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Utilizing Multimedia and Interactive Platforms in a Secondary Vocation School Politics Course: A Quasi-Experimental Study

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Abstract

Background and Aim: Using multimedia and interactive platforms in education has the potential to enhance students' overall learning performance and study motivation. This study explores the integration of Bilibili, a popular video-sharing platform, into the political science curriculum for secondary vocational school students in China. By comparing the performance and motivation levels of students using Bilibili with those following traditional teaching methods, the study aims to determine the effectiveness of multimedia tools in improving educational outcomes among vocational students. Specifically, this study seeks to evaluate whether Bilibili can enhance secondary vocational school students' understanding of basic political science concepts and principles, improve their application and analytical skills in the subject through a quasi-experimental design, and assess their motivation to learn political science using the Motivated Strategies for Learning Questionnaire (MSLQ). The results indicate that students in the experimental group who used Bilibili showed significant improvements in test scores and exhibited higher levels of motivation compared to the control group.

Materials and Methods: A quantitative research design was used to compare the effects of using Bilibili with conventional instruction. 114 secondary vocational school students were selected via stratified random sampling, with 56 in the control group and 58 in the experimental group. Pre-test and post-test assessments measured learning outcomes and motivation levels across key political science concepts and principles.

Results: The use of Bilibili significantly improved understanding of political science concepts compared to traditional methods. Post-test scores were notably higher in the experimental group, indicating the effectiveness of integrating Bilibili into the teaching process. Both mean and t-test analyses supported the superiority of Bilibili-enhanced learning in increasing student motivation and academic performance.

Conclusion: Implementing Bilibili as a teaching tool positively impacts academic performance in political science students at secondary vocational schools. This approach significantly enhances learning outcomes and student motivation, offering valuable insights for educational program design in vocational education.

Keywords: Bilibili; Multimedia learning; Vocational education; Political science; Student motivation; Teaching strategies

Introduction

The rapid advancements in information technology have significantly transformed both cultural and educational spheres. Education, in particular, is experiencing profound changes driven by digitization (Gisbert & Johnson, 2015). The current generation, known as "digital natives," extensively uses social media tools in informal settings, facilitating the acquisition of new skills and promoting self-directed learning. The integration of video platforms as online learning tools has now become indispensable. Not only do these platforms provide students with a more flexible learning experience, but they can also enrich the content and improve the effectiveness of teaching and learning (Hom & Staker, 2017).

Currently, students in secondary vocational schools generally have a low level of academic proficiency and ability to utilize learning resources. Berger and Pan (2018) demonstrated that high-achieving students are more adept at leveraging educational resources, including technology and peer interactions, and efficiently. In contrast, low-achieving students often struggle with resource utilization and exhibit reduced motivation for collaborative learning, whether in-person or online. For now, research by Mbatha (2014) has shown that digital platforms greatly help in enhancing student engagement.

Bilibili, known as the "YouTube of China," was founded in 2009 and has grown into a versatile platform offering diverse content, from education to entertainment and culture. Initially favored for its "secondary yuan" culture, which includes Anime, Comics, and Games (ACG), Bilibili has expanded to

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include educational content, utilizing its unique interactive features to enrich learning experiences (Chen, 2023).

A key feature of Bilibili is Danmu（see Figure 1）, or bullet comments, enabling viewers to post real-time comments that scroll across the screen, creating a dynamic, interactive viewing experience. This feature enhances community and engagement, making learning more interactive and collaborative (Jiang et al., 2018). Additionally, Bilibili's extensive library of user-generated content, from academic lectures to skill-based tutorials, makes it a valuable educational resource.

Figure 1 video with Danmu comments

While platforms such as YouTube have been widely studied and integrated into educational settings, Bilibili's potential remains underexplored, especially in secondary vocational education in China. This study aims to address this gap by examining Bilibili's integration into political science courses for secondary vocational school students. By comparing an experimental group using Bilibili with a control group employing traditional teaching methods, this research seeks to assess the platform's impact on academic performance and student motivation.

Objectives:

1. To determine whether Bilibili can increase the ability of secondary vocational school students to understand the basic concepts and principles of political science classes.
2. To determine whether Bilibili improves the application and analytical skills of secondary vocational school students in political science classes.
3. To determine whether Bilibili increases the motivation of students in secondary vocational schools to learn political science classes.
4. By focusing on these objectives, the study seeks to provide insights into the effectiveness of Bilibili as an educational tool and contribute to the development of more engaging and effective teaching strategies for vocational education.

Literature review

Over the past two decades, multimedia platforms have become essential in educational settings, significantly boosting student engagement and learning outcomes. Liu and Yu (2023) emphasize the crucial role of multimedia platforms in education, including YouTube, WhatsApp, Google Classroom, Superstar Learning System, and Tencent Meeting, which have been widely adopted for online learning. Among these, YouTube stands out, offering extensive instructional videos, tutorials, and lectures. Studies show that YouTube caters to diverse learning styles—visual, auditory, and kinesthetic—by providing accessible content (Giannakos, 2013). Additionally, YouTube reduces educational disparities by offering free resources to a global audience (Moghavvemi et al., 2018).

YouTube also supports innovative teaching methods such as blended learning and flipped classrooms, where students review lecture materials online before engaging in interactive classroom activities (O'Flaherty & Phillips, 2015). This approach optimizes classroom time for collaborative learning and deepens students' understanding of complex subjects. Traphagan et al. (2010) found that students who

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supplemented their learning with YouTube videos experienced reduced pre-examination anxiety and improved content mastery.

Students in vocational education are often those with lower academic performance (Tripney & Hombrados, 2013). Research indicates a direct relationship between academic achievement and learning engagement. Research indicates that students with lower academic engagement levels often show reduced classroom participation, negatively affecting their academic performance (Kelly, 2008).

Therefore, enhancing students' learning engagement through the Bilibili video platform is pivotal for improving the academic performance of vocational education students.

