

Application of Hy-Flex Teaching Based on Digital Technology

Yimiao Lv^{1,2,*}

¹Graduate University of Mongolia, Ulan Bator, 17024, Mongolia

²School of Management, Guangzhou College of Technology and Business, Guangzhou, Guangdong Province, China,

*Corresponding author

Abstract: The current traditional teaching format could not cater for the new generation of students' needs during COVID-19. This article deals with the problems of modern digital technology, which has given a powerful impetus to higher education Hy-flex activities. To identify how digital technologies that contribute to Hy-flex teaching, we investigate the current most widely used digital technologies and platforms that related to Hy-flex teaching. A more active teaching format used 5G and Artificial Intelligence technologies was designed and practiced in this study. The aim of this study is to seek solutions to improve traditional learning programs during the COVID-19 crisis. We present the process of redesigning the procurement management course for our institution, students and faculty. We show a new approach to give class to students by digital technologies and platforms. We also provide the outcomes of an exam test result survey to emphasize the advantages of the Hy-Flex teaching method based on digital technologies, especially associated with the BOPPPS model. This study contributes in theory level, provides a new discussion on digital Hy-Flex teaching as well. At practitioner level, it offers insights to effectively promote education transformation for institutions.

Keywords: Hy-Flex teaching, education, digital technology, BOPPPS model

1. Introduction

The worldwide COVID-19 health crisis has exerted a disruptive influence on universities. The traditional face-to-face teaching mode was the chief method in higher education before COVID-19, which emphasized the output of teachers in the classroom, and students were passive receivers of a large amount of information in limited space and time. The unexpected outbreak of the COVID-19 epidemic has posed a significant challenge to the traditional teaching format: the students with severe symptoms are not able to attend class sessions in the classroom, and faculty members need to teach them online^[1]. The increasing use of digital technology is crucial for higher education, which affects every part of education and provides new approaches to meet multiple needs of students. A possible disadvantage of a classroom model is limited independent thinking of students. Long time didactic lectures usually reduce learners' attention. Numerous studies have shown that the students' attention begins to decline just 10 minutes after the beginning of a class lecture. The digital technology-based Hy-flex teaching was used to promote the students engagement and increase lecture quality. Although students can study synchronous or asynchronous online course content away from campus at any time, they lost the freedom to decide whether to participate in those assigned activities at the same time.

Due to the adoption of digital technologies has opened opportunities for creating innovative learning process, a more powerful mode which is called Hy-flex teaching method have been used successfully at higher education institutions in recent years. We designed a digital Hy-flex teaching approach based on the BOPPPS model to blend the advantages of traditional and online teaching, without requiring additional preparation time for learners or added technical complexity for teachers. This format consisted of a didactic lecture followed by case discussions, role-playing and other activities using digital technologies. The case portion allowed students to synthesize and apply the knowledge from the first phase of the online didactic lecture. The reform of teaching focused on learners' different learning habits and experiences. Their knowledge backgrounds were taken into consideration during teaching resources construction by Artificial Intelligence (AI) technology.

In addition, the digital Hy-flex teaching format has stressed the importance of creative and active mindset among young students. Students with different levels of education are expected to cope with

social uncertainty environment and rules. Digital technologies and platforms can provide more positive support to education by offering access to the online community in which students can exchange and communicate their ideas. As the length of class time affects the teaching time, and students' interaction with teachers were only limited to the class in the past. When students have the freedom and ability to choose and participate in MOOC platforms and class activities, they are motivated to maintain attention and create their own unique learn experience. The application of 5G in Hy-Flex teaching has already existed in practice, some platforms offer digital tools, services and interactive learning that enable activities and communications throughout the education processes. However, there are several challenges which significantly hinder the teaching result. For instance, it is difficult to measure the students' attraction of course, whether the platforms highlight the discussions in which the students participated. The institutions are forced to apply AI to identify students' connection and collaboration, match learning resources and partners to complete programs. The above measures were used to maintain education quality. For example, the online students are out of monitored during class, as a result, teachers need to seek some methods to improve the engagement. The purpose of this study is to investigate and measure the impact of the digital technologies to Hy-Flex teaching upon the students' attention, satisfaction and participation in comparison to traditional and online teaching. Our work aims at exploring the strategies, paths and methods to construct a digital Hy-Flex teaching mode, which provides readers a students-focused approach to make informed decisions and complete teaching objectives.

