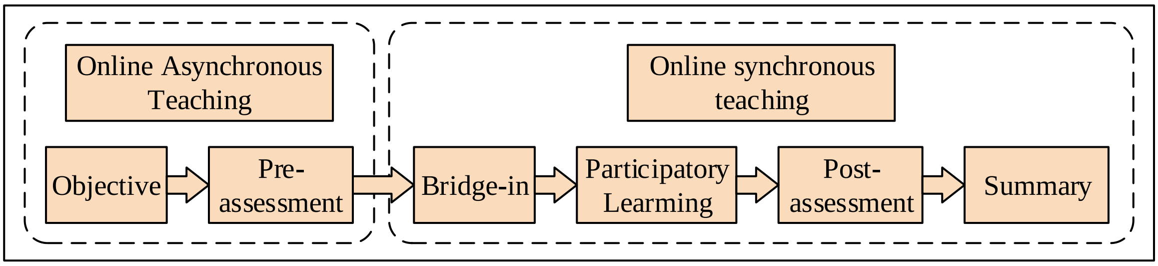

Figure 1. Integration of the BOPPPS model and online mixed teaching

The BOPPPS teaching model consists of six stages. In accordance with the characteristics of online, hybrid teaching, two stages—objective and pre-test—are applied to online asynchronous teaching, where students use the platform to complete the teaching materials in accordance with the needs of the objectives. The other four stages—introduction, participatory learning, post-test, and summary—are applied to online synchronous teaching, where, following self-study, the learning outcomes are assessed. After the self-study before the class, students have a preliminary understanding of some basic educational content. Teachers mostly utilize the online synchronous teaching platform in the classroom to direct students through instructional tasks. Teachers create lesson plans and lead students into the classroom based on what they have learned prior to the lesson. The specific implementation of the above six links needs to be designed with the specific teaching contents.

2.2.2 Selection of online hybrid teaching model platform based on BOPPPS

Conducting online blended learning requires the use of online education tools and platforms. Online education tools and platforms are not only tools and platforms developed for online education, but all tools and platforms that can help teachers better deliver online education fall under this concept. Currently, a very large number of online teaching tools and platforms have emerged, which can be divided into learning platforms that support online asynchronous teaching and learning according to the way they support teaching and learning. The functions that different types of teaching platforms should have are as follows:

1) Functional requirements of online asynchronous teaching platform.

Online asynchronous teaching is teaching in a non-real-time network environment; the creation of resources and the management of students are inseparable from teachers; teaching resource management is mainly the classification and storage management of teaching resources, which requires the online asynchronous teaching platform to have a powerful teaching resource management function. The term “student management” refers to the supervision of student’s academic progress, statistics of their engagement in extracurricular activities, and summaries of their learning outcomes. In order to ensure student’s learning efficiency, teachers need to create diversified teaching resources according to students’ learning habits and needs, and students use the online asynchronous teaching platform for independent learning, so the online asynchronous teaching platform is required to have the characteristics of diversity and flexibility for the release of teaching resources and students’ learning management.

Online asynchronous instruction allows students to finish their learning on their own with the aid of the teaching platform. Teachers cannot directly understand the learning effects of students throughout the entire process because they are the ones who create the teaching resources; therefore, the teaching platform should have management and organization functions for teaching activities, such as setting up after-class homework and facilitating student discussion of challenging issues.

2) Functional requirements of online synchronous teaching platform.

As a crucial component of online, hybrid instruction, online synchronous instruction’s teaching support platform should perform the following duties:

Online synchronous instruction allows for real-time communication and interaction between professors and students. This is the main difference from asynchronous online education. Therefore, the online synchronous teaching platform must have real-time communication capabilities. Real-time communication can be in various ways, such as video, voice, comments, pop-up interaction, likes, etc. Diversified real-time communication not only sparks students’ interest in learning but also improves the instructional methods used by teachers and boosts student engagement.

Online teaching resources must be used to create a virtual classroom where instructors may carry out their instruction. Online teaching tools need to be stable and able to hold as many students as feasible in order for teachers to carry out medium- or large-scale online teaching activities without any problems.