However common instructional videos can become passive and resemble television-like experiences, leading to poor overall learning. One of the major drawbacks of video tutorials is the lack of interactivity, which often diminishes their cognitive appeal and challenge (Palaigeorgiou & Papadopoulou, 2019). However, as technology evolves, Bilibili's Danmu feature, with its social attributes, offers a solution to the monotony of user experiences (Mou et al., 2022). Students can engage in "pseudo-synchronized" communication by responding to Danmu's comments, creating a "live" experience through learner-to-learner virtual interaction (Johnson, 2013). Initially focused on entertainment, Bilibili has recently added an innovative "learning community" driven by millions of education-related videos uploaded by users.

Currently, the literature on the application of Bilibili in education is not extensive. Researchers have summarized some representative studies to demonstrate the feasibility of using Bilibili instead of YouTube in the Chinese education system. （see Table 1）

Table 1 Application of Bilibili in Education

Topics	Details
Impact on Language Learning	Bilibili has demonstrated significant potential in language education. Dai (2023) highlighted its effectiveness in improving listening and speaking skills for Chinese students learning English. The platform provides diverse and authentic language content, which helps learners engage with the material in a more meaningful way.
Continuance Intention to Use Bilibili for Online Learning	Liu and Yu (2023) examined the factors affecting continuance intention to use Bilibili for online learning by integrating the Technology Acceptance Model (TAM), Expectation-Confirmation Model (ECM), and Task-Technology Fit (TTF). The study introduced the danmu interface as a new construct and found that it positively predicted satisfaction but not perceived usefulness.
Features of Bilibili	Peng (2023) explored how Bilibili's unique features such as interception culture, user-generated content, interest-based communities, and differentiated content have contributed to a strong sense of community among users. This influences their cultural decisions on fashion aesthetics and beyond.
Community Building and Engagement	The platform's social features significantly contribute to creating a sense of community among users. Wang (2022) emphasized that Bilibili's Danmu comments not only facilitate content engagement but also help build a community among learners, enhancing the overall educational experience. This sense of community is crucial for fostering collaborative learning and support among students.
The Impact of Danmu Culture	Zhang (2022) analyzed the popularity of bullet screen culture in Bilibili, and the study shows that bullet screen culture can bring a sense of participation, belonging, and identity to the audience.

Over the years, Bilibili has gained immense popularity among young Chinese, Bilibili reported an average daily active user count of 90.3 million (Bilibili, 2022). In secondary vocational educational settings, the integration of information technology into the classroom has largely been confined to traditional tools like PowerPoint for content dissemination (Davies et al., 2023). This limitation is noteworthy, especially

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given that the bulk of existing research on the efficacy of such technological integrations is skewed toward tertiary education.

Overall, despite extensive research demonstrating YouTube's positive impact on education, Bilibili, often referred to as the "Chinese version of YouTube," has not been extensively studied. Most existing studies focus on online learning and user willingness. There is a significant gap in quasi-experimental research on the application of Bilibili in secondary vocational schools.

Conceptual Framework

Theory Relating to the Research Treatment:

Single-Choice Questions (SCQs) and Multiple-Choice Questions (MCQs)

SCQs and MCQs are common forms of objective testing that require the test taker to choose one or more correct answers from several given options. Each question usually consists of a problem statement (or "distractor") and three or more possible answers (or "options"), one or more of which are correct and the rest of which are incorrect (or "distractors "). The origins of single- and multiple-choice questions can be traced back to the early 1900s when educational measurement and psychometrics began to develop. However, these questions were widely used and developed during World War II and in the decades that followed, especially in the United States. This was largely because multiple-choice questions could be easily scored by machine, thus making large-scale standardized testing possible (Haladyna & Rodriguez, 2013). Choice response tests encompass various formats such as multiple-choice, true-false, matching, and fill-in-the-blank questions, collectively referred to as "objective paper-and-pencil tests." This nomenclature accurately captures the process of discerning the correct answer from an array of options, thereby rendering "choice response" the most precise descriptor. The rationale behind the utilization of these assessments is grounded in their perceived objectivity, and their streamlined scoring mechanism contributes to the facilitation of efficient evaluation (Stiggins, 2001). So, the researcher selected relevant single- and multiple-choice questions from the Chinese College Entrance Examination (CEE) question bank as an assessment of basic knowledge

Bloom's taxonomy theory

This theory as a hierarchical framework for educational objectives, was initially introduced by Benjamin Bloom in 1956. This taxonomy encompasses three distinct domains: the cognitive, the affective, and the psychomotor domains. Among these, the cognitive domain has garnered the most extensive application and is subdivided into six hierarchical levels: knowledge, comprehension, application, analysis, synthesis, and evaluation (Callaghan-Koru & Aqil, 2022). Krathwohl (2010) provides an overview of the revised Bloom's Taxonomy and highlights the Bloom's Taxonomy. This taxonomy offers a systematic framework for categorizing educational objectives according to six levels of cognitive complexity: knowledge, comprehension, application, analysis, synthesis, and evaluation. The authors assert that Bloom's Taxonomy serves as a valuable tool for educators, enabling them to design and assess instructional activities and materials that foster elevated cognitive and critical thinking skills among students. The researcher, drawing from the repository of Chinese political science college entrance examination questions, extracted a selection of questions to evaluate students' application and analytical prowess in alignment with Bloom's taxonomy. Specifically, this assortment encompassed case study questions, subjective understanding questions, and policy analysis questions.

The Motivational Strategies for Learning Questionnaire (MSLQ)

MSLQ was meticulously designed and crafted by a collaborative team of researchers hailing from esteemed institutions such as the National Center for Research on the Improvement of Postsecondary Instruction (NCRIFFAL), the University of California, Berkeley, and the University of Michigan School of Education. (Pintrich et al., 1991). The MSLQ emerges from the expertise of scholars who have dedicated their efforts to the exploration of motivation and learning dynamics. For this study, focus on the motivational component of the MSLQ. Employing a cellular phone-based questionnaire software known as "Questionnaire Star," the researcher plans to administer the MSLQ questionnaire to both the experimental

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and control groups. Upon completion of the questionnaire by the participants and its submission through the Questionnaire Star software, the researcher will proceed to gather the collected data. This methodology aligns with the research's intent to examine motivational factors within the specified groups.