2. Literature background

2.1 Hy-Flex teaching

The Hy-Flex teaching, which originated from the distance learning in the United States, is an instructional approach that combines face-to-face (F2F) and online teaching. The concepts of Hybrid Learning and Hy-Flex Course have been put forward by San Francisco State University in the international higher education community (2005). The institution administrators realized that they had to attract more students to enrollment and offer more attractive learning options for current students^[2]. They moved some MA programs online and allowed students who could not attend classroom study to get instructional program online. There were still many challenges^[3]: 1) no enough institution support to develop an entirely online course program, 2) no expertise faculty for completely online teaching, 3) students interest in fully online program was unknown.

To provide the students with online and classroom courses, they searched for methods already being used elsewhere. Orey (2002) described a model that contains both online and classroom students in the same learning programs; Martyn (2003) described a Hy-flex format which is more effective in controlling the students' participation than the teachers' direction mode^[4]; Rasmussen(2003) presented a convincing study of interaction between student and faculty^[5]; Bonk and Graham(2006)provided solutions to many cases^[6]; Graham(2006) provided a frame of blend learning design guidance for given situations; Power(2008) represented asynchronous and synchronous blending modes of teaching^[7]. Miller (2011) provided a hybrid environment under the control of faculty^[1], which allowed students to participate in designed programs.

The above traditional blending approach was not to meet fully online and fully classroom students' requirements, and thus the hybrid classes mixed with online and classroom learning participation was presented to provide flexible learning options and allowed students to choose the suitable type of courses mode by themselves. That is the Hy-flex mode.

Since for many emergency crisis, the online teaching format could remain operational even when the university is not open, the use of digital Hy-flex is expanding all over the world.

2.2 Digital technologies for higher education courses

Online teaching in universities has increased in the past few years^[8], and the education industry has been obviously influenced by the development and introduction of digital technology. A pervasive use of digital technologies in education has been promoted by MOOC providers, institutions and faculty. Digitalization education is supported by 5G, AI, VR/AR to deliver effective personalized learning programs. The application of digital platforms and technologies in experiments can be important to develop efficient and flexible solutions to expand students' practice and team work engagement. Digital technologies can support the group discussions and interactions with mentors during seminars,

presentations and debates to make the education content more attractive and effective. In addition, students always cannot verify the truth of their judgements in different experiments. The model for AI application is proposed to exclude inaccuracy measurements, calculations and analyses.

3. Values and principles of digital Hy-Flex design

The values of digital Hy-Flex format have been shown in many surveys compared online teaching to classroom teaching found that, students in online conditions usually better than fully F2F instruction. Two elements that contributed to the superiority were extra learning time and additional teaching resources. Digital Hy-Flex courses mobilize the enthusiasm of students and encourage them to access the session asynchronously. When meaningful alternatives are built-in, they will be explained that students could not skip classes for any excuse. Teachers strive to expand the outreach and maximize the learning flexibility for students' enrollment, guide students to participate in teaching activities deeply, and create a dynamic class either on campus or online by digital technologies. In addition, students have been provided more access to courses, especially when they attend class in person and when the expected programs are scheduled, they have more schedule control and more learning resources.

Faculty members are able to serve more students in MOOC platforms with the same e-learning resources, develop online teaching skills and experiences, and provide a built-in option when classroom instructions are not suitable due to scheduling conflicts.

The digital Hy-Flex approach is built upon four principles: equivalency, flexibility in learning choices, reusability and accessibility. The four pillars provide a student-directed multi-modal learning foundation, and allows for more variety in courses and programs.

