THE EFFECTIVENESS OF ONLINE TEACHING TOWARDS STUDENTS' INTEREST IN LEARNING PHYSICS OF THE GRADE- 9 STUDENTS IN YUNNAN PROVINCE

SONGBIAO YANG

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
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RAJAMANGALA UNIVERSITY OF TECHNOLOGY KRUNGTHEP
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Author Songbiao YANG
Major Master of Arts (Education and Society)
Advisor Assistant Professor Dr. Saifon Songsiengchai

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of the Requirements for the Master's Degree

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ABSTRACT

This study took the 9th-grade students of Kunming Changshui Experimental Middle School as the research subjects. The purpose of this study is: 1) To study how online learning affects students' interest in learning physics. 2) To compare the differences between online learning and traditional teaching in students' interest in learning physics. 3) To investigate how the teachers' perspectives on online learning affect students' interest in physics. This study adopted quantitative and qualitative research methods. To interpret the data, we used mean, standard deviation, and narrative analysis for statistical analysis. The main research tools were questionnaires, tests, course plans, and teacher logs. The results showed that: 1) online learning affects students' interest in learning physics; the overall mean score of all variables was 2.48, and the standard deviation was 0.64, indicating that the consistency of the respondents was generally high; 2) According to the test results, online learning was 69.36%, and traditional learning was 75.84%, 3) Teachers perspective presented that students who received online teaching performed better in some aspects and average in most aspects. These results show that online teaching did not improve students' interest in learning, which harmed their learning outcomes. This study emphasizes the importance of students' interest in learning. Suggestions include optimizing technical support for online teaching, improving course design, and enhancing interaction. Future research should explore technical support for online teaching, technical training for teachers, and longitudinal impact and integration to improve online teaching strategies continuously.

Keywords: Online Teaching, Interest in Learning, The Effectiveness

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Two years ago, out of my thirst for knowledge and curiosity about foreign institutions, I applied to the Rajamangala University of Technology Krungthep, a university with a long history, profound cultural heritage, and a wealth of talents. I am very grateful to the Institute of Science Innovation and Culture (ISIC), where every teacher has taught me a lot of knowledge and virtues. They taught me to examine educational issues from different perspectives and broadened my horizons. These educators are responsible people with excellent moral character who constantly inspire me to improve.

I am particularly grateful to my supervisor, Assistant Professor Dr. Saifon Sorgsiengchai. From the beginning of her class, I felt her kindness and patience, and I appreciated her friendly attitude and in-depth understanding of students and China. However, what really attracted me was her rigorous academic attitude, gentleness, and kindness. It is my honor to be her student. I am very grateful that I could complete my thesis under her careful guidance. In my future career, I aspire to be a teacher like her, treating my students seriously and sincerely.

I also want to thank my mother, who supported and strengthened me during my postgraduate studies. Finally, I want to thank myself for my courage to study abroad and my persistence. Although I am confused at 26, I have been moving forward and have not stopped learning. School, teachers, friends, I hope we will be better versions of ourselves when we meet next time.

Songbiao YANG

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INTRODUCTION

1.1 Background and Rationale

1.1.1 Background of the Study

As Internet technology matures and network bandwidth increases, people can obtain information faster and stably worldwide. This provides sufficient bandwidth support for online teaching, allowing multimedia elements such as video, audio, and virtual experiments to be widely used in online teaching.

The innovation of Internet technology provides diversified teaching tools and platforms for online teaching. Educators can use online teaching platforms to create virtual classrooms, integrate multimedia resources, and achieve remote interaction. The dominant position of students is more prominent. Teachers can stop and discuss with students anytime without worrying about disrupting the teaching progress, truly realizing “learning to determine teaching” (Li, 2022).

The status students can obtain learning materials, submit assignments, and participate in discussions through the online learning management system. This interactive learning model enriches the educational process and improves student participation and learning experience. The Internet's big data and artificial intelligence technology have injected more intelligent and personalized elements into online teaching. By analyzing students’ learning behaviors and data, educators can better understand students' learning habits and levels and provide personalized learning paths and teaching resources. This intelligent teaching method aligns more with students’ needs and improves learning effects.

The rise of online teaching has also prompted Internet companies and educational institutions to increase investment in online education platforms and technologies, promoting upgrading the Internet industry. Various online learning platforms and educational apps are emerging one after another, and competition is fierce, providing students and educators with more choices. For example, experiments are an important means of physics teaching. In order to better reproduce the experimental inquiry process, teachers can use "digital experiment" software to guide students in conducting inquiry experiments online and reviewing the experimental phenomena of physics intuitively and conveniently (Li, 2022). The above factors have made online teaching increasingly valued by educators and educated people.

Secondly, the COVID-19 epidemic has profoundly impacted global education and promoted the rapid popularization and development of online teaching. China started online teaching in the spring semester of 2020 to implement the Ministry of Education's requirement of undisrupted learning for 276 million students, approximately 40 million of whom were junior secondary school students (China Ministry of Education, 2020). China was the first country to enforce school closures in the name of Suspending Classes without Stopping Learning during the COVID-19 pandemic lockdown (Yan, 2021). School teachers' transition was inevitably challenging to address ever-emerging problems with a vast population and unbalanced ICT development.

With the outbreak of the epidemic, many countries and regions have taken emergency measures to close schools. In order to protect students' learning rights, schools have turned to online teaching. This rapid change has prompted schools and educational institutions to seek online teaching solutions actively. Since traditional classes cannot be held, many schools use online teaching platforms, such as Zoom, Microsoft Teams, and Google Classroom, to achieve remote teaching. The proliferation of these platform applications has contributed to the rapid development of the online education industry. During the pandemic, educational technology companies innovated online teaching tools, including virtual experiments, interactive teaching materials, and online tests, to provide a richer and more effective teaching experience. This technological innovation helps improve the quality of online teaching. With the spread of COVID-19, we believe the global scale of online courses will grow sharply. Therefore, more focus and attention should be paid to the current online teaching model. We call for more online teaching practices to avoid personnel transfer and reduce the risk of cross-infection to the minimum (Jin, 2021).

1.1.2 Motivation of the Study

Physics plays an important role in education at the junior high school level. It provides students with basic scientific knowledge, develops logical thinking and experimental abilities, and lays the foundation for further study in science and engineering. Junior high school physics education helps students establish the foundation of scientific knowledge. By learning physical concepts, laws, and principles, students understand the basic operating laws of nature and develop their understanding and knowledge of the world. Physics involves experiments and observations. Through junior high school physics experiments, students can learn to design experiments, collect data, analyze results, cultivate their experimental and observation abilities, and improve their ability to solve practical problems.

At the same time, middle school physics prepares students for in-depth study in science and engineering fields in high school and college. The physics knowledge students learn in junior high school will support subsequent deeper subject learning and provide a reference for future career choices. Junior high school physics scores are also a subject that accounts for a large proportion of students' high school entrance examination scores, which has attracted the attention of many students, parents, and teachers. Therefore, this researcher hopes it can be improved if study physics as a middle school physics teacher.

This research institute hopes to explore online education in depth. Online education provides innovative teaching methods and tools, and research on new education models and technologies can promote innovation and progress in education. Research on students' interest in online education is an important motivation. Researchers want to know whether online education is comparable to traditional education or superior in some aspects. Online education provides opportunities for personalized learning, and researchers are interested in implementing better personalised learning paths, resource recommendations, and teaching feedback. This helps meet students' different learning needs and styles.

At the same time, researchers are interested in developing and innovating technological tools, teaching platforms, and applications used in online education. This kind of research helps advance the field of educational technology. Next, the recent global epidemic has made online education an urgent teaching model.

In the middle school where the researcher works, school leaders and policies encourage teachers to engage in innovation and research actively and try to use various teaching models, and online teaching is one of them.

1.2 Research Questions

The research questions are listed as follows:

1. How does online teaching affect students' interest in learning physics?

2. What are the differences between traditional and online teaching regarding students' outcomes in learning physics?

3. What is the teachers' perspective on how online teaching affects students' interest in physics?

1.3 Research Hypotheses

1.3.1 Research Hypothesis 1

Online teaching can affect students' interest in learning physics.

1.3.2 Research Hypothesis 2

Online teaching can influence students' interest in physics more than traditional teaching.

1.3.3 Research Hypothesis 3

Teachers believe online teaching can better influence students' interest in learning physics.

1.4 Research Objectives

1. To study online teaching affects students' interest in learning physics.

2. To compare the differences between online and traditional teaching in students' interest in physics.

3. To investigate how teachers' perspectives on online teaching affect students' interest in learning physics.

1.5 Scope of the Research Study

There are 100 grade 9th students in two classes at Kunming Changshui Middle School. Kunming is the capital of Yunnan Province, a province in western China with relatively backward education. Changshui Middle School is where the researchers work, which facilitates the research of this experiment. Changshui Middle School is the top school in Kunming. It is a first-class, complete middle school with reliable research results. This experiment was randomly sampled from 400 students in 8 classes in grade 9 of Changshui Middle School. Two classes were selected from the eight classes as experimental samples, with 100 students. One class used online teaching, and the other class used traditional teaching. Teaching as a control group. The study period is from April 2024 to May 2024.

1.6 Research Framework

The research structure is shown in the figure below:

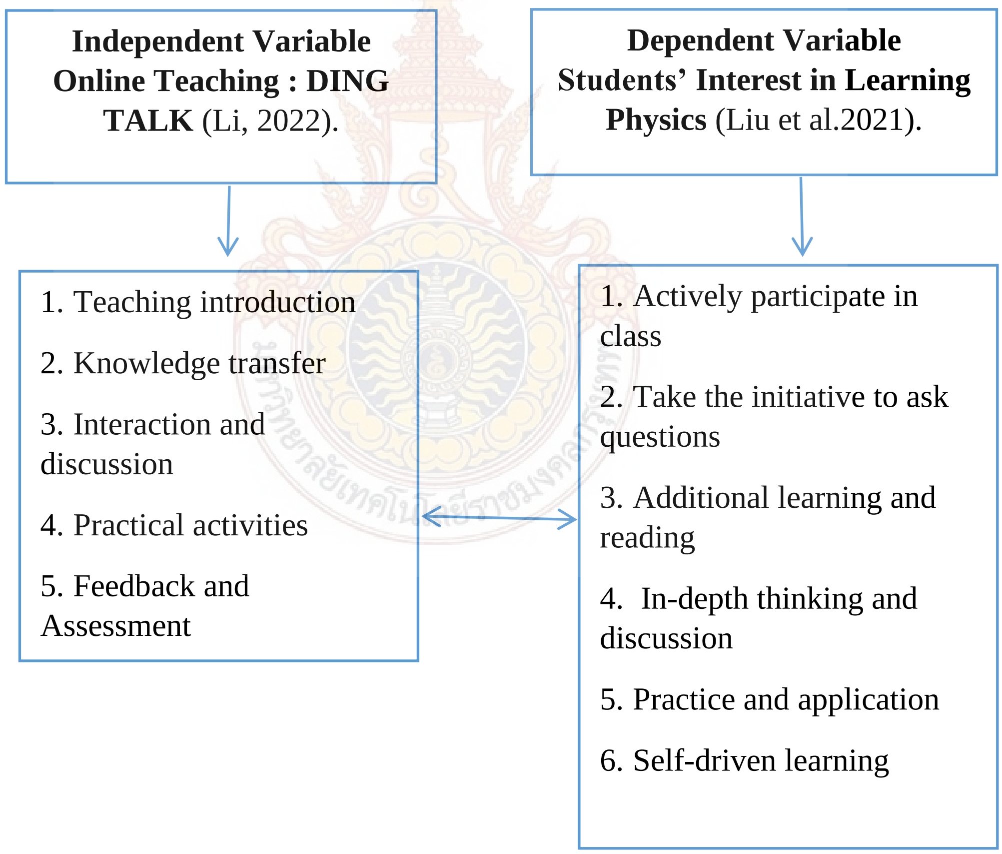


Figure 1 Research Framework

1.7 Definition of Key Terms

This section gives operational definitions of the important terms of this research framework, and the definitions are as follows:

1.7.1 Online Teaching

Online Teaching is the delivery of instruction via DingTalk. The steps of teaching are as follows:

1. Teaching introduction
2. Knowledge transfer
3. Interaction and discussion
4. Practical activities
5. Feedback and Assessment

(Darkwa & Antwi, 2021)

Online teaching is conducted through the Internet and digital technology, and students and teachers conduct distance learning and teaching through online platforms in different geographical locations. The online education mentioned in this study is a form of live teaching through the software DingTalk. The teacher teaches in front of the computer. Through the software, students learn online through computers, mobile phones, and other devices at home. At the same time, they use “Questionnaire Star”, “Homework Help”, and other software to assist.

The specific teaching steps are as follows (taking the knowledge point of buoyancy as an example): Teaching introduction, Knowledge transfer, Interaction and discussion, Practical activities, and Feedback and Assessment.

1.7.2 Students’ Interests in Learning

Student learning interest refers to students’ intense curiosity and desire for a specific subject, theme, or field, manifested in active participation in relevant knowledge and activities, in-depth exploration, and willingness and motivation to learn spontaneously.

For this study, the following aspects are summarized: Actively participate in class, Take the initiative to ask questions, Do additional learning and reading, Engage in in-depth thinking and discussion, Practice and application, and Engage in self-driven learning.

1.7.3 The Effectiveness

In education, “effectiveness” usually refers to the effectiveness of a teaching method, curriculum, or educational policy, that is, its ability to achieve established educational goals and expectations. Effective education should enable students to acquire knowledge, skills, and understanding and improve students’ academic performance and development.

This study mainly focuses on the effectiveness of online teaching on students’ interest in learning physics, which is mainly reflected in students’ various behavioral performances and classroom feedback. We mainly evaluate effectiveness through classroom observations and questionnaires.

Among the five teaching steps in classroom observation, if three or more steps show students’ interest in learning, it can be called effective.

1.8 Benefits of the Study

Understanding the effectiveness of online teaching on students’ interests in learning physics has important practical significance. Through research, we can deeply explore whether online teaching is efficacious in improving students’ interest in learning physics, what aspects of students’ interest in learning physics are reflected, and whether online teaching has more advantages than traditional teaching in terms of students’ interest in learning physics. This type of research can provide targeted intervention measures and support for educational institutions and managers, improve the application of online teaching in middle school physics teaching, and help developers improve online teaching platforms and tools, which is of particular significance.

CHAPTER II
LITERATURE REVIEW

This chapter provides an overview of the relevant literature and key concepts related to the research topic. The following concepts and contents will be introduced:

2.1 Constructivism

2.1.1 The Development of Constructivism

Constructivism is a term that should be used with care. It is widely used in many disciplines, and even in the more limited area of education, it is evident that the term is used with very different meanings. This article focuses on constructivism in education. (Sjoberg, 2010).

The origins of constructivist theory can be traced back to the early 20th century, specifically the 1930s and 1940s. Pioneers of the theory include cognitive psychologist Jean Piaget (Switzerland) and sociologist Lev Vygotsky (Soviet Union). These two scholars independently developed the core ideas of constructivism in different fields, laying the foundation for later constructivist theory and educational practice.

Piaget paid attention to children's cognitive development and proposed cognitive constructivism theory. He believes that children gradually build a cognitive structure of the world through active interaction with the environment. His research emphasizes how learners construct knowledge through active participation, exploration, and adaptation (Piaget, 1932).

Vygotsky proposed sociocultural theory, emphasizing the importance of social interaction and cultural environment on cognitive development. He emphasized that learning is social and occurs in social situations (Vygotsky, 1932).

Bruner further developed the constructivist theory in the mid-20th century and proposed a constructivist educational theory. He emphasized that students construct knowledge through interaction with textbooks and other students (Bruner, 1966).

Simons, Chappell, and others expanded constructivist theory and proposed "social constructivism", emphasizing the impact of the social environment on knowledge construction.

Overall, the development of constructivist theory has gone through multiple stages, from individual cognition to social interaction to application in educational practice. This theory emphasizes that students are the constructors of knowledge and emphasizes the social and participatory nature of learning. Constructivism has had a profound impact on both educational practice and technological applications.

2.1.2 Related Theories of Constructivism

Constructivism involves several related theories, including important cognitive psychology and educational theories. This study mainly focuses on the related theories of constructivism in education.

Piaget's Theory of Cognitive Development: Jean Piaget is an important figure in cognitive psychology. He proposed four stages of cognitive development: the sensorimotor stage, preoperational stage, concrete operation stage, and formal operation stage. He believes that children gradually build a cognitive structure of the world through active interaction and experience (Piaget, 1932).