Research Framework

This study was structured to compare the educational outcomes between an experimental group using Bilibili as a teaching aid and a control group not using Bilibili, focusing on secondary vocational school students' understanding of political science concepts, application and analytical skills, and motivation.

Before initiating the experiment, a pre-test will be administered. This pre-test will utilize the Chinese College Entrance Examination (CEE) paper. At the culmination of the 10-week experiment, a post-test will be conducted for both the control and experimental groups. Additionally, improvements from pre-test to post-test were calculated for both groups and compared to determine which group showed more significant progress over the study period. After the post-test, the researcher will employ the Questionnaire Star software to distribute the Motivational Strategies for Learning Questionnaire (MSLQ) to the sample population. This questionnaire aims to assess the participants' motivation levels about the course (Hypothesis H3), contributing a holistic perspective to the study's exploration of the impact of bilibili as a teaching aid. (see figure 2)

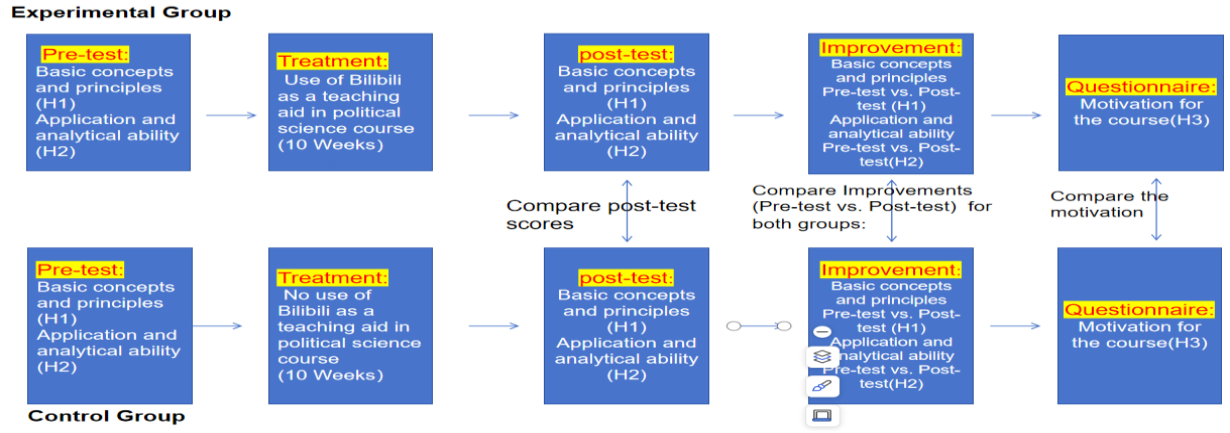

Figure 2 Research Framework

Independent Variables

Use of the Bilibili platform for teaching (whether or not Bilibili is used in the teaching process)

Dependent Variables

Students' academic performance (students' scores in political science courses)

Students learning motivation (measured by the Motivated Strategies for Learning Questionnaire, MSLQ)

Hypotheses

$H_0$1 Bilibili cannot increase the ability of secondary vocational school students to understand the basic concepts and principles of political science class.

H_a1 Bilibili can increase the ability of secondary vocational school students to understand the basic concepts and principles of political science class.

$H_0$2 Bilibili can increase the application and analytical skills of secondary vocational school students in the political class.

H_a2 Bilibili can increase the application and analytical skills of secondary vocational school students in the political class.

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$H_0$3 Bilibili cannot increase the motivation of students in secondary vocational schools to learn politics science class.

H_a3 Bilibili can increase the motivation of students in secondary vocational schools to learn politics science class.

Methodology

Research Design

This study employed a quasi-experimental design to explore the potential impact of integrating the Bilibili video platform into political science courses at secondary vocational schools on student performance. The main reason for choosing quasi-experiments is that Quasi-experimental designs are often more practical and feasible than true experimental designs. Especially in educational settings where experiments can be influenced by educational institutions and people. Quasi-experimental designs can be valuable for preliminary research where the goal is to explore potential causal relationships and generate hypotheses for future research. However, they also present significant challenges in terms of internal validity and causal inference, which will hopefully be further refined in future research.

So, according to the design of the quasi-experimental study. Researchers randomly assigned two classes to either the experimental group or the control group. Both groups began the experiment under identical conditions and received the same course content, with the Bilibili platform incorporated into the experimental group's instruction (see Table 3). After the 10-week experiment, a post-test was administered to evaluate the influence of Bilibili on student performance. Additionally, the Motivated Strategies for Learning Questionnaire (MSLQ) was used to assess classroom engagement for both groups.

Table 3 For example about Research Treatment

Week	Lecture activity	Students Activity
IN CLASS	1. Getting to know the basics of the student and the students introduce themselves. 2. Introduction to the course syllabus, with how the class works, assessment, and grading criteria. 3. Group students and instruct them to complete the download of the Bilibili software or help them access the site through the URL. Students will be required to add the researcher's Bilibili account channel in class. 4. Pre-test	1. Students introduce themselves and interact with the researchers. 2. students get basic information about the course. 3. students are grouped by seat and group leaders are selected. Download and complete Bilibili or familiarize yourself with how to access the website. 4. finish pre-test
AFTER CLASS	1. the researcher publishes 2 videos on Bilibili's channel about primitive society and human class development. 2. The researcher publishes 1 PPT about primitive society and human class development on the Bilibili channel. 3. The researcher collects related danmu and comments on the Bilibili platform. Summarize the common problems of students and prepare to discuss them with students in the next class.	Students watched videos of their choosing over a week, and as they watched the videos, they thought about them in light of the relevant questions posed by the researcher at the bottom of the video. Ask a question or answer a question in the form of a dan mu comment (name should be included when posting the nanmu)
To week 10	Post-test and questionnaire	

Data Collection and Analysis:

For the assessments, the National College Entrance Examination (CEE) question bank was used for both pre-test and post-test evaluations of students' scores. The score improvements in both the experimental and control groups were tracked by averaging their respective scores. The MSLQ questionnaire, distributed through Questionnaire Star software, measured the motivation of both groups toward the course. Before its

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administration, the questionnaire was reviewed by experts and subjected to a pilot test. After data collection, a reliability analysis was conducted.