3 BOPPPS online and offline mixed teaching practice of Civics

3.1 Determination of the research object

The subjects of this study were first-year students of L University in Chaoyang, Liaoning Province. There are 20 classes in the first year of this university, and 50 students in the general class of freshman 2, 49 students in freshman 3, 50 students in freshman 4, 49 students in freshman 5, and 45 students in freshman 6, a total of 243 students, were selected as the subjects of this study. These five classes did not have great differences in the grades of each subject at the time of entering the class, and at the same time, the author compared the numbers of Civics grades in each segment of these five classes according to the results of the questionnaire, and the distribution of the numbers in different grades is shown in Figure 2. Among them, the number of students in the 70-80 grade band is the largest, and the number of students in the 80-90 grade band is the second.

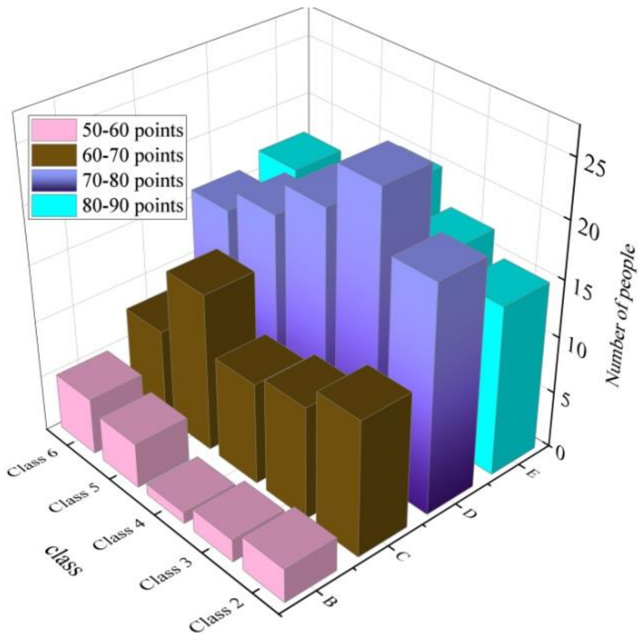

Figure 2. Ideological and political scores statistics

Before practice, the October Civics scores of the selected classes were analyzed and tested using SPSS 23.0 statistical software, and the results of the class October Civics scores test are shown in Table 2. The analysis's findings indicated that there was no significant difference between the classes' monthly test scores and that the significance value was larger than 0.05. These findings might be used in future teaching activities.

Table 2. Examination form of ideological and political achievements

Null hypothesis	Check	Significance	Decision
Within the categories of the class, the distribution of results is the same	Independent sample Cruz Carvalis test	0.585	Preserve the original hypothesis

3.2 The teaching process of the "online teaching + offline teaching" model

During the implementation of this teaching model in the freshman 4 class, the author released the online resources on "Patriotism" on the weekend before the start of the offline course and released the online resources on "Patriotism" on the weekend of the week after the end of the offline course.

Table 3. Teaching process

Link	Teacher activity	Student activity
Online before class	The teacher selects the video resources that meet the teaching objectives and the selection basis, such as Qu Yuan, Wen Tianxiang, etc., and then clips and processes the selected video resources, and makes patriotic video resources with Meizhou APP and releases them. Students are encouraged to find and share video resources related to patriotism by themselves.	Students check and find other similar videos
In-class and off-line	Teaching course based on guidance plan	
After-school online	Guide students to analyze and discuss the phenomena in the video with their own knowledge, and consolidate the course content in time based on micro-lessons.	The students view the video by themselves and supplement the knowledge of patriotism

4 Analysis of teaching practice results

4.1 Learner Analysis

The expectations of students' learning methods are shown in Figure 3. In terms of classroom teaching and study guidance, 66% of students in Class 1 expressed expectations for online teaching methods, 72% in Class 2 expressed expectations for this teaching method, and 77% of students in Class 3 expressed expectations for online and offline hybrid Civics teaching methods. For this survey result, students in Class 3 were slightly more interested in hybrid teaching than students in Class 2. Students in class 2 were more interested in blended teaching than students in class 1. It is clear that students are looking forward to both online and offline instruction, and they are eager to use Chongqing institutions' online teaching and learning platforms as well as their own independent study of the course materials. In the process of learning, students expect to collaborate with their classmates and complete the learning and accumulation of knowledge in thinking and discussing.