Vygotsky's Sociocultural Theory: Leif Vygotsky emphasized the importance of social interaction and cultural environment on cognitive development. He proposed a "proximal development zone" and a "far development zone". He believed that through social interaction, students could achieve a higher level of cognition based on their potential cognitive level (Vygotsky, 1932).

Jerome Bruner's Constructivist Educational Theory: Bruner developed a constructivist educational theory in the mid-20th century, emphasizing that students construct knowledge through interaction with textbooks and other students. He proposed the concept of "enactive learning", emphasizing that learning is a process of active participation (Bruner, 1966).

Social Constructivism: Social constructivism is an extension of constructivism and emphasizes the influence of social environment on knowledge construction. This theory emphasizes the importance of sociocultural background, social interaction, and context in constructing knowledge (Smith, 1998).

John Dewey’s Empiricist Educational Theory: Dewey’s empiricist educational theory profoundly impacted constructivism. He emphasized that students construct knowledge through practical experience and practice and advocated that learning and life are closely connected (Dewey, 1938).

Golfstein’s Cognitive Development Theory: Golfstein proposed the "Cognitive Development Theory of Regret", emphasizing that students construct more complex and profound cognitions by constantly adjusting and revising their understanding of cognitive development structure (Golfstein, 1975).

George Keller’s Theory of Subjective Experience: Keller is an important representative of constructivism and empiricism. He proposed the subjective experience theory, which believes individuals construct their understanding of the world through their subjective experiences (Keller, 1925).

Together, these theories form the theoretical basis of constructivism, emphasizing that students are the constructors of knowledge and that learning is an active and participatory process.

2.1.3 The Influence of Constructivism

Over the years since its development, constructivism has had a profound impact on education and promoted changes in educational concepts and practices (Kılıç & Gürdal, 2010).

Student-Centered Teaching: Constructivism emphasizes that students are the constructors of knowledge, and education should be centered around students’ needs and interests. Therefore, in practice, educators pay more attention to designing personalized learning activities based on students’ backgrounds, experiences, and levels so that students can be more in-depth and meaningful in building knowledge. In short, student-centered teaching methods aim to inspire students to construct knowledge using real-life and relevant assignments (Elen et al., 2007; Struyven & Dochy, 2010) and provide sharing and occasional discussion for individual learners with multiple knowledge opportunities.

Cooperative Learning and Social Interaction: Constructivism encourages cooperative learning and social interaction. Educators advocate cooperation, communication, and the sharing of experiences among students, and they believe that social interaction is an important part of knowledge construction. This has led to more group activities, collaborative projects, and discussions in the classroom to promote students' co-construction of knowledge. Cooperative learning has a deep and rich empirical literature supporting its positive effects on motivation and achievement, interpersonal relationships, and psychological health (Johnson & Johnson, 2005). These effects are well-documented in face-to-face cooperative learning, but the efficacy of asynchronous online cooperative learning is less clear (Peterson, 2023).

Problem-Based Learning: Constructivist education emphasizes the construction of knowledge through problem-solving and inquiry. Educators promote problem-based learning, encouraging students to ask questions and seek answers, developing their critical thinking and problem-solving skills (Chueh & Kao, 2024).

Practical Learning and Situational Teaching: Constructivism believes learning is closely related to experience and situations. Therefore, educators advocate practical learning and situational teaching to help students construct knowledge through practical applications and real situations. This includes field trips, experiments, project learning, and more (Altaker, 2024).

Application of Technology in Education: With the advancement of technology, the concept of constructivism also promotes the application of technology in education. Virtual learning environments, online collaboration tools, and multimedia resources are widely used in constructivist teaching practices to provide students with more diverse and flexible learning experiences. Multimedia technology, as an advanced technology in audio-visual education programs, is being applied increasingly widely with the advancement of time and the development of science and technology, such as in college physical education. The wide use of multimedia technology in college physical education has changed traditional teaching methods, improved teaching effects, and made teaching procedures vivid (Chen & Xia, 2012).

Reflective Learning: Constructivism encourages students to engage in reflective learning, that is, to think deeply about their learning processes and understandings. Educators hope to inspire students to develop a deeper understanding of subject content by encouraging student reflection. For example, mind mapping is a visual manifestation of reflective learning. It often appears in middle school education. It can help students build a more precise knowledge system, understand memory and recitation, and sort out the knowledge they have learned. In recent years, with the increasing use of reflective journals, many have paid attention to the problems and challenges related to their use (Yang, 2022).

Evaluation and Feedback: In constructivist education, evaluation not only focuses on students' achievements but also on the process and students' thinking ability. Educators provide timely feedback to help students realize their learning process and think about problems.

Career and Lifelong Learning: Constructivism emphasizes learning as a lifelong process. While educating students, educators also encourage them to develop into individuals with continuous learning motivation and adapt to changing social and professional needs.

2.1.4 The Relationship between Constructivism and This Study

Students' active participation: The constructivist concept emphasizes active participation and interaction with teachers and classmates (Decristan et al.,2023). In an online teaching environment, researchers can stimulate students' interest in physics by designing interactive and participatory learning activities. Students' participation in whole-class discourse is vital to classroom learning and has gained particular attention in recent research (Böheim et al., 2020; Schnitzler et al., 2021). Therefore, this requires researchers to think carefully and carefully design the online teaching process. For example, the online teaching in this study can use virtual experiments, simulation software, and online discussions to allow students to participate actively in experiments and problem-solving. The results emphasize the role of student-guided participation (and students' engagement) in learning (Decristan et al., 2023).

Cooperative Learning: Both constructivism and online teaching focus on the importance of cooperative learning. Online platforms can provide collaborative tools that enable students to co-construct knowledge virtually (Peterson, 2023). For example, this study uses DingTalk for live teaching. Students can use public chat rooms in DingTalk to interact with teachers and classmates. They can also create group chat rooms to discuss some classroom issues. Through cooperative learning, students can communicate and share ideas, increasing their interest in physics.

Practical Learning: Constructivism advocates practical learning, and online teaching provides many tools to support practical learning. Virtual labs, simulation software, and online projects allow students to engage in real-world applications in physics, making the subject more attractive. Many schools are not equipped with many experiments because the experimental equipment is expensive or inconvenient.

	student-guided participation	teacher-guided participation	student-guided participation	teacher-guided participation	additional hand-raisings only
	Model 6.1 *b* (*SE*)	**Model 6.2** *b* (*SE*)	**Model 6.3** *b* (*SE*)	**Model 6.4** *b* (*SE*)	**Model 6.5** *b* (*SE*)
Within-class level					
Student participation	.26†† (.04)	.12† (.05)	.11†† (.04)	.04 (.04)	.13†† (.03)
Socio-economic status (high)			.07†† (.03)		.07†† (.03)
Prior achievement			.54†† (.03)	.59††† (.03)	.54†† (.03)
Math self-concept			.10† (.05)		.09† (.05)
R^2 within-class	.066	.014	.323	.353	.325
Between-class level					
Student participation	.12 (.18)	.11 (.20)	−.07 (.07)	<.01 (.08)	−.06 (.06)
Socio-economic status (high)			.16* (.07)		.16* (.07)
Prior achievement			.81** (.07)	.90** (.04)	.81** (.07)
Math self-concept			.06 (.08)		.06 (.08)
R^2 between-class	.015	.012	.833	.807	.831

Note. * $p<.05$, two-tailed. ** $p<.01$, two-tailed. † $p<.05$, one-tailed. †† $p<.01$, one-tailed.

However, virtual laboratories can solve this problem and allow students to do experiments at home.

Problem-Based Learning: Problem-based learning is a common teaching strategy in constructivism and online teaching (Chueh, 2024). By guiding students to solve real-world problems, it stimulates their curiosity and thirst for knowledge, thus making learning more engaging. This is an important aspect of students' learning interests. The physics subject emphasizes that students can connect their knowledge with the reality of life.

Multimedia and Technology Applications: Online instruction allows educators to utilize multimedia and technology resources to present physics concepts (Chen, 2012). Abstract physical concepts can be presented more vividly through multimedia forms such as images, videos, and simulations, improving students' interest in physics. This is the most advantageous point of online teaching and is a feature that traditional teaching does not have. This study should make full use of this point.

The above points are some of the connections between constructivism and this study. Researchers should fully integrate the theoretical ideas of constructivism, constantly optimize the research design and process, and combine constructivism, online education, and learning interests well.

2.2 Online Teaching

2.2.1 Definition of Online Teaching

Online teaching delivers instruction via digital resources (Darkwa & Antwi, 2021). Online teaching is conducted through the Internet and digital technology, and students and teachers conduct distance learning and teaching through online platforms in different geographical locations.

Online teaching is not a new thing. It is also called distance teaching or online teaching. It is a real-time, interactive multimedia teaching method based on a network platform. Since teachers and students cannot be in close contact during online teaching, and the communication between teachers and students lacks "warmth", it is worthwhile to focus on how to guide students to participate in online teaching actively, give full play to the leading role of teachers, and promote students' efficient learning. Many front-line teachers conduct practical research (Li, 2022).

The specific teaching steps are as follows (taking the knowledge point of buoyancy as an example):

1. Teaching Introduction: Educators usually conduct a brief teaching introduction at the beginning of the course to introduce today's learning objectives and topics and stimulate students' interest in learning. It is common to play videos about related physical knowledge, such as aerospace space navigation, to introduce the content to be learned today. This essential link can often quickly attract students into today's classroom. At the same time, the video can also trigger students to think about physical phenomena. The teacher asks questions before the video about why such a phenomenon occurs and allows students to watch the video with questions, cultivating students' active learning and independent thinking abilities (Li, 2022).

2. Knowledge Transfer: In online classes, educators transfer knowledge through demonstrations, explanations, and multimedia materials. This may involve teaching lectures, presenting slides, showing videos, and using virtual labs, such as beautiful slides, logical and orderly explanations, and extended video playback (Li, 2022).

3. Interaction and Discussion: To promote student participation and interaction, educators usually arrange interactive sessions, such as online discussions, group discussions, and question answering. This helps students gain a deeper understanding and provides opportunities to share ideas.

4. Interact with students in class: Set up groups or online platforms so students can answer the teacher's questions promptly and conduct group cooperation and discussions (Ahmed et al., 2023).

5. Practical Activities: Some practical activities, such as virtual experiments and project assignments, may be included in online courses. These activities help students apply theoretical knowledge to practical situations. This link mainly allows students to conduct simulation experiments in person.

6. Feedback and Assessment: Educators provide feedback, answer questions, and evaluate students' progress. This may include real-time Q&A, online quizzes, assignment assessments, and more (Darkwa & Antwi, 2021).

2.2.2 Development of Online Teaching

Advances in Technology: The continuous advancement of technology is one of the main driving forces for the development of online teaching. The popularization of efficient Internet connections, smart devices, Virtual Reality (VR), Augmented Reality (AR), and other technologies has provided more possibilities for online teaching. AR has been applied and studied in various STEM fields in higher education, such as mathematics, computer science, engineering graphics, mechanical engineering, science laboratory skills, astronomy, electrical engineering, construction and civil engineering, and engineering management (Hu et al., 2021).

The Spread of the Global Internet: The widespread spread of the Internet around the world has made it easier for educational resources to cross geographical and cultural boundaries. Online platforms allow students and educators to access courses, teaching materials, and expertise worldwide. With the rapid development of the Internet + era, the Internet education model has become an important measure in educational reform and promoting the comprehensive development of education. Many factors limit the traditional teaching model. Therefore, the education model is reformed in the direction of the new era. Online teaching ensures the orderly operation of experimental diagnostics courses and has become a new form of education widely accepted by teachers and students (Xiong et al., 2023)

The Rise of Mobile Learning: The popularity of mobile devices has prompted the rise of mobile learning (m-learning), which allows students to access educational resources anytime and anywhere. The flexibility of mobile learning means that learning is no longer restricted to a specific location or time. As mobile technology is increasingly used in science teaching, it is crucial to understand how mobile devices can most effectively improve students' learning (Zhai et al., 2023).

The Development of Online Learning Platforms: A series of online learning platforms, such as Coursera, edX, and Udacity, have emerged, providing many online courses and degree programs. These platforms provide students with broader academic options by partnering with universities and educational institutions worldwide. In recent years, online teaching has become one of the teaching models widely used by universities, and online open courses have also become a key project that universities are vigorously building. For example, MOOC is a good online learning platform (Chen, 2023).

Online Collaboration and Social Learning: Online teaching platforms enhance collaboration and social learning among students and between students and teachers. Forums, collaboration tools, and virtual groups facilitate the establishment of learning communities (Sirk, 2024).

2.2.3 Related Theories of Online Teaching

Online teaching is related to constructivist theory because constructivist theory emphasizes students building knowledge through interaction and practical experience, and online teaching provides a variety of ways to support this learning philosophy.

Students' Active Participation and Interaction: Constructivism believes that students are the constructors of knowledge and emphasizes the importance of active participation and interaction for in-depth learning. Online teaching provides rich interaction opportunities between students and between students and teachers through discussion forums, online group projects, real-time interactive tools (Li et al., 2023).

Practical Learning: Constructivism emphasizes the need to combine learning with practice, and online teaching provides opportunities for practical learning through virtual experiments, simulation software, project learning, allowing students to construct knowledge in practical applications (Altaker, 2024).

Problem-Based Learning: Constructivism encourages problem-based learning, where problem-solving creates knowledge. Online teaching design can guide students to face specific problems, stimulate their curiosity, solve problems through research and discussion, and promote the construction of knowledge (Chuehkao, 2024).

Social Interaction and Cooperative Learning: In constructivist theory, social interaction and cooperative learning are the keys to knowledge construction. Online teaching provides collaboration tools, online group projects, real-time discussions, and more to promote student social interaction and cooperation (Bandura, 1964).

Application of Technology: Constructivism emphasizes traditional educational methods and includes the application of technology in the learning process. The online teaching environment provides various technological tools, such as multimedia resources, virtual laboratories, and online simulations, to support students' constructivist learning (Zhai et al., 2023).

2.2.4 Related Research on Online Teaching

People's research on online teaching mainly focused on the rapid development of the Internet. Educators at different stages have researched online teaching. However, with the outbreak of the new crown epidemic, more research on online teaching has become available.

According to the relevant literature reviewed, the researchers found that research on online education mainly focuses on the following aspects: (Darkwa & Antwi, 2021); (Liu et al., 2021); (Li, 2022); (Chen, 2023); (Li & Wu, 2023); (Xiong et al., 2023).

Learning Outcomes and Effectiveness: Many studies focus on the impact of online teaching on students' academic performance, knowledge mastery, and skill development. Compare the effectiveness of online learning with traditional face-to-face learning to evaluate the effectiveness of online instruction.

Student Engagement and Interaction: Researchers study student engagement levels and interaction patterns in online learning environments. This includes exploring how students utilize online tools, participate in discussions, complete assignments, and more.

Online Course Design and Teaching Strategies: Research focuses on how to design and implement practical online courses. This includes exploring teaching strategies, course structure, and multimedia use for online teaching.

Online Learning Platforms and Tools: Scholars study different online learning platforms and tools, including virtual classrooms, learning management systems, collaboration tools, and more. They study the impact of these tools on student learning experiences and academic performance.

Student Satisfaction and Experience: Researchers have focused on student satisfaction and experience with online instruction. This includes studying students' feelings, attitudes, needs, and feedback about the online learning process.

Social Interaction and Collaboration in Online Teaching: Research explores social interaction and collaboration in online learning environments. This includes student collaboration, teacher-student interactions, and online discussion and collaboration tools (Liu et al., 2021).