(1) Equivalency: all participation modes of learning activities should lead to equivalent learning outcomes. Equivalency does not imply equality. Students in each case should reflect on teaching content, provide their ideas to discussion and interact with their classmates or teachers.

(2) Learning choices: meaningful alternative participation modes can be chosen free. This principle is considered to give students a choice in completing learning activities.

(3) Reusability: all kinds of representation in class activities such as videos, notes, presentation files that students can use should be prepared in an online format. A digital platform in each participation of learning activities is very helpful both for online and F2F students.

(4) Accessibility: users need the digital technologies and skills to have equal access to all participation modes. If students do not have convenient internet access, then flexible participations are not real options.

4. The design of Hy-Flex course based on digital technology

BOPPPS teaching model is a closed-loop teaching process model based on constructivism and communicative method^[9]. In addition, it is a teaching model that conforms to the teaching curve theory and emphasizes students' participation. In the teaching process, it is divided into six modules: Bridge in, Objective, pre-assessment, participatory learning, post-assessment and Summary.

BOPPPS applied in Hy-Flex teaching is characterized by flexibility, equality, reusability and accessibility, which makes it very suitable for interactive seminar-based courses and lecture-oriented courses for undergraduates^[10].

In a digital Hy-Flex course, teachers provide instructional program, course structure, teaching content and interactive activities to meet the needs of students' participation in classroom and online. Teaching activities in these digital platforms should overlap and be reused. Activities in every format should lead to equivalent outcomes^[11]. The steps below are presented to emphasize the design requirements of digital Hy-Flex course.

In each section, teachers should assess the benefits and challenges encountered firstly, then they should analyze and confirm the expected study outcomes of students, hereby plan learning activities later, and assess and evaluate the outcomes. Take "Procurement Management"(PM) course for example. First we consider the positive and negative effects of the digital Hy-Flex format before we start. Then formulate the teaching strategies in the conditions of Hy-Flex teaching. It should be clear

that learning outcomes not only impact the content design, but also impact the teaching method selection. For example, in this PM course teachers design the BOPPPS participatory learning derived from fundamental values to complete the task of interactive practice. First of all, teachers need to design the case background, and create the problem chain of achieving goals. During the whole process, the students were kept on the scene of thinking, their learning interests and initiatives were stimulated, the habit of independent thinking and scientific literacy were cultivated as well.

The important and difficult parts of Procurement Management contains: supplier management, procurement negotiation, procurement cost and procurement contract management. Taking supplier management as an example, this paper expounds the application of the BOPPPS model in the actual teaching process.

4.1 Bridge in

Learning goals are specific objectives about what the students will ultimately achieve. Instructors should start with a case related to the goals to bridge in. For example, teachers can take McDonald's as an example, which is familiar to the students. Then the teacher introduces the discussion of supplier management. The relationship between the enterprise and suppliers has roughly experienced 4 stages: the traditional relationship stage characterized by technology and management, the logistics relationship stage featured by manufacturing products and technology development, and the strategic partnership stage marked by strategic cooperation. The stages can be showed by videos in a digital platform. The goals of bridge-cases are to explain the fierce market competition and the rapid development of information technology contribute to the formation of strategic cooperative relationship among enterprises, which is embodied in information sharing, service collaboration and group decision making. It is evident that the variation in introduction is desirable, teachers can ask questions to encourage students to get involved during the video, lectures, announcements and assignments in this part.

4.2 Objectives

Learning objectives are not only the students' objectives of learning this lesson, but also the important basis for teachers to conduct teaching design, teaching evaluation and students' self-testing after class. The teaching objectives of supplier management include: understand the objectives and significance of supplier management; master the selection and procedure of supplier management; master the content and methods of supplier performance appraisal. The three objectives are distinct and interlinked. Among them, the selection of suppliers is more difficult, while the performance assessment of suppliers is the key point. Before students begin to learn this chapter, teachers can provide these related learning resources online, and let students read materials and discuss the concepts through face to face in classroom or online. They have a psychological expectation and emphasis during learning activities, and it is easy to attract their attention.