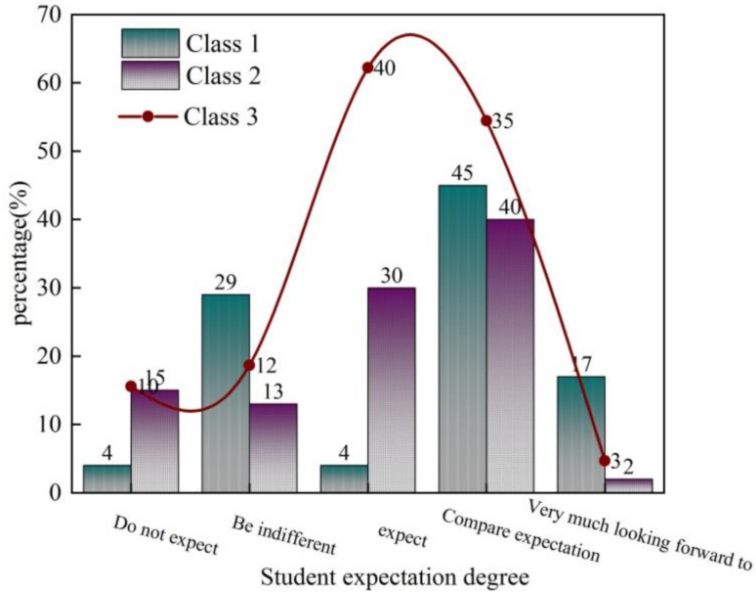

Figure 3. Student learning style expectation

It can be seen that students are looking forward to online, hybrid teaching and are willing to use the university's online teaching platform and nailing platform in the learning process, as well as to study independently based on the materials provided by the teachers. During the learning process, students expect to collaborate with their classmates to learn and accumulate knowledge through reflection and discussion.

4.2 Comparison of Achievements

Table 4 displays the average results of four classes' weekly Civics test scores. Traditional classroom instruction had a mean value of 87.520, "online resources + offline classroom teaching" had a mean value of 89.978, BOPPPS had a mean value of 87.959, and BOPPPS with online and offline integration had a mean value of 92.152.

Table 4. Numerical comparison of different teaching modes

Class	Number of people	Teaching mode	Average value	Standard deviation	Mean standard error
Class 6	49	Traditional teaching mode	87.520	5.7819	0.8192
Class 5	49	Online resources + offline course teaching model	89.978	5.832	0.8301
Class 4	50	BOPPS teaching model	87.959	8.3988	1.1095
Class 2	50	BOPPS teaching model integrating online and offline	92.152	6.0921	0.8698

Class 2 > Class 5 > Class 6 > Class 4 in the mean value comparison of each class, indicating that the teaching effectiveness of the BOPPPS teaching mode with online and offline integration is greater than that of the "online resources + offline classroom teaching" mode, which is greater than that of the BOPPPS teaching mode, which is greater than that of the traditional teaching mode.

5 Conclusion

The primary conclusions of this study's analysis of the BOPPPS teaching model's utilization in hybrid online-offline civics instruction in colleges using the ID3 algorithm are as follows:

1) Students are looking forward to online, hybrid teaching and are willing to use the university online teaching platform and nailing platform in the learning process, as well as to conduct independent learning based on the materials provided by teachers. In terms of classroom instruction and learning support, 66% of students in Class 1 are looking forward to the online teaching technique, 72% in Class 2, and 77% in Class 3, which will combine online and offline instruction to teach Civics.

2) The teaching impact of the BOPPPS teaching mode that integrates online and offline resources is superior to that of the "online resources + offline classroom teaching" method, the BOPPPS teaching mode, and the conventional teaching mode. Traditional teaching method has an average value of 87.520, "online resources + offline classroom teaching" has an average value of 89.978, BOPPPS has an average value of 87.959, and BOPPPS with online and offline integration has an average value of 92.152.

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