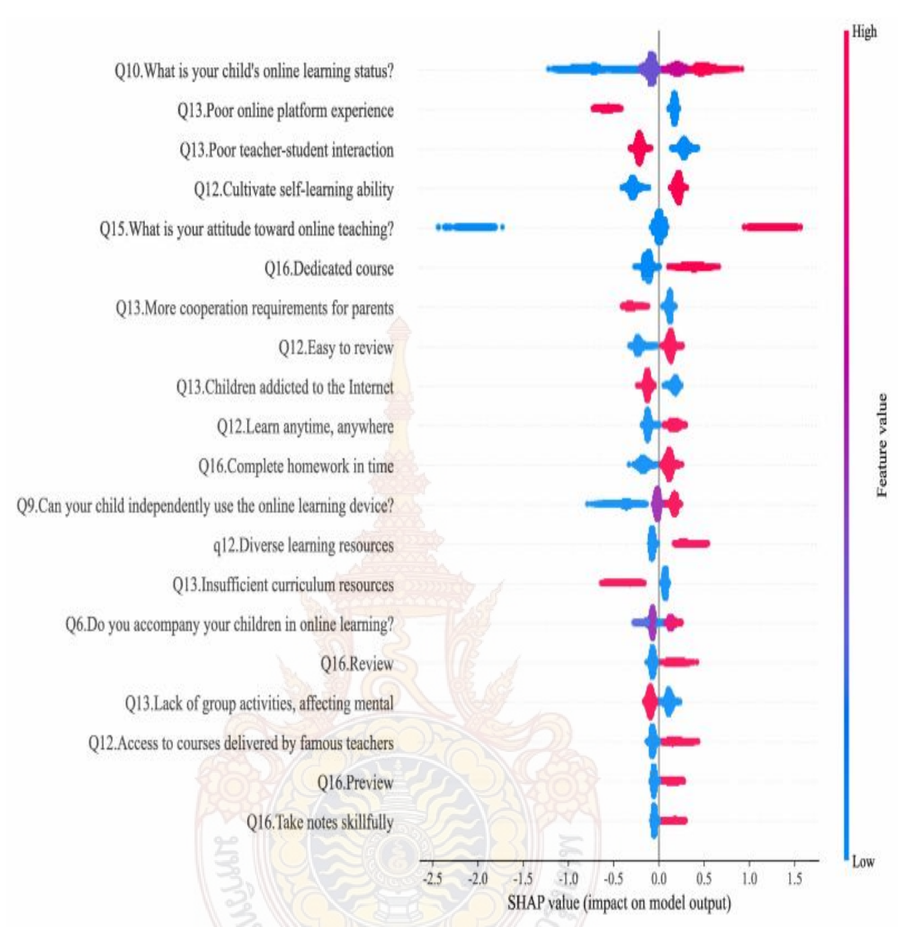


Figure 2 Questionnaire

2.3 Students’ Interests in Learning

For this study, the following aspects are summarized:

1. Actively participate in class: Students interested in learning usually show active class participation. They may pay attention, ask questions, share opinions, and interact with teachers and classmates.

2. Take the initiative to ask questions: Students with strong interests are inquisitive. They may often take the initiative to ask questions to gain a deeper understanding of relevant knowledge. This includes questions during and after class (Li, 2022).

3. Additional learning and reading: Students take the initiative to read and learn additional materials related to the class in their own time, including books, articles, videos.

4. In-depth thinking and discussion: Students interested in learning tend to think deeply about subject content and demonstrate a more nuanced understanding of subject-related discussions. This requires teachers to carefully observe what students discuss during group discussions (Liu et al., 2021).

5. Practice and application: Students may apply the theoretical knowledge they have learned to practical problems through practical practice and application. For example, after studying the buoyancy chapter, can you explain some physical phenomena in life (life jackets, submarines)?

6. Self-driven learning: Learning interest enables students to have self-driven learning motivation. They may formulate learning plans, find resources, and actively solve learning problems (Li et al., 2021).

2.3.1 Related Theories of Students' Interests in Learning

Interest Theory: Interest Theory emphasizes the importance of interest in learning. A student's level of interest in a subject, topic, or activity affects their learning experience and academic performance. The "Interest-Enhancing Model" proposed by Krapp et al. emphasizes the relationship between interest and cognitive grasp.

Cognitive Motivation Theory: Cognitive motivation theory focuses on students' cognitive processes and motivational factors towards learning tasks. Goal setting, task complexity, and autonomy affect students' cognitive motivation, closely related to their subject interests.

Self-Determination Theory: Self-determination theory emphasizes an individual's intrinsic motivation and control over his or her behavior. Students' autonomy, sense of competence, and sense of belonging to learning are related to their subject interests. The three basic needs in the theory are autonomy, a sense of competence, and interpersonal relationships (Li et al., 2021).

Social Cognitive Theory: Social Cognitive Theory emphasizes the influence of social factors on learning. Students develop interests in different subjects by observing and participating in social activities. Social interactions and role models are important in cultivating subject interest (Li, 2023).

2.3.2 Related Research on Students' Interests in Learning

According to relevant literature, research on students' learning interests mainly includes the following aspects: (J.F. Li, 2022); (X.M. Li, 2022); (Chen, 2023); (Fryer et al., 2023); (Li, 2023); (Sun et al., 2023); (Xiong et al., 2023).

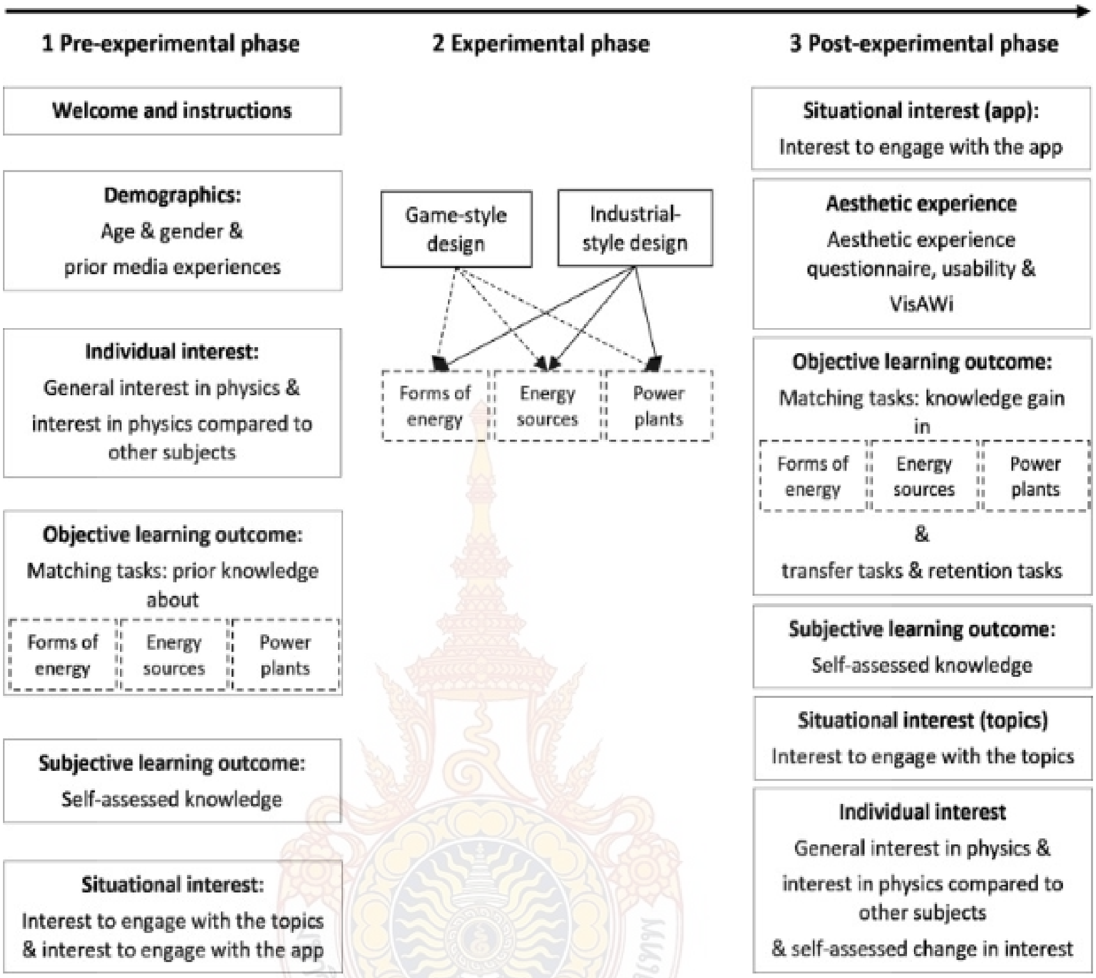
Formation of Subject Interests: Studying the formation of subject interests explores how students' interests in different subjects develop. This includes the evolution and changes in students' interests from middle school to high school and college.

The Relationship between Interests and Academic Performance: Studies focus on the relationship between students' subject interests and academic performance. These studies usually involve the impact of interest on subject choice, learning strategies, and its correlation with subject achievement.

Interest and Learning Motivation: Students' subject interests are closely related to their learning motivation. Research focuses on the differences in motivation among students with different interest levels in learning and how to improve students' motivation by stimulating interest.

Cultivation and Guidance of Interests: Research in educational practice focuses on cultivating and guiding students' subject interests. This may include the teacher's teaching strategies in the classroom, course design, and methods of stimulating student interest. Influencing Factors of Interest: The formation and development of subject interests are affected by many factors, including individual differences, family background, school environment, and teaching methods. Researchers strive to understand how these influences shape student interests (Ruf et al., 2022).

The impact of experiments on students' interest in learning (X.M. Li, 2022)



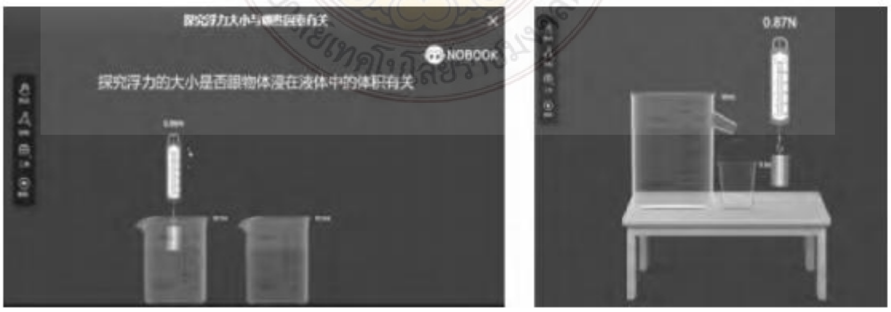


Figure 3 Buoyancy Section Test

CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Design

This study selected 100 students from two 9th-grade classes at Changshui Middle School in Kunming City, Yunnan Province, for a month of online teaching. The control group also received a month of traditional teaching, all of which were based on the buoyancy chapter. The teacher was always the same person, the researcher himself. There are five lesson plans for a month and one for 100 minutes. Each class has a total teaching time of 500 minutes.

For the three questions in this study, the researcher used a questionnaire, lesson plan, test, and teacher diary to conduct research. Furthermore, the research design of this study uses a mixed method, and qualitative and quantitative methods are included in this study. The advantage is that the research topic can be fully explored, statistical analysis can be combined with numerical data, and the problem can be explored more deeply from the aspects of questionnaire, test, lesson plan, and teacher's diary.

3.2 Samples and Sample Size

3.2.1 Population

This study takes 9th-grade students from Changshui Experimental Middle School in Kunming, Yunnan Province, China, as the primary research population. There were 400 students in the 9th grade, which consisted of eight classes, with 50 students in each class.

3.2.2 Samples Group

This study used simple random sampling. Thus, two classes were selected from the eight classes: the experimental group using online teaching and the control group using traditional teaching.

3.2.3 Sampling Methods

Simple random sampling selects several individuals from the population. Each individual has an equal chance of being selected, and every possible sample has an equal opportunity.

This study randomly selected 100 individuals from a population of 400 students. The specific method is to divide 400 students in eight classes into eight groups according to the regular class. Find eight small balls and write the numbers 1, 2, 3, 4, 5, 6, 7, and 8 respectively. Each number corresponds to the class of the corresponding number. Then, two small balls are randomly selected, and the corresponding class is the class participating in this experiment. Select the class with small numbers as the experimental group and the class with large numbers as the control group. For example, the numbers of the drawn balls were 3 and 6. It means that Class 3 and Class 6 participated in this study. Class 3 was the experimental group, and Class 6 was the control group.

3.3 Data Collection

The information-gathering tool is the designed questionnaire, lesson plan, and test teacher daily.

Part 1. For Objective 1: Questionnaire

A questionnaire is a research tool that consists of a series of questions designed to collect information from respondents. Questionnaires can be conducted face-to-face, by phone, online, or by mail. This study used a paper questionnaire. Questionnaires are an economical, fast, and effective method for collecting large amounts of data from a large sample, and the data collection process is very rapid. This method is beneficial for large groups where interviews are not possible. In addition, questionnaires can effectively measure many subjects' behaviors, attitudes, preferences, opinions, and intentions more economically and quickly than other methods.

This questionnaire was distributed to students in both the control and experimental groups. The content of the questionnaire was the same.

The questionnaire survey consists of six aspects as follows:

Students' interest in learning physics

1. Actively participate in class
2. Take the initiative to ask questions
3. Additional learning and reading
4. In-depth thinking and discussion
5. Practice and application
6. Self-driven learning

Part 2. Objective 2: Testing and Lesson Plan

This study used tests and lesson plans to compare the effects of online and traditional teaching on students' interest in learning physics. Since the researcher was not directly involved in these courses, she could look at these experiences objectively and neutrally. The test and lesson plan focused on "The impact of online teaching on students' interest in learning physics." This flexible design allowed participants to complete tasks as they wished, which may provide new insights.

The test and lesson plan were conducted in a familiar environment, with right or wrong answers. It also examined students' learning outcomes during this period.

This study selected 100 students to participate. These students are from Changshui Experimental Middle School in Kunming, Yunnan Province. This test and lesson plan will focus on "The impact of online teaching on students' interest in learning physics." This method ensures the scientific and reliability of the collected data and helps to fully understand the impact of online teaching on students' interest in learning physics.

The test in this study was conducted simultaneously on students in both the control and experimental groups, and the content was consistent.

Part 3. Objective 3: Teacher's Diary

Teacher logs are a qualitative research tool in which teachers document and reflect on their teaching practices, students' responses, and classroom activities in their daily teaching routines. These logs assist teachers in identifying teaching problems, enhancing instructional methods, and monitoring students' progress and challenges. This study focuses on teachers' perspectives as captured in these logs.

The primary data collection method for teacher logs involves teachers' daily recordings and reflections. In this study, data is mainly collected through electronic logs, where teachers use computers or mobile devices to document their logs via electronic documents or specialized software. Teacher logs serve as a crucial tool for teachers' self-reflection and professional development and provide invaluable first-hand data for educational research. By systematically recording and analyzing these logs, we can gain an in-depth understanding of teaching practices and student learning processes, ultimately improving teaching strategies and the overall quality of education.

3.4 Research Instrument

Part 1. Objective 1: Questionnaire for students

A questionnaire was used to collect data from the student section. The questions were designed based on the research objectives of the article as well as the relevant literature. Before using the questionnaire, the advice of relevant experts was taken, and the questionnaire was tested to ensure its validity.

The questionnaire survey consists of 6 aspects as follows (See Table 3.1):

1. Actively participate in class (5 items);
2. Take the initiative to ask questions (5 items);
3. Additional learning and reading (5 items);
4. In-depth thinking and discussion (5 items);
5. Practice and application (5 items); and
6. Self-driven learning(5 items)

Table 1 Questionnaire Structure

	Subject	Item	Reference Source
Actively participate in class	1-5	5	Liu et al. (2022)
Take the initiative to ask questions	6-10	5	
Additional learning and reading	11-15	5	
In-depth thinking and discussion	16-20	5	Chen (2023)
Practice and application	21-25	5	
Self-driven learning	26-30	5	Li (2022)
The overall questionnaire consists of 30 measurement items.			

3.4.1 Data Collection

The researcher designed the questionnaire based on the framework of the study, where all the questions were in declarative sentence form, and the sampled students were allowed to choose their answers based on their ideas. The Likert (1932) 5 scale is used in this study because the participants are 15 years old. There are 30 questions divided into three dimensions, with each dimension measuring a variable number of questions as follows:

A rating of 5 means “completely agree.”

A rating of 4 means “agree.”

A rating of 3 means “not sure.”

A rating of 2 means “disagree.”

A rating of 1 means “completely disagree.”

3.4.2 Data Analysis

Quantitative data are analyzed using frequencies, percentages, means ($\bar{x}$), and standard deviations (S.D.). The mean value of the suitability score of expert opinions is calculated and compared with the following criteria:

A mean score of 1.00-1.50 means “completely disagree,” interpreted as “very low.”

A mean score of 1.51-2.50 means “disagree,” interpreted as “low.”

A mean score of 2.51-3.50 means “not sure,” interpreted as “moderate.”

A mean score of 3.51-4.50 means “agree,” interpreted as high.

A score of 4.51-5.00 means “completely agree,” interpreted as “very high.”