Population and Sample

The selection of the sample for this research was based on the following essential criteria:

Participants were required to be students currently enrolled in secondary vocational-technical schools.

Students needed to be taking political science courses during the current semester to ensure the relevance of the study to their coursework. Participants were required to possess basic information technology literacy and have access to multimedia equipment, as the study involved the use of digital learning tools. Students had to be aware of the experimental conditions and obtain consent from their guardians, ensuring that they fully understood the study's purpose and procedures. These criteria were established to ensure that the sample was appropriately qualified and that the findings would apply to the target population of secondary vocational school students studying political science.

This research applied an independent sample t-test as a statistical method. To calculate the sample size, the G*Power software is utilized for sample size estimation. (see figure 3) The G*Power software is designed to provide an accurate power analysis based on most statistical tests in behavioral science (Faul et al., 2009).

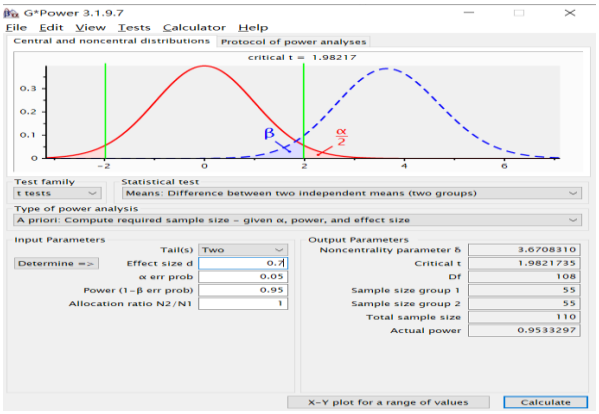

Figure 3 G*Power software

In this study, a priori analysis that computed the required sample size was calculated via the following value; a priori analysis for means difference between two independent means, Tail(s) 2, Effect size, 0.7 error probability of 0.05, and .95 power and Allocation ratio N2/N1. The results showed that the study needed a minimum of group 1 or 55 and group 2 of 55, which totaled 110 samples.

The researcher has opted to employ the random sampling method to select a representative subset of their classes for the study. To achieve this, the researcher utilized the sampling website "Research Randomizer" (2003, RESEARCH RANDOMIZER) available at https://www.randomizer.org. (see Figure 4) Through this platform, a total of 10 classes were sampled, ultimately resulting in the selection of 2 classes that will serve as the experimental groups for the upcoming experiment.

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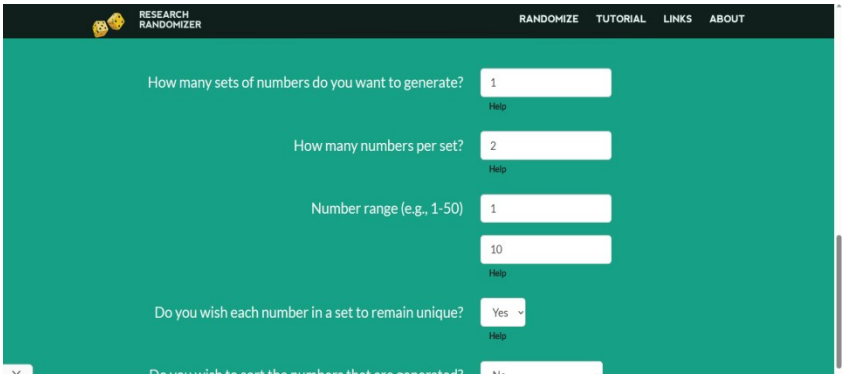

Figure 4 RESEARCH RANDOMIZER

This strategic approach to sampling underscores the researcher's commitment to ensuring a fair and unbiased representation of classes, enhancing the study's credibility and validity. The use of "Research Randomizer" adds a layer of objectivity and transparency to the sampling process, aligning with best practices in research methodology.

Research Instruments

The National College Entrance Examination (CEE) holds immense significance in the Chinese educational landscape, acting as a pivotal gateway for a majority of Chinese students aiming to secure admission into universities. Administered by the Ministry of Education's Educational Examination Office (EEO). In this experiment, research hypothesis 1 and research hypothesis 2 will be tested using CEE question papers.

1. Basic concepts and principles (H1)

Written tests consisting of a set of 10 multiple-choice questions and 5 points per question were administered to assess students' basic concepts and principles. These questions were obtained from the CEE Real Questions Question Bank.

2. Application and analytical ability (H2)

To assess students' Application and analytical ability, 2 papers with subjective responses based on given material.

3. Motivation for class (H3)

The Motivated Strategies for Learning Questionnaire (MSLQ) came into existence through the collaborative endeavors of a team of researchers from the National Center for Research to Improve Postsecondary Teaching and Learning (NCRIFFAL) and the School of Education at the University of Michigan. Notably, the focal point of this particular study centered exclusively on the motivational component inherent within the MSLQ (Pintrich et al., 1993). This questionnaire stands as a testament to the researchers' dedication to advancing the understanding of learning dynamics and motivation within the educational landscape

Validity of the Performance Tests and Questionnaire

The performance tests will be based on the official past examination papers from the Chinese National College Entrance Examination (CEE) for political science.CEE is issued by the Examination Yuan of the Ministry of Education of China and is one of the most important exams in China.

The CEE political science examination is considered a standard because it was developed by the National Education Examination Authority (NEEA) under the Ministry of Education of the People's Republic of China. The examination is meticulously designed to cover a comprehensive range of topics and skills pertinent to political science education at the secondary level.

Cheng and Qi (2006) provide a comprehensive analysis of the English portion of the CEE. The study found that the National Matriculation English Test (NMET) demonstrates a high level of both validity and reliability. This is evident through its consistent ability to measure what it intends to (English proficiency) and produce stable results across different administrations.

Based on the reasons mentioned above, the CEE political science examination is a valid and reliable measure for assessing the political science knowledge and skills of secondary vocational school students.