4.3 Pre-assessment

Mastering the weighted average method is the basis of learning supplier selection. Therefore, the index of unit cost, pass rate and delivery time of products is designed to select suppliers. According to students calculate the results, teachers can decide whether to strengthen the relevant concepts and calculation process in class. Teachers can understand students learning outcomes in last step and make suitable decisions in the next teaching stage.

4.4 Participatory learning

The core of participatory learning is to take students as the main body in teaching activities, mobilize students' enthusiasm comprehensively and carry out creative learning. For example, in teaching activities, teachers can start by asking questions: people often mention the word "development", but in "supplier management", what is the definition of supplier development? Then, the students were organized to have a discussion in classrooms or in the digital platforms. Finally, the students shared the results of the free discussion. The groups made comments on each other. If they have different opinions, let them explain their reasons. In fact, it is impossible to reasonably develop and select potential qualified suppliers based on the only enterprise demand information, because the selection of suppliers cannot be carried independently out of the supply environment.

The reasonable choice is to analyze the demand and supply environment at the beginning, because the environmental analysis is an important step in the selection of suppliers. Not only should the supply environment be analyzed, but also the demand analysis should be carried out. When conducting external environmental analysis, students can be encouraged to adopt PEST analysis method and to list the key points under different elements in the note. In the process of demand analysis, students are required to have group discussions and find out at least two conditions for enterprises to develop new suppliers: one is the need for expansion, and the other is the termination of cooperation with the original suppliers.

4.5 Post-assessment

After the teaching of knowledge, teachers can set up a number of test questions around the learning objectives to test the class teaching effect. For example, what are the principles we should follow in order to select suppliers effectively? How does the quantitative method of supplier selection be calculated, such as procurement cost? What is the total cost model of suppliers in ABC activity-based Costing?

4.6 Summary

The teacher summed up the main content of this lesson, emphasizing the key and difficult knowledge and students' mistakes in class exercises.

In order to design teaching activities, select teaching content and develop the students' interaction paths, it is crucial to establish clear objectives according the students' learning outcomes, which are then used to identify content requirements and develop teaching plans (see table 1).

Table 1: Teaching design based on BOPPPS model

BOPPPS model	Supplier management		
	Content	Dominant role	Duration
B	Introduce: McDonald's case	teacher	3 minutes
O	Present learning objectives	teacher	1 minute
P1	Complete pre-assessment questions	student	3 minutes
P2	Teaching & participatory learning	student	30 minutes
P3	Complete post-assessment question	student	5 minutes
S	Summarize	teacher	3 minutes

5. Application of digital technology in education process

Hy-Flex teaching not only needs advanced Internet technology and software, but also a suitable digital network teaching platform. Meanwhile, teachers are required to master certain courseware development technology, so as to provide continuous update resources for teaching work. UNESCO and SLIBNU released a new Handbook on Facilitating Flexible Learning, which also summarizes the network including live, online interaction based on the flip video teaching, group learning, other teaching methods and case studies. It also introduces the design, method, content, tools, activities and evaluation related ideas, as the corresponding reference in 2020.

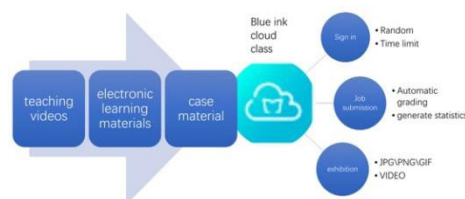


Figure 1: Functions of blue ink cloud class platform

At present, some template software and platforms that can simplify the courseware production

[12]are widely used in China, such as Super Star Learning, Blue Ink Cloud Class, Tencent Class, etc.. Taking Blue Ink Cloud Class as an example, teachers create courses and upload electronic textbooks to the platform, and record teaching videos in accordance with important and difficult chapters, so as to facilitate students' online learning. At the same time, some extracurricular teaching videos can also be uploaded to the platform to broaden the breadth and depth of students' knowledge. On the platform of blue ink cloud, students can sign in, submit homework, test in class, and use other functions. As shown in the Figure 1.