The Development Process of Questionnaire

The preparation process of the semi-structured questionnaire “Questionnaire on the Impact of Online Teaching on the Interest of the 9th-Grade Students in Learning Physics at Kunming Changshui Middle School”.

1) Research the concept and preparation process of the questionnaire "Questionnaire on the Impact of Online Teaching on the Interest of the 9th-Grade Students in Learning Physics at Kunming Changshui Middle School".

2) Draft the questionnaire.

3) Review the questionnaire by the instructor.

4) Modify the questionnaire according to the suggestions.

5) Verify the validity of the questionnaire by three experts. Three are from China. The test consistency index is 0.50-1.00.

6) Modify the questionnaire according to the suggestions and select ten questions for the teacher to organize into a questionnaire to implement the tool.

Part 2. Objective 2: Lesson plan

Lesson Plan

There are five lesson plans for four weeks and one for 100 minutes. Each class has a total teaching time of 500 minutes.

1) Lesson Plan 1 : Understanding buoyancy

Example :

Objectives :

1. The students can actively participate in class;

2. Take the initiative to ask questions;

3. Additional learning and reading;

4. In-depth thinking and discussion;

5. Practice and application;

6. Self-driven learning

Content: The phenomenon, definition, range, and object of buoyancy.

Focus: Understand the definition of buoyancy, appreciate the existence of buoyancy, and be able to explain life phenomena.

Teaching Method:

1. Teaching introduction: Play a video introducing buoyancy phenomena in daily life. Guide students to ask questions. (Focus Actively participate in class, Take the initiative to ask questions, Additional learning and reading).

2. Knowledge transfer: Combine video knowledge with the buoyancy definition, provide the definition, and analyze the definition. (Focus: Actively participate in class).

3. Interaction and discussion: Group discussion sharing the understanding of buoyancy, giving examples, teacher questioning (Focus: Actively participate in class, In-depth thinking and discussion).

4. Practical activities: Conduct experiments on buoyancy phenomena. (Focus: Practice and application, Actively participate in class, In-depth thinking and discussion)

5. Feedback and Assessment: Complete relevant exercises, ask questions from teachers, and have students evaluate each other. (Focus: Actively participate in class, Self-driven learning).

2) Lesson Plan 2: Exploring the Factors Influencing the Buoyancy of Objects

3) Lesson Plan 3: Archimedean Principles

4) Lesson Plan 4: Conditions for Object Floatation and Sinking

5) Lesson Plan 5: Balance of Buoyancy

The Development Process of the Lesson Plan

The development process of the semi-structured lesson plan for “Online teaching affects the interest of the 9^{th}-grade students in learning physics in Kunming Changshui Experimental Middle School”.

1) Research the concept and development process of the lesson plan for “Online teaching affects the interest of the 9^{th}-grade students in learning physics in Kunming Changshui Experimental Middle School.”

2) Draft the lesson plan.

3) Review the lesson plan by the instructor.

4) Modify the lesson plan according to the suggestions.

5) Three experts verified the validity of the lesson plan. Three of them were from China. The test consistency index was 0.50-1.00, and

6) Modify the lesson plan according to the suggestions and select ten questions for teachers to organize into a lesson plan to implement the tool.

Part 2.1 The Test

For course testing, this study selected 100 students from two Changshui Experimental Middle School classes in Kunming, Yunnan Province.

Understanding Buoyancy	= (5 items)
Exploring the Factors Influencing the Buoyancy of Objects	= (5 items)
Archimedes' Principle	= (5 items)
Conditions for Objects to Float and Sink	= (5 items)
Balance of Buoyancy	= (5 items)

Total 25 items

Test Development Process of the Test

1) Goal Setting: Test students' buoyancy knowledge in grade 9 physics through a multiple-choice test.

2) Material Preparation: Prepare test papers and black signature pens.

3) Test Content Design: Buoyancy knowledge involved in five days of teaching.

4) Test Steps:

- Fill in the test information.
- Answer the questions.
- Submit the work and answer sheet.

5) Evaluation Criteria: Scoring is based on the standard answers to the multiple-choice questions.

2.1) Data Collection

The researcher administered the test and implemented the lesson plan during the selected student class time. The researcher provided the test paper and guided the students through the test steps. Data were collected from 25 items.

2.2) Data Analysis

Quantitative data analysis scored each student based on their test scores.

The students gave one correct answer, and they got four scores. When they did all the correct answers, they got 100 scores.

Part 3. Objective 3: Teacher's Diary

Teacher's Diary

The teacher's diary was kept for five weeks, lasting ten hours. After finishing the lesson daily, the researcher wrote the teacher's diary to record the student's performance and interest.

Teacher's Diary Development Process

The development process of the teacher diary of "Online teaching affects the interest of ninth-grade students in learning physics in Kunming Changshui Experimental Middle School."

1) Research the concept and development process of the teacher diary: "Online teaching affects the interest of ninth-grade students in learning physics in Kunming Changshui Experimental Middle School.".

2) Study how to write the teacher's diary.

3) Using the research framework as a guideline to write the teacher diary as follows:

1. The students can actively participate in class. Students can follow the teacher's ideas and actively participate in the class.

2. The students can take the initiative to ask questions. Students can ask teachers questions about buoyancy in and out of class.

3. The students can do additional learning and reading. Students can understand and learn about buoyancy.

4. The students can think in depth and discuss things. Students can have lively discussions in class and generate thoughts and understandings about buoyancy.

5. The students have practice and application. Students can participate in some experiments on buoyancy and use the knowledge they have learned to explain phenomena in life.

6. The students have self-driven learning. After the class, students can actively and proactively gain a deeper understanding of buoyancy.

4) Modify the teacher's diary according to suggestions.

5) Three experts verified the effectiveness of the lesson plans. Three of them were from China. The test consistency index was 0.50-1.00.

6) Modify the lesson plans according to the suggestions, select ten questions, and organize them into lesson plans by teachers to implement the tool.

3.5 Content Validity and Reliability

Part 1. To ensure the validity of the content of the student questionnaires, a panel of educational research experts will review the questionnaires.

The process for developing a validated evaluation form for the questionnaire on the impact of online teaching on the interest of 9th-grade students in learning physics at Kunming Changshui Middle School

1) Studied the concept and development process of assessment form for validity of questionnaire form.

2) Drafted an assessment form for the validity of the Questionnaire on the Impact of Online Teaching on the Interest of the 9th-Grade Students in Learning Physics at Kunming Changshui Middle School. The levels of consideration are as follows:

The rating is +1. There is an opinion that “Corresponds to content.”

The rating is 0. There is an opinion that “Not sure it corresponds to content.”

The rating is -1. There is an opinion that “Inconsistent with content.”

At the end of each section, there is a space for experts to write suggestions that can help improve.

3) The assessment form was verified for the validity of the questionnaire form by advisers.

4) Modified the assessment form for the validity of the questionnaire form according to the suggestion.

Find the Index of Objective Congruence (IOC). The content consistency standards index should be greater than or equal to 0.5 to be considered suitable for use in research. The analysis result of the IOC for the Questionnaire on the Impact of Online Teaching on the Interest of the 9th-Grade Students in Learning Physics at Kunming Changshui Middle School is 1.00.

Check the reliability of the questionnaire. The analysis results are as follows: the reliability is 0.853, and the influence on emotional involvement is 0.52, as measured by Cronbach's alpha.

Part 2. A panel of educational research experts will review the lesson plan to ensure its validity.

The development process of the lesson plan effectiveness evaluation form for teachers at Kunming Changshui Experimental Middle School

1) Studied the concept and development process of the assessment form for the validity of the lesson plan and the test.

2) Draft the effectiveness evaluation form for the Kunming Changshui Experimental Middle School lesson plan. The levels of consideration are as follows:

The rating is +1. There is an opinion that "Corresponds to content."

The rating is 0. There is an opinion that "Not sure it corresponds to content."

The rating is -1. There is an opinion that "Inconsistent with content."

At the end of each section, there is a space for experts to write suggestions that can help improve.

3) Verified assessment form for validity of lesson plan and the test by advisers.

4) Modified the assessment form to ensure the validity of the lesson plan and the test according to the suggestion.

Find the Index Objective Congruence (IOC). The content consistency standards index should be greater than or equal to 0.50 to be considered suitable for use in research. The IOC analysis result of the Kunming Changshui Experimental Middle School lesson plan is 1.00.

Part 2.1. A panel of educational research experts will review test content to ensure the validity of the results.

Understanding buoyancy = (5 items)

Exploring the Factors Influencing the Buoyancy of Objects = (5 items)

Archimedes' principle = (5 items)

Conditions for objects to float and sink = (5 items)

Balance of buoyancy = (5 items)

Total 25 items

The physics knowledge test development process for the 9th-grade students in Kunming Changshui Experimental Middle School

1) The concept and development process of the test validity evaluation form were studied.

2) The validity evaluation form for the physics knowledge test for the 9th-grade students in Kunming Changshui Experimental Middle School was drafted. The consideration levels are as follows:

The score is +1. There is an opinion that "Conforms to the content."

The score is 0. There is an opinion that says, "Unsure whether it conforms to the content."

The score is -1. There is an opinion that is "Inconsistent with the content."

An expert opinion column is left at the end of each section to help experts make suggestions for improvement.

3) The instructor verified the test validity evaluation form.

4) Modify the test validity evaluation form according to the suggestions.

Request IOC (Index Object Congruence). The content consistency standard index should be greater than or equal to 0.50 to be suitable for research. The IOC analysis result of the physics knowledge test for 9th-grade students in Kunming Changshui Experimental Middle School is 1.00.

Part 3. To ensure the validity of the teacher's diary, the teacher diary is reviewed by a group of educational research experts.

The development process of the teacher diary validity evaluation form of Kunming Changshui Experimental Middle School

1) Research the concept and development process of the teacher diary validity evaluation form and test.

2) Draft the teacher's diary validity evaluation form of Kunming Changshui Experimental Middle School. The consideration levels are as follows:

The score is +1. There is an opinion that "is consistent with the content."

The score is 0. There is an opinion that "is not sure whether it is consistent with the content."

The score is -1. There is an opinion that "is inconsistent with the content."

At the end of each section, there is a space for experts to write down suggestions that can help improve.

3) The consultant verifies the teacher's diary validity evaluation form and test.

4) The teacher's diary validity evaluation form and test are modified according to the suggestions.

Find out the IOC (Index Object Congruence). The content consistency standard index must be greater than or equal to 0.50 for the study. The IOC analysis result of the teacher's diary of Kunming Changshui Experimental Middle School is 1.00

3.6 Data Analysis

Part 1. The data were analyzed as follows.

Quantitative data are analyzed using frequencies, percentages, means ($\bar{x}$), and standard deviations (S.D.). The mean value of the suitability score of expert opinions is calculated and compared with the following criteria:

A mean score of 1.00-1.50 means "completely disagree," construed as "very low."

A mean score of 1.51-2.50 means "disagree," interpreted as "low."

A mean score of 2.51-3.50 means "not sure," interpreted as "moderate."

A mean score of 3.51-4.50 means "agree," interpreted as high

A score of 4.51-5.00 means "completely agree," interpreted as "very high."

Part 2. Data analysis is as follows.

Quantitative data analysis on student test scores

Understanding buoyancy = (5 items)

Exploring the Factors Influencing the Buoyancy of Objects	= (5 items)
Archimedes’ principle	= (5 items)
Conditions for objects to float and sink	= (5 items)
Balance of buoyancy	= (5 items)

Total 25 items

Section 2.1

Quantitative data analysis used mean scores and standard deviations to compare the effects of online teaching on students’ interest in learning physics.

Part 3. Qualitative data were analyzed through the narrative analysis method by MAXQDA to analyze frequently occurring words or content that appears more frequently. Based on this framework, the researcher will study six aspects. This paper uses narrative analysis to understand the stories of students interested in learning. Narrative analysis is a method of analyzing information and providing some interpretation, and it takes many forms. It is called an analytical narrative, narrative description, narrative structure analysis, or sequence analysis (Abell, 2004).

CHAPTER IV
ANALYSIS RESULT

This study focused on the 9th-grade students from Kunming Changshui Experimental Middle School. The objectives of this research were twofold: 1) To study how online learning affects students' interest in learning physics, 2) To compare the differences between online learning and traditional teaching in students' interest in learning physics, and 3) To investigate how the teachers' perspectives on online learning affect students' interest in learning physics. The analysis results revealed as follows:

4.1 Analysis of Student's Questionnaire

This section presented the analysis results for objective one using tables and descriptions. It includes the mean, standard deviation, and coefficient of variation. Subsequently, the items of all factors are presented similarly.

Part 1:

For research objective 1 presented the information as follows:

Studying online learning affects students' interest in learning physics.

The questionnaire survey consists of six aspects as follows:

1. Actively participate in class
2. Take the initiative to ask questions
3. Additional learning and reading
4. In-depth thinking and discussion
5. Practice and application
6. Self-driven learning

4.1.1 Basic Information about the Participants in the Questionnaire

This study conducted an anonymous questionnaire survey on 100 9th-grade students who participated, which can better ensure the authenticity of the questionnaire results.

4.1.2 Means and Standard Deviation Analysis for Each Study Variable

This study employed SPSS statistical software to calculate the mean and standard deviation for the primary variables under investigation. SPSS used to assess respondents' perceptions of each research variable. The questionnaire in this research utilized the Likert five-point scale method, where a higher mean value for a given research variable suggested more substantial capabilities or positive attitudes among respondents in that area. Conversely, a mean value of 3 indicated a neutral or medium level of perception towards the variable. Table 5 presented the mean and standard deviation for each leading research variable, facilitating an understanding of respondents' attitudes and capabilities related to the study's focus.

Table 2 Means and Standard Deviation Analysis for Each Study Variable (Online Teaching n=50)

Items	**n**	**($\bar{x}$)**	**S.D.**
Active participation in class	50	2.06	0.63
Ask questions actively	50	2.24	0.70
Additional learning and reading	50	1.91	0.69
In-depth thinking and discussion	50	2.33	0.57
Practice and application	50	3.82	0.58
Self-driven learning	50	2.54	0.68
TOTAL	50	2.48	0.64

Table 4.1 shows the results from All Variables: The mean score is 2.48, with a standard deviation of 0.64. It means "not sure," which is interpreted as low.

Active class participation: The mean score is 2.06, with a standard deviation of 0.63. The score is 3.00, which means "Agree," which is interpreted as low.

Additional learning and reading: The mean score is 1.91, with a standard deviation of 0.69. Which means "Agree," which is interpreted as low.

Practice and application: The mean score is 3.82, with a standard deviation of 0.58. Which means "Agree," which is interpreted as high.

Table 3 Means and Standard Deviation Analysis for Each Study Variable (Traditional Teaching n=50)

Items	**n**	**($\bar{x}$)**	**S.D.**
Active participation in class	50	3.86	0.70
Ask questions actively	50	3.99	0.59
Additional learning and reading	50	4.02	0.61
In-depth thinking and discussion	50	4.11	0.66
Practice and application	50	3.02	0.65
Self-driven learning	50	2.46	0.58
TOTAL	50	3.58	0.63

Table 4.2 shows the results from

All Variables: The mean score is 3.58, with a standard deviation of 0.63. Which means "Agree," which is interpreted as high.

Additional learning and reading: The mean score is 4.02, with a standard deviation of 0.61. Which means "Agree," which is interpreted as high.

In-depth thinking and discussion: The mean score is 4.11, with a standard deviation of 0.66. Which means "Agree," which is interpreted as high.

Self-driven learning: The mean score is 2.46, with a standard deviation of 0.63, which means "Agree," interpreted as low.

4.2 Analysis of Test

Part 2: Research objective 2 presented the information as follows:

To compare the differences between online learning and traditional teaching in students' interest in learning physics using the test (Multiple choice)

Understanding buoyancy = (5 items)
Exploring the factors influencing the buoyancy of objects = (5 items)
Archimedes' principle = (5 items)
Conditions for objects to float and sink = (5 items)
Balance of buoyancy = (5 items)
Total 25 items

The test content includes Understanding buoyancy, Exploring the factors influencing the buoyancy of objects, Archimedes' principle, Conditions for objects to float and sink, and Balance of buoyancy. The maximum score for each section is 20 points, with a total score of 100 points.