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The test paper underwent evaluation by three experts, who employed the S-CVI (Content Validity Index) method to calculate the S-CVI/Ave value, resulting in a score of 1. This signifies that the entire questionnaire exhibits sufficient content validity and is well-suited for achieving the research objectives.

Considering the young age of the experimental sample, the seven-level Likert scale in the original article was reduced to five levels to take into account changes in the study sample. The researcher chose 31 students who had experience in political science courses to pilot the program, and the researcher released the questionnaire translated by the English teacher to the students through Questionnaire Star software, and the students completed the answer sheet and submitted it through their cell phones. The researcher tested the collected questionnaires for internal consistency through the data analysis website. （Jamovi Project, n.d., https://www.jamovi.org/cloud.html） And the results showed high internal consistency. (see table 4)

Table 4 Results of Cronbach's Alpha of the research instruments

Variable	Number of Items	Cronbach's Alpha
Motivation for class	31	0.946

Data Collection

According to the variables, after the completion of the 10-week experiment, students completed the test papers selected from the question bank and submitted them to the researcher for scoring.

The MSLQ questionnaire was administered to the experimental and control groups using cell phone questionnaire software (Questionnaire Star) and data will be collected by the researcher after the study participants complete and submit the questionnaire in the Questionnaire Star software.

Data Analysis

Upon the conclusion of the performance test, a statistical analysis will be conducted to compare the outcomes of the experimental and control groups. An independent samples t-test will be employed to assess potential differences between these two groups. This analysis will be carried out utilizing the Jamovi website, a user-friendly platform for statistical analysis.

Furthermore, following the questionnaire survey, the collected responses from both the control and experimental groups will undergo assessment for internal consistency. This process involves scrutinizing the reliability of the questionnaire's items within each group. This step is vital to ensure the robustness of the collected data. The Jamovi website will again serve as the platform for conducting this analysis.

The utilization of jamovi for these analyses speaks to the researchers' commitment to employing efficient and accessible tools in the statistical evaluation of their data. Such rigorous analysis helps bolster the study's validity and enhances the credibility of its findings.

Demographic Information

The number of students in the experimental and control groups was 59 and 60 respectively. Among them, 100% were 15-17 years old with an average age of 16 years old. There were 51 males representing 42.9% of the total sample and 68 females representing 57.1% of the total sample. All students were from the first grade.

Results Descriptive Statistics

Basic concepts and principles (Hypothesis H1)

The descriptive statistics for the Basic concepts and principles scores performance scores were calculated for all samples. The results are presented in Table 5, The control group's pre-test mean is 29.0, and the post-test mean is 30.4, an increase of 1.4. The experiment group's pre-test mean is 28.3, and the post-test mean is 36.4, an increase of 8.1. The improvement mean shows 1.27 for the control group and 8.10 for the experiment group, indicating a greater improvement in the experiment group. The control group's pre-test and post-test standard deviations are 9.22 and 9.36, respectively, with an improvement mean standard deviation of 12.2. The experiment group's pre-test and post-test standard deviations are 7.64 and 7.09, respectively, with an improvement mean standard deviation of 8.80. The control group's pre-test and post-test minimum values are both 10, with maximum values of 46 and 48, respectively. The experiment group's pre-test minimum value is 6, and the post-test minimum value is 17, with maximum values of 42 and 49, respectively. For the improvement mean, the control group has a minimum value of -29 and a maximum value of 31, while the experiment group has a minimum value of -12 and a maximum value of 31. The data shows that the experiment group has a significantly greater improvement in test scores compared to the control group. The improvement mean for the experiment group is also higher than that of

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the control group, suggesting that the experimental treatment may have had a significant positive impact on the experiment group.

Table 5 Basic concepts and principles Pre-test, Post-test, and Improvement Mean

	N	Mean	SD	Minimum	Maximum
Control group pre-T	58	29.0	9.22	10	46
Control group post-T	56	30.4	9.36	10	48
Experiment group pre-T	58	28.3	7.64	6	42
Experiment group post-T	58	36.4	7.09	17	49
Control group Imp	56	1.27	12.2	-29	31
Experiment group Imp	58	8.10	8.80	-12	31

Application and analytical ability (Hypothesis H2)

The descriptive statistics for the application and analytical ability performance scores were calculated for all samples. Table 2 shows the results of the calculation. The experimental group showed a significant improvement in mean scores from pre-test (29.2) to post-test (33.7), with a mean improvement of 4.53.

The control group, however, showed a slight decrease in mean scores from pre-test (28.3) to post-test (27.6), with a mean improvement of -0.672, indicating a slight decline. The median scores also reflect this trend, with the experimental group increasing from 30.5 to 36.5 and a median improvement of 4.00.

The control group's median scores remained relatively stable, with an improvement median of 0.00.

The standard deviations for both groups increased from the pre-test to the post-test, indicating a wider spread of scores in the post-test. The improvement standard deviation for the experimental group (13.9) is slightly higher than that of the control group (13.0), suggesting more variability in improvement among the experimental group participants. The range of scores (minimum to maximum) increased for both groups from pre-test to post-test. The improvement scores show a wide range, particularly in the experimental group, with a minimum of -39 and a maximum of 31, indicating that some participants improved significantly while others did not. The data indicates that the experimental group had a substantial positive change in performance from the pre-test to the post-test, while the control group did not show significant improvement. This suggests that the intervention applied to the experimental group was effective in enhancing their performance. The results highlight the potential benefits of the experimental treatment and warrant further investigation to understand the factors contributing to the varied improvement among participants.

Table 6 Application and Analytical Ability Performance Scores Pre-test, Post-test, and Improvement Mean

	N	Mean	SD	Minimum	Maximum
Control group pre-T	58	28.3	7.57	7	42
Control group post-T	58	27.6	9.93	10	46
Experiment group pre-T	58	29.2	9.16	10	48
Experiment group post-T	58	33.7	9.38	9	45
Control group Imp	56	-0.672	13.0	-26	27
Experiment group Imp	58	4.53	13.9	-39	31

Descriptive Statistics of Student Motivation for the course (Hypothesis H3)

Table 7 and Table 8 show the analysis presenting the students' opinions regarding their motivation and attitudes towards the course. So according to the tables, we can summarize: the experimental group exhibited significantly higher motivation and confidence across all questions compared to the control group,

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indicating the effectiveness of the new learning method in enhancing student engagement and perceived advantages over traditional methods.