Teachers collect course related materials to make teaching videos by using Adobe Present Video Express, Crazy Talk, Easy Sketch Pro, Vector Magic, Format Factory and other tools to form a lively MOOC, and continuously updated learning resources in the blue ink cloud platform.

According to the learning resources on the platform, students can preview before class, check in during class, view electronic textbooks, browse videos and other resources. They can study independently, ask questions in the discussion area, communicate with each other among students in different groups, and finally make comments by teachers. After class, the teacher can summarize and feedback the performance of the students in this class, and assign learning tasks for the next class. The course mode of mixed teaching is shown in the figure 2 below:

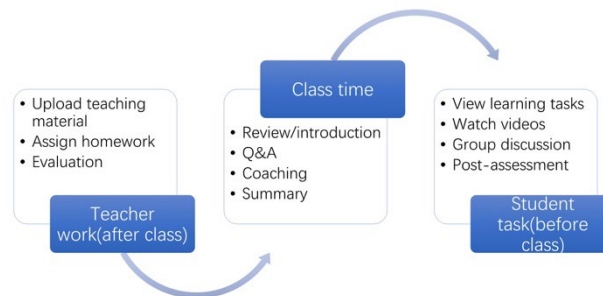


Figure 2: The teaching process of a Hy-flex organization

The use of digital technology in the above education process is as follows:

In the field of remote interactive teaching, the required terminals (such as 4k high-definition Camera, an intelligent interactive teaching screen, etc.) will use 5G technology, and teaching resource will be directly pushed to the edge cloud through the 5G network. Video acceleration module of edge cloud is used to transcode and encode recorded resources, and then push them to remote edge cloud by dedicated network to decode, then sent them to local terminals through 5G network, so as to realize real-time remote interactive learning with low delay.

The application of Artificial Intelligence (AI) technology, which takes the machine learning and deep learning as the key support, reshapes and rebuilds personalized learning. Artificial intelligence technology can recommend learning resources according to students' learning needs, draw up a learning plan according to their learning development, and form a personalized learning manual to provide "One-to-One"personal counseling teaching. Through self-learning, students discover problems, ask questions, explore for themselves, or work with peers to discuss with each other. Artificial intelligence can truly reflect students' learning state, dig out the problems that students need to improve, and help students gradually move from the teacher-centered closed learning style, turning to self-discovery type of personalized learning.

6. Results

At our institution, 120 students were randomly divided into experimental group (Hy-flex teaching mode) and control group(traditional teaching mode) to learn this course. The comparison of their mid-term exam results and final exam grades was performed with the statistical software (SPSS). A p value of 0.05 was considered statistically significant (table 2).

Table 2: Students' exam results

group	Exam results(centesimal system)
Control group(n=64)	72.8±1.68
Experimental group(n=56)	83.6±1.60 **
**P≤0.01	

6.1 Advantages

(1) In digital platforms, students have the autonomous control of learning time and space, can flexibly choose and participate in teaching activities, and reduce travel time and travel cost.

(2) Students with different participation forms can obtain equal learning activities by digital technology, and achieve the same teaching objectives or produce the same learning effects through repeated e- learning in digital platforms.

(3) Students can provide, share and create information online to form interactive resources and upload these resources reduce the workload of course resource designers. Students with different forms of participation can form online or offline learning communities to exchange ideas and resources.

6.2 Challenges

(1) The greatest challenge to students is extra effort required to participate online activities[13]. Many students' time managing skill is not effective. The distractions and non-educational options proliferate in students' lives, they need further competing for cognitive engagement.

(2) Students need technical support for obtaining teaching resources in different software and hardware environments.