Table 4 Results from the Test

Teaching Method	**Understanding Buoyancy (20)**	**Exploring Factors Influencing the Buoyancy of Objects (20)**	**Archimedes' Principle (20)**	**Conditions for Objects to Float and Sink (20)**	**Balance of Buoyancy (20)**	**Total Score (100)**
Online Teaching	15.20*	15.60*	10.00	16.88	11.68	69.36
Traditional Teaching	15.68	16.64	12.4	18.08	13.04	75.84

Table 5 Statistical Results from the Test

	Teaching Method	**df.**	**($\bar{x}$)**	**S.D.**	**t-test**
Post-test	Online Teaching	50	75.84	30.67	7.46
Post-test	Traditional Teaching	50	69.36	66.36	-0.56

Each class has 50 students on this test, of which the average score of online teaching students was 69.36, and the average score of traditional teaching students was 75.84.

$t_{.05,49} = 1.68$

From table

Traditional Teaching: $\bar{x} = 75.84, S = 30.67$

$$t - test = 7.46 \rangle t_{.05,49} = 1.68$$

Accept average scores of achievements in traditional teaching more than the criteria, 70 percent, at a significant .05.

Online Teaching: $\bar{x} = 69.36, S = 66.36$

$$t - test = -0.56 \langle t_{.05,49} = 1.68$$

Accept average scores of achievements in online teaching less than the criteria, 70 percent, at a significant .05

4.3 Analysis of Teacher's Diary

Part 3: To investigate how the teachers' perspectives on online learning affect students' interest in physics. The results are shown in the Table 4.5 as follows:

Table 6 Results from Teacher's Diary

		Online Teaching	**Traditional Teaching**
Understanding buoyancy	Active participation in class	√ (participate)	√ (Follow the teacher and concentrate; participate)
	Ask questions actively	√	√ （more students)
	Additional learning and reading	√	√ (more student reading)
	In-depth thinking and discussion	x	√ (intense discussion)
	Practice and application	√ (More engaged students)	√

Table 6 Results from Teacher’s Diary (continued)

	Self-driven learning	√ (more students)	√
		Online Teaching	**Traditional Teaching**
Exploring Factors Influencing the Buoyancy of Objects	Active participation in class	√	√ (Follow the teacher and concentrate)
	Ask questions actively	√ (more than last week)	√
	Additional learning and reading	x	√
	In-depth thinking and discussion	√	√
		Online Teaching	**Traditional Teaching**
	Practice and application	√	√
	Self-driven learning	√ (more students)	√
		Online Teaching	**Traditional Teaching**
Archimedes' principle	Active participation in class	√	√
	Ask questions actively	√	√ (more than last week)
	Additional learning and reading	x	√
	In-depth thinking and discussion	√	√ (intense discussion)
	Practice and application	√ (Students are interested in experiments)	√
	Self-driven learning	√	√ (more students)

Table 6 Results from Teacher's Diary (continued)

		Online Teaching	**Traditional Teaching**
Conditions for objects to float and sink	Active participation in class	√ (More students follow the teacher than before)	√ (More focused students)
	Ask questions actively	√	√
	Additional learning and reading	x	√
	In-depth thinking and discussion	√	√ (intense discussion)
	Practice and application	√ (Students are interested in experiments)	√
	Self-driven learning	√	√ （more students)
		Online Teaching	**Traditional Teaching**
Balance of buoyancy	Active participation in class	√ (More students follow the teacher than before)	√ (More focused students)
	Ask questions actively	√ (more students)	√
	Additional learning and reading	√	√
	In-depth thinking and discussion	√ (intense discussion)	√
	Practice and application	√	√ (Students are interested in experiments)
	Self-driven learning	√ （more students)	√

As seen from Table 4.5, the performance of online teaching students in practice and application and asking questions actively is relatively good. Most students actively participate in exercises and applications primarily related to virtual experiments. At the same time, they can also actively answer the teacher's questions, which shows that the attitude of online teaching students towards practice and application and asking questions actively is positive. The performance in other aspects is relatively poor, such as active participation in class and self-driven learning, indicating that students have low autonomy in online teaching.

Positive:

Most students have a positive attitude towards virtual experiments in class. One student said, *"I do not need to worry about operational safety and operational errors in virtual experiments, and there will be corresponding operational prompts, which has greatly improved my confidence."* This is indeed the advantage of virtual experiments. In addition to ensuring safety, they can also provide many experimental equipment that is difficult to obtain in reality, and the phenomena and conclusions of the experiment are presented in a particular way.

In addition, I also found that many students in online teaching will have more intense and interesting discussions when I enter the discussion room, and more and more students will speak. This may be because many students want to get the teacher's attention and desire to show themselves.

Negative:

One student also said about virtual experiments, *"I would rather touch that experimental equipment and operate them myself."* This shows that not all students have a positive attitude toward virtual experiments. Some students prefer to operate them and observe the experimental phenomena with their own eyes.

The discussion link in online teaching has low overall interactivity. Some groups did not even notice that the teacher entered the group discussion room to listen, and no one spoke.

CHAPTER V
CONCLUSION AND DISCUSSION

This study focused on 9th-grade students from Kunming Changshui Experimental Middle School. The objectives of this research were twofold: 1) To study how online learning affects students' interest in learning physics, 2) To compare the differences between online learning and traditional teaching in students' interest in learning physics, and 3) To investigate how the teachers' perspectives on online learning affect students' interest in learning physics. The analysis results revealed as follows:

5.1 Conclusion

The purposes of this study are: 1) To study how online learning affects students' interest in learning physics, 2) To compare the differences between online learning and traditional teaching in students' interest in learning physics, and 3) To investigate how the teachers' perspectives on online learning affect students' interest in learning physics. The study was divided into three parts: a questionnaire survey of the students, tests with lesson plans, and a teacher diary.

Part 1. Research Objective 1: To study how online learning affects students' interest in learning physics.

This study aimed to analyze the impact of online learning on students' interest in physics. The study involved a questionnaire survey conducted among 100 third-year art students at the Grade 9 students from Kunming Changshui Experimental Middle School. The questionnaire covered six aspects: Active participation in class, Asking questions actively, Additional learning and reading, In-depth thinking and discussion, Practice and application, and Self-driven learning.

Online Teaching:

All variables: The mean score is 2.48, with a standard deviation of 0.64, which means "not sure," interpreted as low.

Active class participation: The mean score is 2.06, with a standard deviation of 0.63. A score of 3.00 means "Agree" and is interpreted as low.

Ask questions actively: The mean score is 2.24, with a standard deviation 0.70. Which means “Agree,” which is interpreted as low.

Additional learning and reading: The mean score is 1.91, with a standard deviation of 0.69. Which means “Agree,” which is interpreted as low.

In-depth thinking and discussion: The mean score is 2.33, with a standard deviation 0.57. Which means “Agree,” which is interpreted as low.

Practice and application: The mean score is 3.82, with a standard deviation of 0.58. Which means “Agree,” which is interpreted as high.

Self-driven learning: The mean score is 2.54, with a standard deviation of 0.68. Which means “Agree,” which is interpreted as not sure.

Traditional Teaching:

All Variables: The mean score is 3.58, with a standard deviation of 0.63. Which means “Agree,” which is interpreted as high.

Active class participation: The mean score is 3.86, with a standard deviation of 0.70. The score of 3.01. Which means “Agree,” which is interpreted as high.

Ask questions actively: The mean score is 3.99, with a standard deviation of 0.59. Which means “Agree,” which is interpreted as high.

Additional learning and reading: The mean score is 4.02, with a standard deviation of 0.61. Which means “Agree,” which is interpreted as high.

In-depth thinking and discussion: The mean score is 4.11, with a standard deviation of 0.66. Which means “Agree,” which is interpreted as high.

Practice and application: The mean score is 3.02, with a standard deviation of 0.58. Which means “Agree,” which is interpreted as not sure.

Self-driven learning: The mean score is 2.46, with a standard deviation of 0.63. Which means “Agree,” which is interpreted as low.

Comparing two tables

All Variables: Online teaching scores are lower.

Active class participation: Online teaching scores are lower.

Ask questions actively: Online teaching scores are lower.

Additional learning and reading: Online teaching scores are lower.

In-depth thinking and discussion: Online teaching scores are lower.

Practice and application: Online teaching scores are higher.

Self-driven learning: Online teaching scores are higher.

In conclusion, these findings suggest that online teaching does not positively impact students’ learning interests. The changes in standard deviations indicate differences in students’ learning habits and attitudes, which suggests that it is important to consider the self-discipline of most students when implementing online teaching strategies.

Part 2. Research Objective 2: To compare the differences between online learning and traditional teaching in students’ interest in learning physics.

In this study, a hundred students participated in the test, 50 from online teaching and the other 50 from traditional teaching.

The total score of online teaching students was 69.36, and the average score of traditional teaching students was 75.84.

The five parts of the test are as follows:

Understanding buoyancy： Online teaching students was 15.20, and the average score for traditional teaching students was 15.68.

Exploring factors influencing the buoyancy of objects: Online teaching students was 15.60, and the average score of traditional teaching students was 16.64.

Archimedes’ principle: Online teaching students was 10.00, and the average score of traditional teaching students was 12.40.

Conditions for objects to float and sink: Online teaching students were 16.88, and the average score of traditional teaching students was 18.08.

Balance of buoyancy: Online teaching students were 11.68, and the average score of traditional teaching students was 13.04.

In conclusion, this study shows that online teaching does not enhance students’ interest in learning. On the contrary, students seem to prefer traditional teaching. Students who received online teaching performed lower than those who received traditional teaching in all five aspects of the test, including the total score. This confirms that online teaching does not positively affect students’ interest in learning.

Part 3. Research Objective 3: To investigate how the teachers' perspectives on online learning affect Students' interest in learning physics.

The five logs show that traditional teaching is better than online classes in most aspects. In particular, offline teaching is more effective regarding classroom concentration, active participation, and in-depth discussion. This may be related to the directness of face-to-face communication and the convenience of real-time interaction. Students in offline teaching perform better in practice and application, which may be because the experimental tools used in online teaching are relatively new, and students are very interested.

5.2 Discussion

Part 1: Research Objective 1: To study how online learning affects students' interest in learning physics.

All Variables: The mean score is 2.48, with a standard deviation 0.64. Which means "Disagree," which is interpreted as low.

The study employed SPSS statistical software to analyze each research variable's means and standard deviations from the survey. The results indicated that the overall mean score for all variables was 2.48 with a standard deviation of 0.64, suggesting that respondents generally held a negative attitude toward the impact of online teaching on students' interest in learning physics. Specifically, variables such as Practice and application had high mean scores (3.82), indicating that students widely recognized the importance of these factors in promoting students' interest in learning physics. Theoretically, these findings support the perspectives of constructivism, interest development theory, and motivation theory, as emphasized by scholars such as Li (2021) and Chen (2022). These theories emphasize the importance of interaction, motivation, and a rich environment in learning. Therefore, the results of this study confirm these theories and emphasize that student diversity, motivation cultivation, and learning conditions and environment should be considered when implementing online teaching to enhance their learning interest.

The details are explained as follows:

1) Active participation in class

This indicates that most respondents find it challenging to actively participate in classes during online teaching. However, the standard deviation of 0.63 indicates a certain degree of diversity of opinions among participants, which may stem from different personal learning attitudes and learning conditions. This observation highlights the overall negative attitudes of the respondents but also points to the importance of further exploring the root causes of these different views.

As Nguyen et al. (2016) emphasized, student classroom engagement is a complex and multidimensional concept, and the classroom environment, teachers' teaching strategies, and students' characteristics (such as self-efficacy and learning motivation) are all important factors affecting student engagement. This is consistent with the findings of Mary et al. (2021), who emphasized that the design of active learning classrooms plays an important role in improving student engagement. For online teaching, the classroom environment is a part that is difficult for teachers to interfere with because both parties use smart devices for teaching and learning. Therefore, the results of this study emphasize the importance of classroom engagement for online teaching.

2) Ask questions actively

This indicates that most respondents find it challenging to actively answer questions during online classes. However, the standard deviation of 0.70 indicates a certain degree of difference in the respondents' opinions, possibly due to differences in personal learning attitudes and habits. Some students do not like answering questions, and online teaching magnifies this problem. This observation highlights the overall negative attitude of the respondents but also points out that it is important to explore the root causes of these different opinions further.

As Wang et al. (2023) emphasized, frequent teacher-student and peer interactions are essential for improving student engagement, and answering questions in class, as a standard way of teacher-student interaction, has an impact on student learning engagement and interest. However, the online students in this study were relatively indifferent to actively answering the teacher's questions, which is consistent with the results of Hollister et al. (2022). In their study, 57% of the respondents said that it became more challenging to maintain interest in the course content in online learning, which involved answering questions. The results of this study emphasize the importance of students actively answering questions for online teaching.

3) Additional learning and reading

This shows that most respondents believe there is little additional learning and reading during online classes. This may be because most students are not sufficiently engaged in the class during online teaching, resulting in a relatively cold attitude toward the knowledge learned in class. This observation highlights the overall negative attitude of the respondents.

In the study by Barber and Klauda (2020), the issue of reading motivation and engagement was explored, and the autonomy of students' reading was analyzed based on the self-determination theory. The study found that when students could choose reading materials and decide how to read independently, their reading motivation and engagement increased significantly. Teachers can enhance students' autonomy by providing various reading materials and allowing students to make their own choices. This has a lot in common with the current study, which showed that students who were taught online had a significant lack of reading autonomy and low engagement.

4) In-depth thinking and discussion

This shows that most people have a negative attitude towards in-depth thinking and discussion in online teaching. This may be because it is difficult for students to engage in class thinking during online teaching. Online classes do not allow students to discuss face-to-face, which has a particular impact on the effectiveness and intensity of the discussion.

Dhanielly et al. (2019) explored the advantages and challenges of educational discussion forums in online learning. Online discussion forums are currently widely used as an asynchronous communication tool. However, teachers and students face various difficulties in using discussion forums, including insufficient student motivation and difficulty for teachers to accompany them. It is difficult for teachers to keep up with the large number of posts and provide timely feedback, especially when there are many students. This is similar to the results of this study. Most students in online teaching are indifferent to in-depth thinking and discussion in class.

5) Practice and application

The analysis displayed in This shows that most students have a positive attitude towards the practice and application of online teaching, that is, some classroom experiments and the application of knowledge. This is very important for this study. This may be because students are curious about online experimental tools. Through these tools, they can restore and display experiments that are difficult to operate in traditional teaching and, at the same time, observe experimental phenomena. Students can also use props at home to conduct experiments, such as water, basins, and cooking oil. These can have a positive impact on students' learning interests.

Shen et al. (2024) studied the effects of online and classroom Team-Based Learning (TBL) in virtual simulation experiments. The study's primary purpose was to evaluate the impact of these two teaching methods on student performance and learning experience. The questionnaire results showed that students were optimistic about online TBL and believed that these methods could better stimulate learning interest and improve learning efficiency and the ability to apply practical knowledge. Studies have shown that online TBL improves student engagement and learning outcomes, especially in virtual simulation experiments. This is consistent with the results of this study, and students in online teaching have a positive attitude toward virtual experiments. Similarly, Senapati (2021) also mentioned that virtual laboratories provide a simulated experimental environment, allowing students to perform experimental operations and learn without actual equipment. Students can perform safe and low-cost experimental operations to enhance their understanding and interest in scientific concepts.

6) Self-driven learning

This shows that most students do not care about autonomous learning during online teaching. Although there are some different ideas, this result is worth discussing. This may be due to each student's different learning habits and autonomy. Some students rarely take the initiative to learn, whether online or offline.

Li et al. (2013) analyzed the determinants of students' attitudes toward autonomous learning and online learning. The study used the fuzzy Delphi and DEMATEL methods to collect and analyze the causal relationship between different indicators. The research subjects included online learners from different universities, and data was collected through online questionnaires. Students' confidence in the use of technology is a key factor affecting their attitudes toward online learning and their ability to learn autonomously. Studies have shown that improving students' confidence and skills in the use of technology can effectively promote students' autonomous learning. This situation also exists in this study because students are not proficient in using online tools and smart devices, which affects their autonomous learning.

Part 2: Research Objective 2: To compare the differences between online learning and traditional teaching in students' interest in learning physics.

The test results show that the scores of students receiving online teaching are lower than those receiving traditional teaching, which, to a certain extent, indicates that the impact of online teaching on students' interest in learning physics is smaller than that of traditional teaching.

Paul and Jefferson (2019) aimed to compare the student scores of online and face-to-face learning in environmental science courses between 2009 and 2016, focusing on analyzing the impact of different teaching modes on student performance. The study used traditional chi-square analysis and independent sample t-test to analyze the data, the same as this study.