Table 7 Descriptive Statistics of Student experimental group students' Motivation for the course

	Item Statement	Mean	SD	Interpretation
1	I prefer challenging content in class as it enables me to learn new things.	4.22	0.418	Agree
2	If I use appropriate study methods, I can grasp the content of this course well.	4.32	0.471	Agree
3	During exams, I feel that I perform poorly compared to my classmates.	4.47	0.504	Agree
4	I believe I can apply the knowledge gained in this course to other subjects.	4.37	0.488	Agree
5	I am confident that I will achieve excellent results in this course.	3.46	0.795	Agree
6	I am sure I can understand the most difficult content in the course readings.	4.39	0.526	Agree
7	Achieving good grades in this course is the most satisfying thing for me right now.	4.02	0.130	Agree
8	During exams, I often worry about the questions I cannot answer in other sections.	4.47	0.504	Agree
9	I believe it is my fault if I do not master the content of this course.	4.24	0.429	Agree
10	I need to learn the content of this course well.	4.53	0.504	Agree
11	Improving my overall GPA is most important to me right now, so my primary concern in this course is how to achieve good grades.	4.25	0.439	Agree
12	I am confident in mastering the basic concepts taught in this course.	4.39	0.492	Agree
13	If possible, I would like to achieve better results in this course than most other students.	4.37	0.488	Agree
14	During exams, I think about the consequences of failing.	4.41	0.591	Agree
15	I am confident in understanding the most complex content introduced by the instructor in this course.	3.73	0.848	Agree
16	In class, I prefer content that piques my curiosity, even if it is difficult to learn.	4.27	0.448	Agree
17	I am interested in the content of this course.	4.25	0.439	Agree
18	As long as I work hard enough, I can understand the course content.	4.39	0.492	Agree
19	During exams, I feel a sense of anxiety and frustration.	4.25	0.779	Agree
20	I am confident in excelling in assignments and exams for this course.	4.29	0.457	Agree
21	I want to achieve good grades in this course.	3.46	0.727	Agree
22	The most satisfying thing for me in this course is to understand the content as thoroughly as possible.	4.31	0.534	Agree
23	I find the content of this course helpful to my studies.	4.39	0.492	Agree

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	Item Statement	Mean	SD	Interpretation
24	If given a choice, I would opt for assignments that truly enable me to learn, even if they do not guarantee high grades.	4.44	0.595	Agree
25	If I do not understand the course content, it is because I am not working hard enough.	3.63	0.849	Agree
26	I like the topic of this course.	3.92	0.857	Agree
27	I need to understand the topics of this course.	4.36	0.483	Agree
28	During exams, I feel my heart racing.	4.41	0.495	Agree
29	I am confident in mastering the skills taught in this course.	4.39	0.492	Agree
30	I want to achieve good grades in this course because it is important to demonstrate my abilities to my family, friends, employers, and others.	4.22	0.767	Agree
31	Considering the difficulty of this course, the teacher, and my abilities, I believe I will achieve good grades in this course.	3.58	0.814	Agree
	Total	4.2	0.559	Agree

Table 8 Descriptive Statistics of Student control group students' Motivation for the course

	Item Statement	Mean	SD	Interpretation
1	I prefer challenging content in class as it enables me to learn new things.	1.57	0.5	Disagree
2	If I use appropriate study methods, I can grasp the content of this course well.	1.00	0	Disagree
3	During exams, I feel that I perform poorly compared to my classmates.	1.73	0.446	Disagree
4	I believe I can apply the knowledge gained in this course to other subjects.	1.35	0.481	Disagree
5	I am confident that I will achieve excellent results in this course.	1.03	0.181	Disagree
6	I am sure I can understand the most difficult content in the course readings.	1.00	0	Disagree
7	Achieving good grades in this course is the most satisfying thing for me right now.	1.43	0.5	Disagree
8	During exams, I often worry about the questions I cannot answer in other sections.	1.95	0.22	Disagree
9	I believe it is my fault if I do not master the content of this course.	1.78	0.415	Disagree
10	I need to learn the content of this course well.	1.38	0.49	Disagree
11	Improving my overall GPA is most important to me right now, so my primary concern in this course is how to achieve good grades.	1.38	0.49	Disagree
12	I am confident in mastering the basic concepts taught in this course.	1.02	0.129	Disagree
13	If possible, I would like to achieve better results in this course than most other students.	1.42	0.497	Disagree
14	During exams, I think about the consequences of failing.	1.78	0.454	Disagree
15	I am confident in understanding the most complex content introduced by the instructor in this course.	1.37	0.486	Disagree
16	In class, I prefer content that piques my curiosity, even if it is difficult to learn.	1.02	0.129	Disagree
17	I am interested in the content of this course.	1.43	0.5	Disagree

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	Item Statement	Mean	SD	Interpretation
18	As long as I work hard enough, I can understand the course content.	1.38	0.585	Disagree
19	During exams, I feel a sense of anxiety and frustration.	1.72	0.490	Disagree
20	I am confident in excelling in assignments and exams for this course.	1.42	0.530	Disagree
21	I want to achieve good grades in this course.	1.33	0.475	Disagree
22	The most satisfying thing for me in this course is to understand the content as thoroughly as possible.	1.05	0.220	Disagree
23	I find the content of this course helpful to my studies.	1.35	0.481	Disagree
24	If given a choice, I would opt for assignments that truly enable me to learn, even if they do not guarantee high grades.	1.37	0.454	Disagree
25	If I do not understand the course content, it is because I am not working hard enough.	1.12	0.490	Disagree
26	I like the topic of this course.	1.38	0.527	Disagree
27	I need to understand the topics of this course.	1.4	0.725	Disagree
28	During exams, I feel my heart racing.	2.52	0.536	Disagree
29	I am confident in mastering the skills taught in this course.	1.47	0.490	Disagree
30	I want to achieve good grades in this course because it is important to demonstrate my abilities to my family, friends, employers, and others.	1.37	0.530	Disagree
31	Considering the difficulty of this course, the teacher, and my abilities, I believe I will achieve good grades in this course.	1.37	0.520	Disagree
	Total	1.42	0.418	Disagree