(3) Faculty members need to design and develop courses that can support different modes of students' participation, but some teachers lack experience in content and activity design of mixed teaching and asynchronous participation.

(4) The selection of the digital platform is not easy. It is important that the platform can run stably, maintain reasonable range of course resources, and ensure normal access for all kinds of users under different loading conditions.

(5) Some experimental, performance, multi-participant, site-specific courses are not suitable for Hy-Flex.

7. Conclusion

The study aimed to explore how digital Hy-flex can facilitate students learning in PM teaching. The findings of the study illustrate that the use of digital technology in the Hy-flex program not only involves technical skill in using digital platform tools, but also should be adapted to students learning needs. We explained the values and principles of digital Hy-Flex course teaching based on 5G and AI, highlight the process of design, and discusses implementation factors that teachers and students have experienced in our institution. In Section 4, we explain how to build and deploy Hy-Flex course from faculty perspectives. In Section 5, we evaluate the impact of Hy-Flex course based on digital technology to assess the value of Hy-Flex approach in our course context. First and foremost, students and educators must be involved in the design of the teaching process to raise awareness of learning needs, facilitating teacher-student interactions and providing online discussions in the digital platform. The digital Hy-Flex format provides students with flexible learning period and the opportunity to actively participate in course teaching, which plays an important role in improving students' enthusiasm and realizing the teaching reform objectives.

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References

- [1] Miller, W. (2011). *Mode-neutral and the need to transform teaching*. *Public Administration Quarterly*, 35(4), 446-465.
- [2] Crede, M., Roch, S. G., and Kieszczynka, U. M. (2010). *Class Attendance in College: A meta-Analytic Review of the Relationship of Class Attendance with grades and Student Characteristics*. *Review of Educational Research* 80(2), pp. 272-295.
- [3] Bower, M., Dalgarno, B., Kennedy, G.E., Lee, M., & Kenney, J. (2015). *Design and implementation factors in blended synchronous learning environments: outcomes from a cross-case analysis*. *Computers & Education*, 86, 1-17.
- [4] Martyn, M. (2003). *The hybrid online model: Good practice*. *Educause Quarterly*, 26(1), 18–23.
- [5] Rasmussen, R. C. (2003). *The quantity and quality of human interaction in a synchronous blended learning environment*. Doctoral dissertation. Brigham Young University. (UMI No. 305345928).
- [6] Graham C. R. (2006). *Blended Learning Systems: Definition, Current Trends, and Future Directions*. In C. J. Bonk and C. R. Graham (Eds.) *Handbook of blended learning: Global Perspectives, local designs*. San Francisco, CA: Pfeiffer Publishing. (pp. 3-21).
- [7] Power, M. (2008). *The Emergence of a Blended Online Learning Environment*. *MERLOT Journal of Online Learning and Teaching* 4(4).
- [8] Beatty, B.J. *Transitioning to an online world: Using HyFlex courses to bridge the gap*. *Proceedings of the ED-MEDIA 2007 World Conference on Educational Multimedia, Hypermedia, and Telecommunications*. Vancouver, Canada.
- [9] Ren Yi, Ning Hong, Liu Dan. *Application of BOPPPS Model in Teaching Design and Practice of Micro-class*. *Computer Education*, vol.4, 2017, pp. 104-108.
- [10] Cao Danping, Yin Xingyao. *Laboratory Research and Exploration*, 2016, 35 (2) : 196-200., pp.68–73.
- [11] <https://library.educause.edu/resources/2020/7/7-things-you-should-know-about-the-hyflex-course-model>.
- [12] Duan Zhenya, Zhang Mingzhe, Guo Jianzhang et al. *Construction and Application of Process Equipment Design Online Open Course Based on Superstar Network Teaching Platform*. *Shandong Chemical Industry*, 2018 (22), pp. 146-147,149.
- [13] Dong Bingbo. *Discussion on the Application of Online and Offline Mixed Teaching Mode in Basic Computer Teaching*. *Computer Science and Technology*, 2019 (17), pp. 22-23.