This study believes that the reasons for the lower scores of students in online teaching are as follows:

1. Technical problems: The effective use of technology is crucial to the success of online learning. Technical problems and lack of skills can affect learning interests and grades. Hongsuchon et al. (2022) and Chung et al. (2022) both stated in their comparative studies on online and offline teaching that online schools usually provide fewer support services, which may lead to a lack of help for students when they encounter learning difficulties, thus affecting interest and grades. The effective use of technology can increase interest in learning. However, technology overload and students' lack of technical confidence can lead to poor learning results. The result is in line with this study.

2. Lack of learning initiative: Online learning environments are usually asynchronous and require students to have more potent autonomous learning abilities. Online learning requires higher self-discipline and time management skills. Students

with poor self-discipline are easily distracted, resulting in poor learning interest, which affects learning outcomes. This is also shown in Ordway's (2020) study, in which he explored the reasons for the poor performance of students in online schools. One important point is that students in online teaching lack the initiative to learn because it is difficult to be effectively supervised by teachers in class. Many students seem to listen carefully but do not participate seriously in class.

3. Lack of feedback and interaction: This includes two aspects. On the one hand, it is about teachers; the interaction between teachers and students is not direct enough. When students are active, they may not get the feedback from teachers as they expect. Hongsuchon et al. (2022) also showed this in their research. They believe positive and effective feedback can help students build confidence and understand their learning progress. This is consistent with the view of this study.

On the other hand, it is about students. The interaction between students is not face-to-face. For example, the discussion and communication in online teaching are not as interactive and social as in traditional teaching, which affects students' interest in learning to some extent. The research of Ordway et al. (2020) also shares similarities with this study. He also believes that the lack of social interaction may lead to insufficient learning motivation and poor performance, and social presence is a key factor affecting the quality of online learning.

Part 3: Research Objective 3: To investigate how the teachers' perspectives on online learning affect students' interest in learning physics.

1. Actively participate in class.

Positive: Researchers have found that autonomy is key for students to participate in class actively. Usually, more self-disciplined students can listen carefully in online classes and follow the teacher's ideas. Such students often feel that the rich online teaching tools can enhance their interest in learning. This view is consistent with Finn and Zimmer (2012), who explored the key role of the classroom environment in student participation and believed that using technological tools and multimedia resources can enhance students' learning experience and participation. Mary et al. (2021) also stated that integrating technology can promote students' active participation, provide opportunities for personalized learning, and support diverse teaching methods.

Teachers should actively adopt modern technological tools and use their advantages to enhance students' learning experience and participation. Therefore, technological tools in online teaching are worthy of further development and utilization.

Negative: However, most students find it difficult to demand themselves in online teaching, and some students may need to be called by the teacher many times before responding. The student said, "Sometimes the network is unstable, and the classroom screen will be stuck." This shows that network stability impacts students' classroom participation but is not the key reason. Ordway's (2020) research shows that students' learning autonomy and self-discipline are key factors affecting online teaching interest and outcomes, consistent with this study.

2. Take the initiative to ask questions.

Positive: *"Answering questions online makes me feel relaxed*," a student told me, which shows that some students still prefer to answer questions online because it does not make them feel nervous and more confident. This is also pointed out in the study of Hollister and Nari (2022). Most students in the study said that they felt more comfortable asking and answering questions in online classes, which suggests that some characteristics of online learning may be attractive to students. The researcher also agrees with this view.

Negative: Although students feel relaxed when answering questions in online teaching, many students are indifferent to answering questions, and some students are less motivated to answer questions, which is still related to students' learning autonomy and network stability. In addition, the interaction between teachers and students also affected this. One student said, *"I do not know if my answer is correct. I cannot see the expression on the teacher's face, which makes me unconfident."* This shows that the teacher's facial reactions are difficult to observe during online teaching. Many students are accustomed to observing the teacher's expressions in traditional classrooms to judge whether their answers are correct, but online teaching affects this. In other words, the interaction between teachers and students affects students' enthusiasm and interest in learning, which is consistent with the views of Hongsuchon et al. (2022).

3. Additional learning and reading

Positive: A few students still do extra learning and reading because the experiments or videos demonstrated by many technology tools in the classroom aroused students' interest in this knowledge. *"After class, I looked up the information at home and experimented. The result was the same as the virtual experiment,"* said a student. This shows that online teaching uses technology tools to arouse students' curiosity and encourage them to do extra learning and reading. Marry et al. (2021) also mentioned the effectiveness of technology tools.

Negative: However, most students rarely do extra learning and reading. The researcher thinks this is mainly due to the lack of interaction between students. In traditional classes, if students read some interesting books, they will share them with their desk mates. Their connection strengthens and promotes students' interest in learning, but this is missing online. Barber et al. (2020) pointed out that relevance refers to the connection and belonging students feel with others during the reading process. Studies have found that social interaction and peer support are important factors in promoting reading motivation. This is consistent with the views of this study.

4. In-depth thinking and discussion

Positive: Online forums record all interactions, making it easier for teachers to monitor and evaluate student participation. *"With the log, everything stays on the platform. You know who interacts with whom and who is not participating*" Dhanielly et al. (2019). Their research found that forum participants had time to think and respond to questions in detail, making the discussion more in-depth. Students can see the information, reflect on it, and have the opportunity to refine their ideas better. This is helpful for students' in-depth thinking and discussion in online teaching.

Negative: Two main reasons affect students' thinking and discussion. On the one hand, it is difficult for teachers to accompany, which is also mentioned by Dhanielly et al. (2019), "*It is difficult for teachers to keep up with a large number of posts and give timely feedback, especially when there are a large number of students*." It is an actual problem in online teaching. On the other hand, the lack of direct interaction between students also affects it. Students cannot discuss face-to-face, but they can do so in front of a computer or mobile phone screen, which weakens the direct connection between students.

5. Practice and application.

Positive: Most students have a positive attitude towards virtual experiments in class. One student said: *"In virtual experiments, I do not need to worry about operational safety and operational errors, and there will be corresponding operational prompts, which greatly improves my confidence."* This is indeed the advantage of virtual experiments. While ensuring safety, it can also provide much experimental equipment that is difficult to obtain in reality and the phenomena and conclusions of the experiment are presented in a particular way. This is consistent with the research results of Senapati (2021). Her research shows that virtual laboratories have important educational value in science teaching, especially during the pandemic when the demand for remote teaching has surged. Students can conduct safe, low-cost experimental operations through virtual experiments and enhance their understanding and interest in scientific concepts.

Negative: One student also said about virtual experiments: *"I would rather touch that experimental equipment and operate them myself."* This shows that not all students have a positive attitude toward virtual experiments. Some students prefer to operate independently and observe the experimental phenomena with their own eyes. This is also something that virtual experiments cannot do. If students can experience the experiment in person, it should help cultivate students' interest.

6. Self-driven learning

Positive: During online teaching, students generally report that they can use more resources, such as online forums and course videos. *"After class, I will watch the class replay again for the parts I did not understand,"* one student told me. It is mentioned in the study of Zhu et al. (2024) that autonomous learning strategies play a vital role in online learning environments, and active use of online resources and auxiliary tools, such as course videos, e-books, and online discussion forums, can help students better understand and master the learning content.

Negative: However, some students said their lack of proficiency in online learning tools would affect their confidence, leading to a lack of independent learning. Li (2023) stated that students' confidence in the use of technology is a key factor affecting their online learning attitude and independent learning ability. Improving students' skills in using technology can significantly improve their attitudes toward learning. This is consistent with the researcher's point of view. Secondly, there is another reason similar to the above point. A student's online learning device will also affect his independent learning. *"Teacher, my computer at home is broken. I can only use my mobile phone to attend class. The screen is too small and difficult to operate,"* one student said. Every student's learning device is different. Some are computers, some are mobile phones, and some are tablets. Different devices support different online tools, and the complexity of operations is also different, which affects students' interest in learning.

5.3 Recommendations

Based on the results and analysis of this study, several recommendations can be made to enhance the impact of online teaching on students' interest in learning physics.

The study showed that online teaching had little impact on students' interest in physics. To further improve this, the following strategies are recommended:

1) Optimize technical support for online teaching: Ensure all students and teachers have access to a stable internet connection and necessary hardware equipment. Provide technical support to help students and teachers solve technical problems encountered using online platforms and tools, optimize and develop online teaching platforms, especially virtual experiments, online forums and provide more relevant training for teachers.

2) Improve course design: A blended learning approach can be adopted to combine the advantages of online and face-to-face teaching to improve learning interest and student engagement while enhancing students' self-discipline and autonomy.

3) Enhance interaction: For example, establish an online learning community to promote interaction and support among students through social media groups and virtual learning groups. Teachers can set up Q&A time to answer students' questions and provide timely and constructive feedback to help students understand and improve their learning outcomes.

4) Home-school cooperation: Cooperate with parents to encourage and monitor students' online learning.

5.4 Recommendation for Future Research

Based on the findings and implications of this study, several recommendations are proposed to expand the impact of online teaching on students' learning interests. Future research should consider longitudinal methods to track the long-term effects of online teaching on students' learning interests and learning outcomes. These studies will provide valuable insights into the lasting impact of these learning environments on students' long-term outcomes, including their academic performance and personal growth after graduation. In addition, comparative studies across different educational settings and disciplines will also be of great benefit. These studies can shed light on the effectiveness of online teaching relative to traditional teaching, potentially revealing the unique advantages or challenges inherent in each environment and are conducive to optimizing hybrid teaching models. Research the best-blended learning practices, combining the advantages of online and offline teaching and optimizing course design and teaching methods.

In addition, with the continuous advancement of technology, it has become crucial to explore integrating cutting-edge tools such as virtual reality and artificial intelligence-driven platforms into online teaching. For example, a significant advantage of online teaching is research on how VR and AR technologies can be applied to education to provide immersive learning experiences and increase students' learning interest and engagement. In addition, research on the impact of online teaching on different groups of students (including those with special educational needs, different cultural backgrounds, or different levels of prior achievement), such as studying how to use online education platforms to provide equitable educational opportunities, especially for students in remote areas and disadvantaged groups, will make online teaching methods more inclusive and effective for all students.

Finally, there is a need to focus on developing and evaluating assessment methods for online teaching. This includes pioneering assessment strategies that accurately and fairly measure individual and group contributions, which are essential to ensuring accountability and fairness in educational outcomes.

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APPENDICES

This questionnaire is used to study the difference between online and offline teaching in terms of students' interest in learning physics.

Strongly agree: 5, Generally agree: 4, Sometimes: 3, Disagree: 2, Never: 1

Choose 5 for 5 points, 4 for 4 points, 3 for 3 points, 2 for 2 points, and 1 for 1 point.

There are 30 questions in total. Use this to study Q2.

Table 1. Student's Questionnaire

Factors	**Opinions**	1	2	3	4	5
Active participation in class	1. You do not get sleepy quickly in class.					
	2. You do not pay attention to things unrelated to the class in class.					
	3. You often share your ideas with teachers and classmates in class.					
	4. You are very interested in the content in class.					
	5. You always pay attention in class.					
Ask questions actively	6. You will take the initiative to ask questions in class.					
	7. You often ask the teacher questions after class.					
	8. You will ask questions during group discussions.					
	9. You will ask questions related to what you have learned.					
	10. You will discuss your problems with your parents.					
Additional learning and	11. You like to take the initiative to read relevant books after class.					

reading	12. You like to watch physics videos in your spare time.					
	13. You will learn more advanced physics knowledge in your spare time.					
	14. You will be interested in seeing physics-related videos at home.					
	15. You will share the extracurricular physics knowledge you have learned with your classmates or parents.					
In-depth thinking and discussion	16. You often think deeply about the questions asked by the teacher.					
	17. You often perform well in group discussions.					
	18. You often spend time thinking about after-school assignments that you do not understand.					
	19. The videos played in class often make you think.					
	20. Some physical phenomena in life often make you think.					
Practice and application	21. You always do simulation experiments with the teacher in class.					
	22. You often do experiments at home after class					
	23. After learning buoyancy, you often think about related phenomena in life					
	24. You will explain the buoyancy phenomenon in life to your parents or classmates					
	25. You will use the knowledge you have learned to make some props yourself					

Self-driven learning	26. You can take the initiative to learn physics without the supervision of others.					
	27. You will make plans for yourself to study physics					
	28. You are not just taking the initiative to study physics to improve your grades					
	29. Studying physics will not make you tired					
	30. You will actively look for resources to learn physics					

Validity Checking

Name…………………………..Surname…………………….

Workplace………………………..Position…………………..

Direction: Please put the / in the table according to your opinion.

Meaning: Rated +1. There is a view that “fits the definition”.

The rating is 0. One comment was, “Not sure it meets the definition”.

The rating is -1. There is a view that is “inconsistent with the definition”.

Factors	Opinions	+1	0	-1
Active participation in class	1. You do not get sleepy quickly in class.			
	2. You do not pay attention to things unrelated to the class in class.			
	3. You often share your ideas with teachers and classmates in class.			
	4. You are very interested in the content in class.			
	5. You always pay attention in class.			
Ask questions actively	6. You take the initiative to ask questions in class.			
	7. You often ask the teacher questions after class.			
	8. You ask questions during group discussions.			
	9. You ask questions related to what you have learned.			
	10. You discuss your problems with your parents.			
Additional learning and reading	11. You like to take the initiative to read relevant books after class.			
	12. You like to watch physics videos in your spare time.			
	13. You learn more advanced physics knowledge in your spare time.			
	14. You are interested in seeing physics-related videos at home.			
	15. You share the extracurricular physics knowledge you have learned with your classmates or parents.			

In-depth thinking and discussion	16. You often think deeply about the questions asked by the teacher.			
	17. You often perform well in group discussions.			
	18. You often spend time thinking about after-school assignments that you do not understand.			
	19. The videos played in class often make you think.			
	20. Some physical phenomena in life often make you think.			
Practice and application	21. You always do simulation experiments with the teacher in class.			
	22. You often do experiments at home after class.			
	23. After learning buoyancy, you often think about related phenomena in life.			
	24. You explain the buoyancy phenomenon in life to your parents or classmates.			
	25. You use the knowledge you have learned to make some props yourself.			
Self-driven learning	26. You can take the initiative to learn physics without the supervision of others.			
	27. You make plans for yourself to study physics.			
	28. You are not just taking the initiative to study physics to improve your grades.			
	29. Studying physics will not make you tired.			
	30. You actively look for resources to learn physics.			

Signature…………………..

Date…../………/…….

Buoyancy Section Test

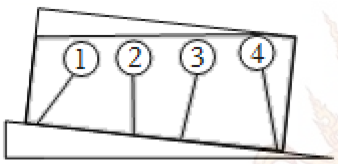
There is only one correct answer for each question, which is worth 4 points, for 100 points.