Hypotheses Testing

Basic concepts and principles (Hypothesis H1) As shown in Table 9, the results of the independent T-test indicate a significant difference in scores between the experimental group and the control group. The T-value is 3.83, with a degree of freedom (df) of 112, and a p-value less than 0.001, indicating a significant difference between the two groups. The mean difference in scores between the experimental group and the control group is 5.95, with a standard error (SE) of 1.55. Cohen's d is 0.718, indicating a large effect size and suggesting that the experimental treatment had a significant impact on the scores. In summary, the scores of the experimental group were significantly higher than those of the control group, indicating that the experimental treatment had a pronounced positive effect on student performance.

Table 9 Independent t-test for the Basic concepts and principles scores

		Statistic	df	p	Mean difference	SE difference		Effect Size
Grade	Student's t	3.83 [a]	112	< .001	5.95	1.55	Cohen's d	0.718

Application and analytical ability (Hypothesis H2)

As shown in Table 10, we conducted independent samples t-tests to compare the mean differences between the control group and the experimental group for the variables. The t-value is -3.41 with 114 degrees of freedom (df). The p-value is less than .001, indicating that the difference between the two groups is statistically significant. The mean difference between the experimental and control groups is -6.12, with a standard error (SE) of 1.79. Cohen's d is calculated to be -0.634, which suggests a medium to large effect size. This indicates that the experimental intervention had a substantial impact on the student's grades. These

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results provide strong evidence that the intervention implemented in the experimental group significantly affected their grade outcomes, highlighting the efficacy and impact of the new teaching method or intervention used.

Table 10 Independent T-test for the Application and Analytical Ability

		Statistic	df	p	Mean difference	SE difference		Effect Size
Grade	Student's t	-3.41	114	< .001	-6.12	1.79	Cohen's	-0.634

Student Motivation for the course (Hypothesis H3)

As shown in Table 11, The independent samples t-test results for the course motivation questionnaire reveal significant differences between the experimental and control groups across all measured items. The t-values for all 31 questions are highly significant ($p < .001$), indicating that the differences in mean scores between the experimental and control groups are statistically significant. The mean differences for all questions range from 1.89 to 3.39, consistently favoring the experimental group. Cohen's d values, which measure the effect size, indicate medium to very large effects across all items, ranging from 3.04 to 10.01. These values suggest that the experimental group's responses show a substantial improvement in motivation and positive attitudes towards the course compared to the control group. Overall, the data demonstrate that the experimental intervention had a significant positive impact on students' motivation and attitudes towards the course. The consistent and large effect sizes across all questionnaire items provide strong evidence that the intervention was effective in enhancing students' engagement and learning experience. These findings highlight the potential benefits of implementing such interventions in educational settings to improve student motivation and outcomes.

Table 11 Independent t-test for the Student Motivation of the course

		Statistic	df	p	Mean difference	SE difference		Effect Size
1.	Student's t	31.4 [a]	117	< .001	2.65	0.0845	Cohen's d	5.76
2.	Student's t	54.6 [a]	117	< .001	3.32	0.0608	Cohen's d	10.01
3.	Student's t	-31.4 [a]	117	< .001	-2.74	0.0872	Cohen's d	-5.77
4.	Student's t	34.0	117	< .001	3.02	0.0888	Cohen's d	6.24
5.	Student's t	23.0 [a]	117	< .001	2.42	0.1053	Cohen's d	4.22
6. 。	Student's t	49.9 [a]	117	< .001	3.39	0.0679	Cohen's d	9.16
7.	Student's t	38.4 [a]	117	< .001	2.58	0.0672	Cohen's d	7.05
8.	Student's t	-35.5 [a]	117	< .001	-2.52	0.0710	Cohen's d	-6.52
9.	Student's t	31.7	117	< .001	2.45	0.0774	Cohen's d	5.81
10	Student's t	34.5	117	< .001	3.14	0.0911	Cohen's d	6.32
11	Student's t	33.6 [a]	117	< .001	2.87	0.0854	Cohen's d	6.17
12.	Student's t	51.4 [a]	117	< .001	3.37	0.0657	Cohen's d	9.42
13.	Student's t	32.7	117	< .001	2.96	0.0903	Cohen's d	6.00
14.	Student's t	-27.2 [a]	117	< .001	-2.62	0.0965	Cohen's d	-4.98
15.	Student's t	18.7 [a]	117	< .001	2.36	0.1264	Cohen's d	3.43
16.	Student's t	54.0 [a]	117	< .001	3.25	0.0603	Cohen's d	9.90
17.	Student's t	32.7 [a]	117	< .001	2.82	0.0863	Cohen's d	5.99
18.	Student's t	30.3	117	< .001	3.01	0.0992	Cohen's d	5.56

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		Statistic	df	p	Mean difference	SE difference		Effect Size
19.	Student's t	-21.3	117	< .001	-2.54	0.1191	Cohen's d	-3.91
20.	Student's t	31.6 [a]	117	< .001	2.87	0.0908	Cohen's d	5.80
21.	Student's t	18.9 [a]	117	< .001	2.12	0.1124	Cohen's d	3.46
22.	Student's t	43.6 [a]	117	< .001	3.26	0.0746	Cohen's d	8.00
23.	Student's t	34.1	117	< .001	3.04	0.0892	Cohen's d	6.25
24.	Student's t	30.9	117	< .001	3.07	0.0995	Cohen's d	5.66
25.	Student's t	20.2 [a]	117	< .001	2.51	0.1245	Cohen's d	3.70
26.	Student's t	19.8 [a]	117	< .001	2.53	0.1277	Cohen's d	3.64
27.	Student's t	31.9	117	< .001	2.96	0.0927	Cohen's d	5.84
28.	Student's t	-16.6 [a]	117	< .001	-1.89	0.1140	Cohen's d	-3.04
29.	Student's t	31.0	117	< .001	2.92	0.0943	Cohen's d	5.68
30.	Student's t	23.8	117	< .001	2.85	0.1199	Cohen's d	4.36
31.	Student's t	17.7 [a]	117	< .001	2.21	0.1250	Cohen's d	3.24