1. The following objects that do not receive buoyancy are the ()

   A. Leaves floating on the water B. The space station flying in space

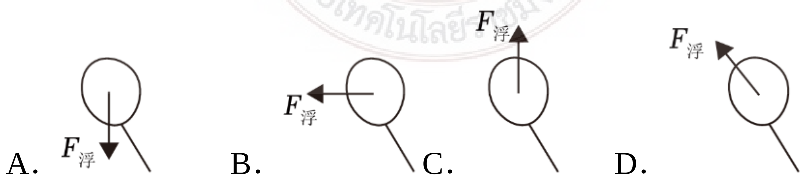
   C. The sunken rocks in the water D. Rising balloon in the air

2. In science class, the teacher puts the sink full of water on the inclined plane and leads the table tennis ball immersed in the water with one end of the rope (the gravity of the rope is ignored). After the static state, the table tennis ball is the closest to the () in the figure



   A．① B．② C．③ D．④

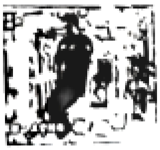
3. Children play with the balloons in the park. The correct direction of the buoyancy of the balloon is ()



4. On December 9, 2021, the signal was connected, and "Tiangong Classroom" officially opened on the Chinese space station. The three space astronaut teachers showed the work and life scene of the space station and demonstrated that the microgravity environment (can be approximated as completely lost gravity), regardless of the microgravity in space, the following objects are buoyancy by ()

 A. Table tennis, as shown in the picture, is "suspended" in the water in the changing class

 B. As shown in the Chinese space station in space

 C. See the astronaut floating during the space turn experiment

 D. Astronauts undergoing underwater training before being shown in space

5. The object without buoyancy in the following scenarios is the ()

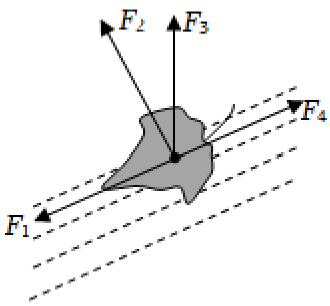
A. Tiangong-1, traveling in space

B. Rising hot air balloon

C. The “Liaonin” sailing at sea

D. Jiaolong, diving in the sea

6. As shown in the picture, a fallen leaf in the stream of Xiushan Park drifted down with the current. The direction of the buoyancy is ()



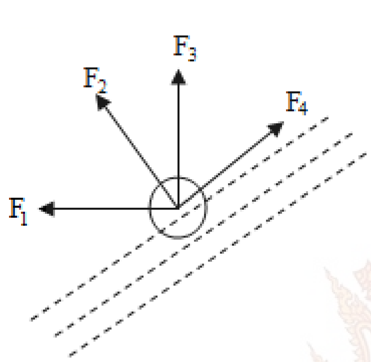
A. F1 B. F2 C. F3 D. F4

7. Among the following objects, no buoyancy is ()

A. Aircraft flying in the air B. Students in the classroom

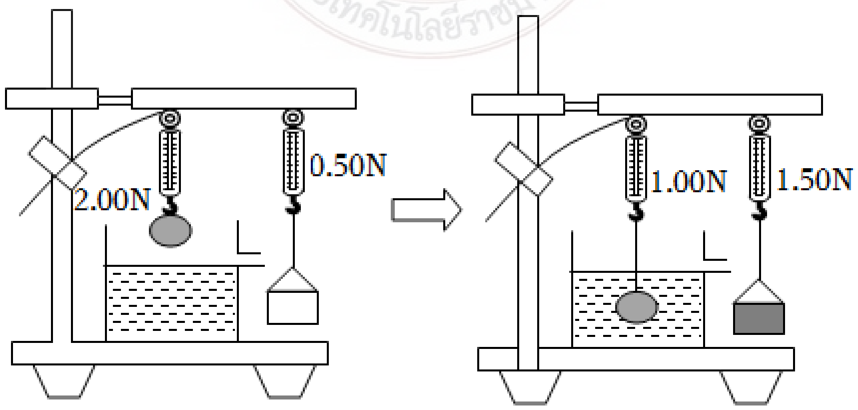
C. The piers inserted into the riverbed D. The rising hot-air balloon

8. During the holiday, Xiao Wang saw a ball drifting in a stream near his grandmother's house along the stream (as shown in the picture). Please help him analyze the direction of the buoyancy of the ball should be ()



A. F1 B. F2 C. F3 D. F4

9. Check the Archimedes principle with the experimental device in the figure. When the mass is immersed in the overflowing cup, the water will flow into the empty bucket for ()



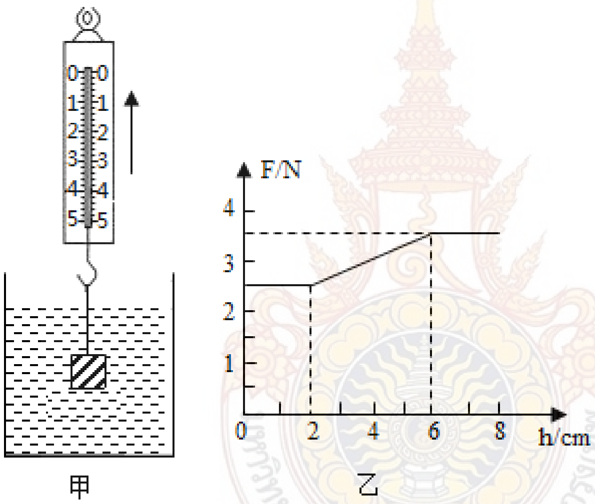
A. The overflowing water cup was not filled with water before the experiment and did not affect the experimental results

B. The deeper the mass is immersed in the water, the greater the pressure on the bottom of the overflowing glass

C. The deeper the mass is immersed in the water, the larger the number of the left spring dynamometer

D. The density of the blocks used in the experiment is 2103kg / m3

10. Xiao Li, in the experiment of exploring a liquid density, with a gauge hanging a cube metal block immersed in the liquid (the container is big enough, regardless of the change of liquid level, as shown in Figure a), the process of gauge reading of F with metal height h relationship as shown in figure b, according to the image information can determine the ()



A. The side length of the metal block is 6cm

B. During the change of height h from 2cm to 6cm, the buoyancy of the metal block gradually increased

C. The density of this liquid is approximately 1.56103kg/m3

D. The density of this metal block is about 3.46103kg/m3

11. The mass m and volume V of the three balls, A, B, and C, are shown in the table below. They are released by immersion in water, and after their stabilization, the buoyancy of the three pellets is the first of the ten Heavenly Stems, the second of the ten Heavenly Stems, and the third of the Ten Heavenly Stems. The following judgment is correct for the (　)

bobble	the first of the ten Heavenly Stems	the second of the ten Heavenly Stems	the third of the Ten Heavenly Stems
m/g	30	40	54
V/cm3	60	50	20

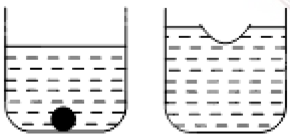
A．Fthe first of the ten Heavenly Stems＞Fthe second of the ten Heavenly Stems＞Fthe third of the Ten Heavenly Stems

B．Fthe second of the ten Heavenly Stems＞Fthe first of the ten Heavenly Stems＞Fthe third of the Ten Heavenly Stems

C．Fthe third of the Ten Heavenly Stems＞Fthe second of the ten Heavenly Stems＞Fthe first of the ten Heavenly Stems

D．Fthe first of the ten Heavenly Stems＞Fthe third of the Ten Heavenly Stems＞Fthe second of the ten Heavenly Stems

12. The two identical containers of A and B on the horizontal table, containing the same amount of water, with two identical silly putty, one pinched into a bowl and put in them respectively Floating armor, FFloating b; The pressure of containers A and B to the horizontal table top is F, respectively the first of the ten Heavenly Stems. The second of the ten Heavenly StemsThen, ()



甲　乙

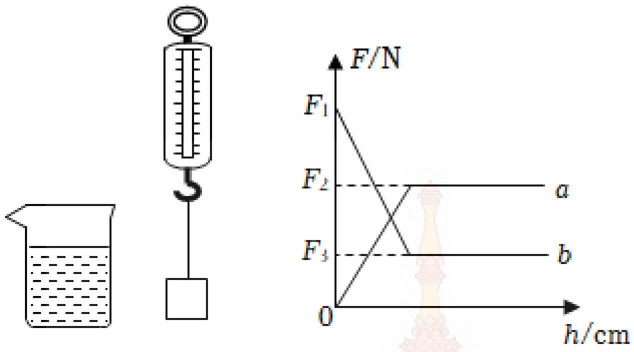
A．FFloating armour＜FFloating b

B．FFloating armour＝FFloating b

C．Fthe first of the ten Heavenly Stems＜Fthe second of the ten Heavenly Stems

D．Fthe first of the ten Heavenly Stems＞Fthe second of the ten Heavenly Stems

13. When Xiao Ming uses the Figure A device to explore the relationship between the size of buoyancy and the volume of the immersed liquid in the object ", he obtains the image shown in Figure B. The other is the image of the number of spring scales changing with the depth of the immersed liquid, Gthing=2 cattle, then the following statement is wrong is ()



甲 乙

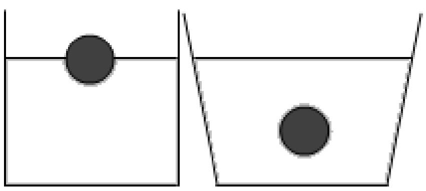
A． F1=2.0 Cattle

B. The density of the liquid is ρ liquid＝ ρ thing $\frac{F_1}{F_2}$

C． F1＝F2+F3

D. Volume V of the objectthing＝ $\frac{F_2}{(\rho_{液} g)}$

14. There are two containers of A and B with the same mass and bottom area, respectively containing liquids with different densities, and put two identical small balls into the container, as shown in the figure. The following statement is correct for ()



甲 乙

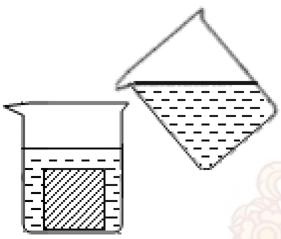
A. The density of liquid in container A is less than that of liquid in container B

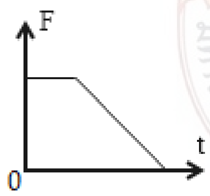
B. The buoyancy of the ball in container A is greater than that of the ball in container B

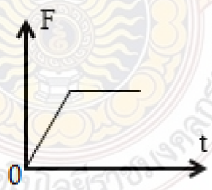
C. The pressure of container A to the desktop must be greater than that of container B to the desktop

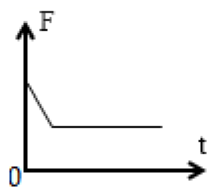
D. The pressure at the bottom of container A is greater than the pressure at the bottom of vessel B

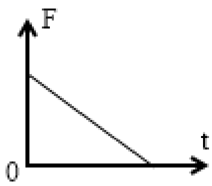
15. As shown in the figure, place the iron block in an empty container and slowly add water to the container along the container wall to the dotted line. In the process of adding water, the relationship of the bottom of the container F and time t is ()



A. 

B. 

C. 

D. 

16. On November 10, 2020, China's manned submersible Striver successfully landed under the Mariana Trench in the western Pacific Ocean, setting a new record for China's manned deep submersible. As shown in the figure, during the constant dive of the Striver submersible, the following analysis is reasonable for ()

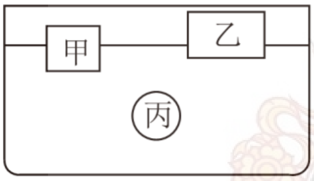
A. The buoyancy of the submersible is always less than its dead weight

B. The seawater pressure of the submersible remains the same

C. The buoyancy of the submersible increases with the depth

D. The buoyancy of the submersible is always equal to the gravity of the seawater

17. As shown in the figure, there are three equal-mass solid objects in the sink at rest, and a and b are cuboids ()



A. The C object has the largest volume of water discharged out

B. B objects receive the least buoyancy

C. The density of A objects is greater than that of B

D. Unable to judge the density-size relationship between the three objects

18. Engineers use "microgravity spider Man" technology to repair "China's Sky Eye". A helium balloon is shown in the picture to lift the maintenance staff, reduce the pressure on the reflection panel, and even form a "zero gravity" effect ()

A. The helium balloon is subjected to a buoyancy force equal to the magnitude of its gravity

B. The helium balloon is equal to the gravity force of the maintenance personnel

C. The maintenance personnel is subjected to a tension equal to the magnitude of his gravity

D. "Zero gravity" indicates that the maintenance personnel's gravity becomes zero

19. On December 9, 2021, astronaut Wang Yaping showed that a tennis tennis submerged in water. The following explanation is reasonable to be ()

A. Table tennis gravity is greater than buoyancy

B. The density of table tennis is equal to the density of water

C. Table tennis is not subject to buoyancy in a weightless environment

D. The ping-pong ball is located deep and is under greater pressure from the water

20. Since its launch, China's first aircraft carrier, the Shandong, has carried out many actual combat training. The following statement is correct for the ()

A. After loading supplies, the Shandong will float up

B. After the carrier-based aircraft takes off, the Shandong warship is still floating, and the buoyancy remains unchanged

C. The floating "Shandong" receives buoyancy equal to gravity

D. The buoyancy is greater than gravity. During the Shandong, it sailed at a constant speed.

21. As shown in the picture, it is a beautiful sight of the Antarctic Ocean iceberg. Icebergs are essentially large pieces of freshwater ice floating in the sea. According to scientific analysis, global warming will cause the iceberg to melt the ()

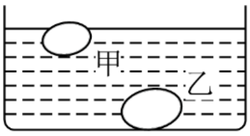
A. An iceberg must receive more buoyancy than its gravity

B. The gravity of an iceberg is less than the gravity of it releases water

C. Part of the iceberg still floats on the water after melting

D. The volume of the boiling water in the back of the melted part of the iceberg remains unchanged

22. Put two solid balls with different volumes and different materials in water, respectively. When the two balls are still, as shown in the figure, the volume of A is known to be () smaller than that of B



A. A’s mass is larger than B's

B. A receives a buoyancy force equal to gravity

C. A has a greater density than does B

D. B receives a buoyancy force equal to gravity

23. The pontoon salvage method is commonly used to salvage sunken ships. The way is to sink several filled floats to the bottom and tie them to both sides of the wreck, press the air into the buoy to drain the water from the buoy, and the wreck floats with the buoy. The following statement is correct for the ()

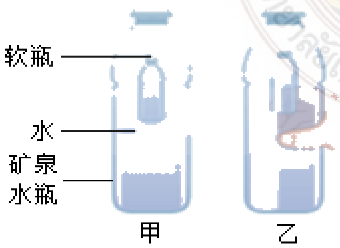
A. When the wreck is at the bottom of the river, its buoyancy is equal to its gravity

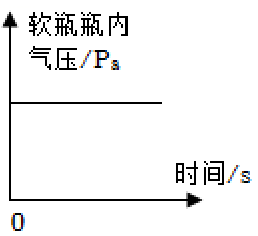
B. When the float is filled with air, the buoyancy force is greater than its gravity

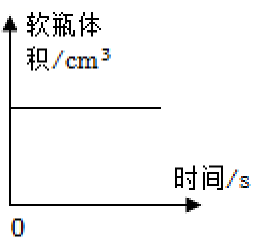
C. When the ship and the buoy float up, the buoyancy force gradually decreases

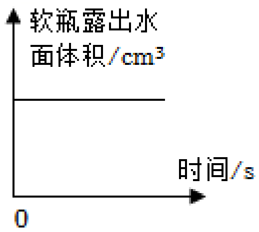
D. When the ship and the buoy float on the surface, the buoyancy force is greater than its gravity

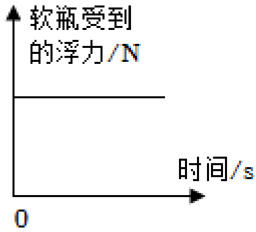
24. A student made out of soft bottles and mineral water bottles. First, add an appropriate amount of liquid to the soft bottle and seal it, then put it in the mineral water bottle and make it float (as shown in Figure A), and finally, seal the mineral water bottle. Squeeze the mineral water bottle vigorously (as shown in Figure B). During extrusion, the correct image of ()



A. 

B. 

C. 

D. 

25 The following correct statement of buoyancy is the


①“天宫”课堂上做乒乓球实验


②奋斗号载人潜水器在深海中往下潜


③福建舰在海面上航行


④ 核潜艇在海水中悬停

A. Figure ① The ping-pong ball does not float because its gravity is greater than its buoyancy

B. Figure ② The buoyancy increases with the depth

C. Figure ③ Floating on the sea surface because of the use of new materials with less density than water

D. Figure ④ The buoyancy in suspension is greater than the buoyancy when it is floating on the surface

Name…………………………..Surname…………………….

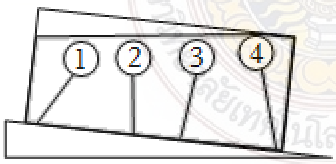
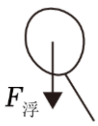
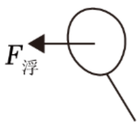
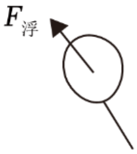
Workplace………………………..Position…………………..

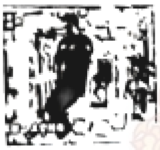
Direction: Please put the / in the table according to your opinion.

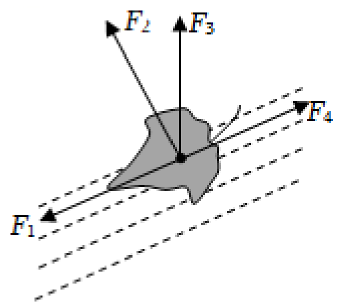
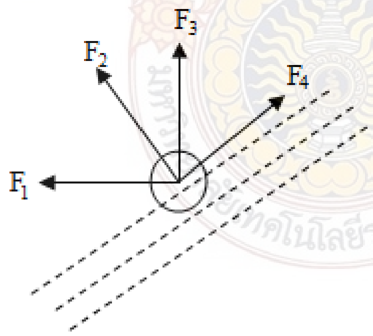
Meaning: Rated +1. There is a view that “fits the definition”.