Summary of Hypothesis testing and results

Based on the independent t-test results for the three research hypotheses, the final results can be summarized in a table as follows:

Table 12 Summary of Hypothesis testing and results

Hypotheses	Statement	Result after Analysis
$H_0$1	Bilibili cannot increase the ability of secondary vocational school students to understand the basic concepts and principles of political science.	rejected
$H_0$2	Bilibili cannot increase the application and analytical skills of secondary vocational school students in the political class.	rejected
$H_0$3	Bilibili cannot increase the motivation of students in secondary vocational schools to learn political science	rejected

Discussion and Conclusion

The results showed that students in the experimental group showed a significant improvement in their ability to grasp and understand the basic concepts and principles of political science as evidenced by their performance indicators. This finding is consistent with existing literature that highlights the efficacy of blended learning platforms in improving students' conceptual understanding (Gisbert & Johnson, 2015). Research by Hom and Staker (2017), among others, highlights similar benefits of using video-based learning tools in educational settings, supporting the idea that visual and interactive content contributes to a better understanding of complex perspectives in academic disciplines. The positive results of this study corroborate these findings, demonstrating the effectiveness of Bilibili as an educational tool to improve students' grasp of basic political science concepts. The results obtained indicate that students who utilized Bilibili demonstrated superior application and analytical skills compared to those in the control group. This enhancement in skills can be attributed to the interactive and engaging nature of Bilibili, which fosters deeper cognitive engagement with the material. The findings are consistent with Berger and Pan (2018), who noted that students benefit significantly from educational resources that promote active learning. The study's data show a significant increase in student motivation within the experimental group compared to the control group. This suggests that the interactive and relatable content on Bilibili resonates well with students, making the learning process more engaging and stimulating. This finding is in line with existing research indicating that digital platforms can enhance student engagement and motivation (Mbatha, 2014).

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An unexpected aspect of this experiment was the students' interaction with the Bilibili platform. Although the experimental group showed significant improvement in their academic performance, researchers observed that many students did not engage with the social features of the Bilibili platform as anticipated. Contrary to expectations, there was limited discussion among classmates in the comment section of the videos posted by the researchers. Instead, most students preferred to independently select and watch related course videos of their interest and then pose questions to the researchers on the platform.

This finding suggests that while Bilibili's multimedia resources and interactive content had a positive impact on student understanding and achievement, the platform's social interaction features were underutilized. Students seemed to value the flexibility and variety of the content more than the opportunity for peer discussion.

However, this study has the following limitations, which may have biased the results:

1. Relatively short intervention period

The relatively short intervention period in this study may not be sufficient to fully observe the long-term effects and potential changes of the intervention.

2. The sample is from a relatively homogenous source

The sample in this study was mainly from specific districts or schools and lacked broad representation. This limitation in sample selection may affect the external validity of the results.

3. Differences in informatization literacy of the sample

Participants differed in their informational literacy, which may have affected their acceptance of the intervention and its actual effectiveness. These differences may have increased the variability of the data, thus affecting the reliability of the results.

These limitations provide directions for improvement in future studies to enhance the generalisability and credibility of the findings.

Overall, this study not only reinforces the effectiveness of multimedia and interactive learning platforms like Bilibili in significantly enhancing educational outcomes but also highlights a promising direction for integrating such technologies in vocational education.

Recommendation

The study showed that the integration of the Bilibili platform into the teaching of political science in a secondary vocational school had a positive impact. Recommendations based on the findings of the study are as follows

For Educators:

Adopting Blended Learning Approaches: The significant improvement in students' understanding, application, and motivation highlights the potential of incorporating digital learning platforms like Bilibili into the curriculum. Educators should consider combining traditional teaching methods with interactive digital tools to enhance student outcomes. In particular, learn to produce and edit relevant course videos and to scrutinize relevant course videos on the Bilibili video platform, including danmu content.

For Educational Institutions and Policy Makers:

1. The results suggest that incorporating platforms like Bilibili into the curriculum can significantly enhance student understanding, application, and motivation. Educational institutions should consider adopting blended learning approaches that combine traditional teaching methods with interactive digital tools to improve student outcomes. Collaborate with instructional designers to develop interactive and engaging game-based learning modules that align with the curriculum objectives

2. To maximize the benefits of digital learning platforms, institutions should provide adequate training and support for educators in utilizing these tools effectively. For example, video production, video editing, data retrieval, etc.

3. Establish interdisciplinary teams to continuously innovate and adapt digital learning tools to meet evolving educational needs.

4. Policymakers should support the integration of digital learning technologies in educational institutions to promote innovative teaching and learning practices and improve the overall quality of education. Examples include increased funding for digital technologies, improved multimedia infrastructure, and digital technology education advocacy

For Future Research and Advancements

1. Based on the additional findings of this study, further research could be conducted to explore the impact of social interaction features on Bilibili on students' learning performance in vocational schools.

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Specifically, future studies should investigate whether online social interactions can positively influence the learning outcomes of secondary vocational school students. Explore the potential of incorporating virtual reality and augmented reality technologies into web game-based teaching methods for enhanced student engagement and learning outcomes.

2. Future studies should consider more collaborative research designs that involve educators, students, and technology developers. This collaborative approach can ensure that the digital tools are not only educationally effective but also user-friendly and aligned with the student's needs and preferences.

3. Recommending longitudinal studies to examine the long-term effects of using platforms like Bilibili on student learning outcomes and motivation would provide deeper insights. Additionally, suggesting research on the scalability of such interventions across different educational contexts and subjects could help in generalizing the findings.

4. A feedback mechanism could be included in the future research process to continuously collect and analyze students' opinions on the use of digital learning tools.

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