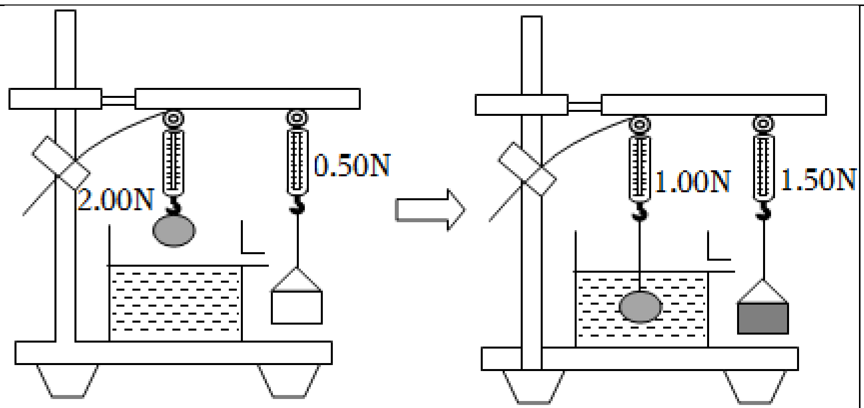
The rating is 0. One comment was, “Not sure it meets the definition”.

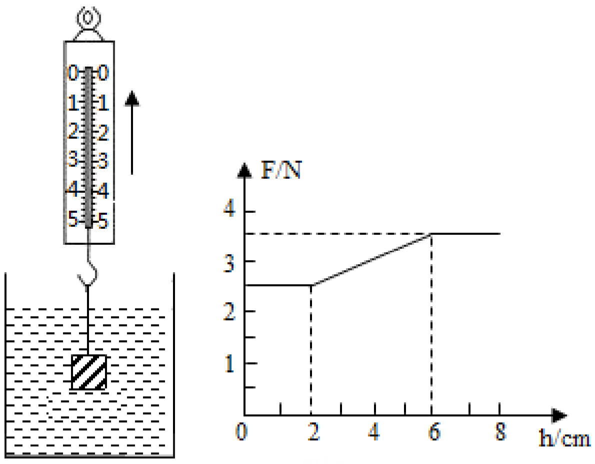
The rating is -1. There is a view that is “inconsistent with the definition”.

No	Question	+1	0	-1
1	The following objects that do not receive buoyancy are the () A. Leaves floating on the water B. The space station flying in space C. The sunken rocks in the water D. Rising balloon in the air			
2	In science class, the teacher puts the sink full of water on the inclined plane and leads the table tennis ball immersed in the water with one end of the rope (the gravity of the rope is ignored). After the static state, the table tennis ball is the closest to the () in the figure.  A． ① B． ② C． ③ D． ④			
3	Children play with the balloons in the park. The correct direction of the buoyancy of the balloon is () A．  B．  C．  D． 			
4	The signal was connected on December 9, 2021, and "Tiangong Classroom" officially opened on the Chinese space station. The three			

	space astronaut teachers showed the work and life scene of the space station and demonstrated that the microgravity environment (can be approximated as completely lost gravity), regardless of the microgravity in space, the following objects are buoyancy by ()  A. Table tennis, as shown in the picture, is "suspended" in the water in the Tiangong class  B. As shown in the Chinese space station in space  C. See the astronaut floating during the space turn experiment  D. Astronauts undergoing underwater training before being shown in space			
5	The object without buoyancy in the following scenarios is the () A. Tiangong-1, traveling in space B. Rising hot air balloon C. The "Liaoning" sailing at sea D. Jiaolong, diving in the sea			

6	As shown in the picture, a fallen leaf in the stream of Xiushan Park drifted down with the current. The direction of the buoyancy is ()  A．F1　B．F2　C．F3　D．F4			
7	Among the following objects, no buoyancy is () A. Aircraft flying in the air　B. Students in the classroom C. The piers inserted into the riverbed　D. The rising hot-air balloon			
8	During the holiday, Xiao Wang saw a ball drifting in a stream near his grandmother's house along the stream (as shown in the picture). Please help him analyze the direction of the buoyancy of the ball should be ()  A．F1　B．F2　C．F3　D．F4			
9	Check the Archimedes principle with the experimental device in the figure. When the mass is immersed in the overflowing cup, the water will flow into the empty bucket for ()			

	 A. The overflowing water cup was not filled with water before the experiment and did not affect the experimental results B. The deeper the mass is immersed in the water, the greater the pressure on the bottom of the overflowing glass C. The deeper the mass is immersed in the water, the larger the number of the left spring dynamometer D. The density of the blocks used in the experiment is 2103kg / m3			
10	Xiao li, in the experiment of exploring a liquid density, with a gauge hanging a cube metal block immersed in the liquid (the container is big enough, regardless of the change of liquid level, as shown in figure a), the process of gauge reading of F with metal height h relationship as shown in figure b, according to the image information can determine the ()			



甲　　　　乙

A. The side length of the metal block is 6cm

B. During the change of height h from 2cm to 6cm, the buoyancy of the metal block gradually increased

C. The density of this liquid is approximately 1.56103kg/m3

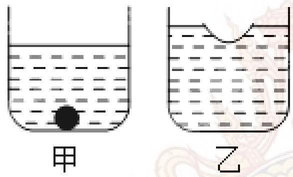
D. The density of this metal block is about 3.46103kg/m3

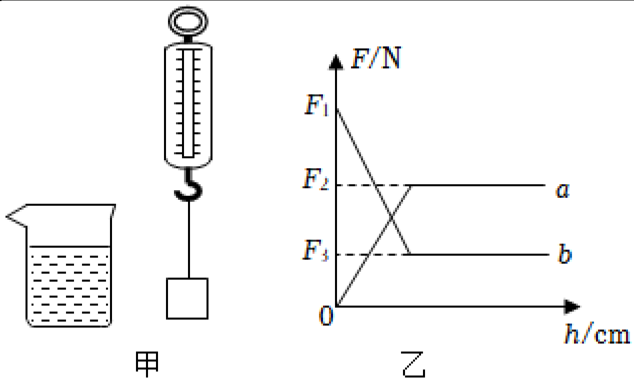
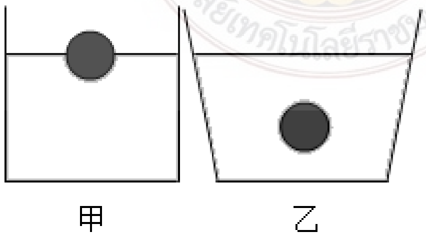
11 The mass m and volume V of the three balls, A, B, and C, are shown in the table below. They are released by immersion in water, and after their stabilization, the buoyancy of the three pellets is, respectively The first of the ten Heavenly Stems, The second of the ten Heavenly Stems, and the third of the Ten Heavenly Stems. The following judgment is correct for the ()

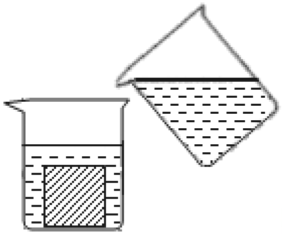
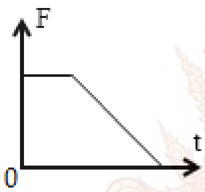
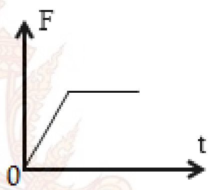
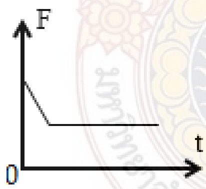
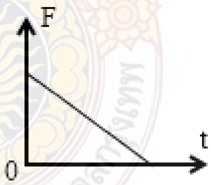
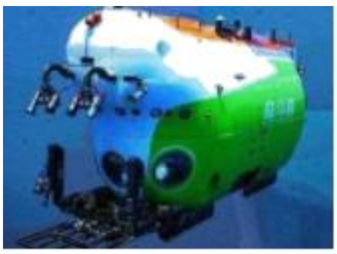
bobble	the first of the ten Heavenly Stems	the second of the ten Heavenly Stems	the third of the Ten Heavenly Stems
m/g	30	40	54
V/cm3	60	50	20

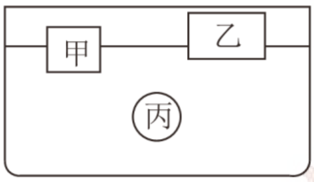
A． Fthe first of the ten Heavenly Stems＞Fthe second of the ten Heavenly Stems＞Fthe third of the Ten Heavenly Stems

B． Fthe second of the ten Heavenly Stems＞Fthe first of the ten

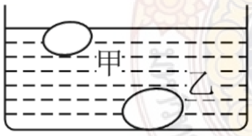
	Heavenly Stems＞Fthe third of the Ten Heavenly Stems C．Fthe third of the Ten Heavenly Stems＞Fthe second of the ten Heavenly Stems＞Fthe first of the ten Heavenly Stems D．Fthe first of the ten Heavenly Stems＞Fthe third of the Ten Heavenly Stems＞Fthe second of the ten Heavenly Stems			
12	The two identical containers of A and B on the horizontal table, containing the same amount of water, with two identical silly putty, one pinched into a bowl and put in them respectively Floating armor, FFloating b; The pressure of containers A and B to the horizontal table top is F, respectively the first of the ten Heavenly Stems, Fthe second of the ten Heavenly StemsThen, ()  A．FFloating armour＜FFloating b B．FFloating armour＝FFloating b C．Fthe first of the ten Heavenly Stems＜Fthe second of the ten Heavenly Stems D．Fthe first of the ten Heavenly Stems＞Fthe second of the ten Heavenly Stems			
13	When Xiao Ming uses the Figure A device to explore the relationship between the size of buoyancy and the volume of the immersed liquid in the object ", he obtains the image shown in Figure B. The other is the image of the number of spring scales changing with the depth of the immersed liquid, Gthing=2 cattle, then the following statement is wrong is ()			

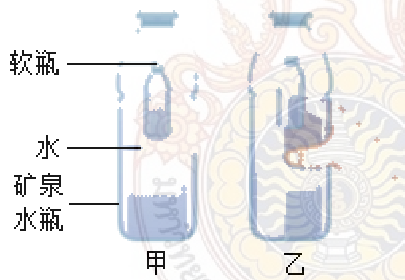
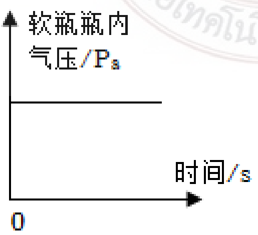
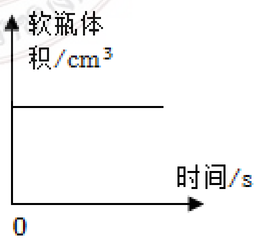
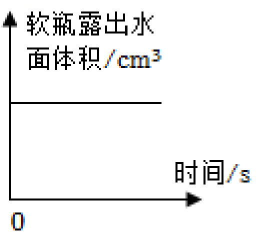
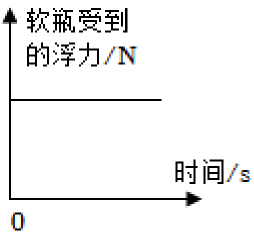
	 A． F1=2.0 Cattle B. The density of the liquid is ρ liquid＝ρ thing $\frac{F_1}{F_2}$ C． F1＝F2+F3 D. Volume V of the objectthing＝$\frac{F_2}{(\rho_{液} g)}$			
14	There are two containers of A and B with the same mass and bottom area, respectively containing liquids with different densities, and put two identical small balls into the container, as shown in the figure. The following statement is correct for ()  A. The density of liquid in container A is less than that of liquid in container B B. The buoyancy of the ball in container A is greater than that of the ball in container B C. The pressure of container A to the desktop must be greater than that			

	of container B to the desktop D. The pressure at the bottom of container A is greater than the pressure at the bottom of vessel B			
15	15. As shown in the figure, place the iron block in an empty container and slowly add water to the container along the container wall to the dotted line. In the process of adding water, the relationship of the bottom of the container F and time t is ()  A.  B.  C.  D. 			
16	On November 10, 2020, China’s manned submersible Striver successfully landed under the Mariana Trench in the western Pacific Ocean, setting a new record for China's manned deep submersible. As shown in the figure, during the constant dive of the Striver submersible, the following analysis is reasonable for () 			

	A. The buoyancy of the submersible is always less than its dead weight B. The seawater pressure of the submersible remains the same C. The buoyancy of the submersible increases with the depth D. The buoyancy of the submersible is always equal to the gravity of the sea water			
17	As shown in the figure, there are three equal-mass solid objects in the sink at rest, and a and b are cuboids ()  A. The C object has the largest volume of water discharged out B. B objects receive the least buoyancy C. The density of A objects is greater than that of B D. Unable to judge the density-size relationship between the three objects			
18	Engineers use "microgravity spider Man" technology to repair "China's Sky Eye". A helium balloon is shown in the picture to lift the maintenance staff, reduce the pressure on the reflection panel, and even form a "zero gravity" effect ()  A. The helium balloon is subjected to a buoyancy force equal to the magnitude of its gravity			

	B. The helium balloon is equal to the gravity force of the maintenance personnel C. The maintenance personnel is subjected to a tension equal to the magnitude of his gravity D. “Zero gravity” indicates that the maintenance personnel's gravity becomes zero			
19	On December 9, 2021, astronaut Wang Yaping showed that a tennis tennis submerged in water. The following explanation is reasonable to be ()  A. Table tennis gravity is greater than buoyancy B. The density of table tennis is equal to the density of water C. Table tennis is not subject to buoyancy in a weightless environment D. The ping-pong ball is located deep and is under greater pressure from the water			
20	Since its launch, China's first aircraft carrier, the Shandong, has carried out many actual combat training. The following statement is correct for the () A. After loading supplies, the Shandong will float up B. After the carrier-based aircraft takes off, the Shandong warship is still floating, and the buoyancy remains unchanged C. The floating "Shandong" receives buoyancy equal to gravity D. The buoyancy is greater than gravity. During the Shandong, it sailed at a constant speed.			
21	As shown in the picture, it is a beautiful sight of the Antarctic ocean			

	iceberg. Icebergs are essentially large pieces of fresh water ice floating in the sea. According to scientific analysis, global warming will cause the iceberg to melt the ()  A. An iceberg must receive more buoyancy than its gravity B. The gravity of an iceberg is less than the gravity of it releases water C. Part of the iceberg still floats on the water after melting D. The volume of the boiling water in the back of the melted part of the iceberg remains unchanged			
22	Put two solid balls with different volumes and different materials in water, respectively. When the two balls are still, as shown in the figure, the volume of A is known to be () smaller than that of B  A. A's mass is larger than B's B. A receives a buoyancy force equal to gravity C. A has a greater density than does B D. B receives a buoyancy force equal to gravity			
23	The pontoon salvage method is commonly used to salvage sunken ships. The way is to sink several filled floats to the bottom and tie them to both sides of the wreck, press the air into the buoy to drain the water from the buoy, and the wreck floats with the buoy. The following statement is correct for the () A. When the wreck is at the bottom of the river, its buoyancy is equal			

	to its gravity B. When the float is filled with air, the buoyancy force is greater than its gravity C. When the ship and the buoy float up, the buoyancy force gradually decreases D. When the ship and the buoy float on the surface, the buoyancy force is greater than its gravity			
24	A student made out of soft bottles and mineral water bottles. First, add an appropriate amount of liquid to the soft bottle and seal it, then put it in the mineral water bottle and make it float (as shown in Figure A), and finally, seal the mineral water bottle. Squeeze the mineral water bottle vigorously (as shown in Figure B). During extrusion, the correct image of ()  A.  B.  C.  D. 			
25	The following correct statement of buoyancy is the ()			

	 ①"天宫"课堂上做乒乓球实验  ②奋斗号载人潜水器在深海中往下潜  ③福建舰在海面上航行  ④ 核潜艇在海水中悬停 A. Figure ① The ping-pong ball does not float because its gravity is greater than its buoyancy B. Figure ② The buoyancy increases with the depth C. Figure ③ Floating on the sea surface because of the use of new materials with less density than water D. Figure ④ The buoyancy in suspension is greater than the buoyancy when it is floating on the surface			

BIOGRAPHY

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	Materials Forming and Control Engineering Yanshan University June 25, 2020
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	High School Physics Teacher Changshui Experimental Middle School Kunming, Yunnan Province
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