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Digital Transformation of Higher Education in China: Ways to Improve Academic Performance

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Abstract

The globalization of the economy creates the need for tech-savvy specialists, thereby stimulating the digital transformation of the education industry. This study aims to determine whether the integration of virtual reality and flipped classroom is able to increase academic performance of individuals enrolled in the course "Strategic management for the sustainable development of national and international tourism". The study took place in the 2021/22 academic year in the department of tourism management at Zhejiang University, China. The study population consisted of 407 third-year students (54 % male and 46 % female); the mean age of the respondents was 20.81±0.94. Students in the Virtual Reality (VR) group showed 7.84 % better performance that those in the Flipped Classroom (FC) group. The percentage of difference between the VR and traditional groups was 13.01 %. Students in the FC group showed 4.79 % better performance than students in the traditional group ($p > 0.05$). According to the respondents, the major benefits of innovative learning over traditional education methods are the support of personalized learning, flexibility, visual and auditory memory development, complete immersion into the learning process, and accessibility of learning materials. On the other hand, users reported getting addicted to the virtual world, spending a lot of money on the necessary software and hardware, experiencing reduction in interpersonal communication, and having problems with content creation. The present findings can be useful to teachers who seek to integrate innovative technologies into the learning process. Future research will focus on investigating the impact of other innovative technologies by integrating them into an online course "Analysis of the economic activity of tourist enterprises".

Key words: *academic performance; flipped classroom; higher education; immersion; traditional education; virtual reality.*

Background

In present era of globalization and informatization, innovative technologies penetrate all spheres of human life, including education (Chang, Chou, Chuang, Li, & Tsai, 2023; Yelbayeva et al., 2017). Digitalization caused a rapid transition from traditional education to novel learning methods, tools, and technologies (Abdallah & Alriyami, 2022). In this new reality, however, students appear to be more tech-savvy than their teachers (Mikidenko & Storozheva, 2021).

The global wave of cutting-edge technology growth imposes new requirements for teacher education. To be more specific, pre-service teachers have to possess digital competencies, be digitally literate, and have innovative thinking skills in order to meet the demands of the global labor market (Frolova & Rogach, 2021). The education system thus tends to integrate advanced technologies that improve the quality of education, are accessible, and facilitate the acquisition of the 21st-century competencies (Morris & Rohs, 2023).

Technology-enhanced learning refers to a wide range of learning experiences enhanced with digital technology, including those obtained in distance, virtual, mobile, online, and offline contexts (Khutorskoy, 2019). The technology-driven teaching models include, but are not limited to, the flipped classroom (FC), VR/AR simulations, massive open online courses, video lectures, online conferences, webinars, and real-time virtual lessons (Kolykhmatov, 2020). Digital learning environments allow learners to gain innovative skills in different conceptual areas, such as STEM and STEAM (science, technology, engineering, arts, and math). In general, virtual classrooms are spaces where teachers can deliver more knowledge and learners can develop their creative thinking (Wannapiroon & Pimdee, 2022).

The FC approach is a technology-enhanced pedagogy that one can implement in different subject areas, such as mathematics, medicine, languages, and so on (Lo & Hew, 2020). Within FC teachers can reorganize the learning process while moving to a new learning space and instill creative abilities in learners through the deployment of video materials, digital presentations, and online questionnaires (Salas-Rueda, 2021).

The technology-enhanced learning initiatives can also integrate some elements of computer programming (Akhitova, 2023). The most commonly used software for this purpose is Scratch, a software program that allows creating new programmatic constructs with ready-made puzzle pieces (Ishihara & Rattanachinalai, 2022).

The innovative learning technologies in modern education also include Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) (Artun et al., 2020). The VR technology allows learners to immerse into a virtual 3D environment that completely replaces the real word and where they can interact with artificial objects via making use of electronic devices, such as goggles, headset, and gloves. Because VR creates a presence effect, it allows, among other things, for effective practical training (Sosnilo, 2021). The AR technology enables teachers to create virtual objects and introduce them into the real-world learning environment (Qiu et al., 2023). The hybrid MR technology

is a system where physical and digital objects coexist and interact in real time (Ivanova, 2018). These technologies help to promote creativity in the classroom, improve logical and analytical thinking skills in learners, stimulate their imagination, motivate and encourage them to learn, and to build creative self-efficacy (Lin & Wang, 2021).

Despite extensive research on innovative technologies in higher education, in-depth studies are scarce. This study aims to determine whether the integration of virtual reality and flipped classroom is able to increase academic performance of Chinese students.

Literature review

Today, the integration of innovative technologies in higher education servesto modernize the teaching and learning process. Exploring the prospects and challenges of virtual learning (Matee et al., 2023), researchers emphasize that it is a very helpful user-friendly technology, but it may be ineffective due to a range of problems. Among them are the lack of resources and clear instructions from the teacher, Internet connectivity issues, and data expenses. One way to overcome these challenges is to encourage learners to participate in the assessment process.

The flipped classroom approach is increasing in popularity. Yet, little is known about its effectiveness. Chinese researchers argue that in a course where 40–50 % of lessons are flipped, learners can reach high outcomes in terms of communication skills, critical thinking, and problem-solving skills (Ng & Lam, 2023).

Flipped learning was reported to increase student motivation and education outcomes (Meyliana et al., 2022). The dimensions of classroom engagement included the student learning factors, engagement with course topics, personal motivations, relationships within the group, academic performance, and general education outcomes.

According to Chinese researchers (Wu & Liu, 2021), technological innovation in education has positive effects on industrial structure upgrade and urbanization. It supports the development of leaders' innovation potential and improves enterprise efficiency. The introduction of innovative technologies contributes to the accumulation of capital, talent, and foreign investment.

The primary property of VR is data visualization. Exploring the impact of immersive VR (Chan et al., 2022), a team of US scientists found that the complex information details combined with high-resolution imagery provided a good learning experience. In the VR environment, information can be delivered to students as video and audio objects.

Digitalization plays an important role in the strategic development of education in China. Chinese scientist investigating digital modernization in higher education (Xiao, 2019) found that nearly 75 % of universities used digital technologies to build the online campus ethnos and culture. For example, Zhejiang University has launched an e-campus construction project, which consists of various media platforms that are popular in China, such as micro-blogging; WeChat and Tencent QQ. The project is aimed at promoting positive social values, building an innovative online culture, advertising the university, enhancing its public image, and improving its reputation.

The author also reports that 56 % of universities used digital technologies to strengthen students' belief in the socialist system and foster their patriotism.

The Finish researcher distinguishes six key attributes of an innovative educational technology (Cai, 2017): its nature, type, stages, social context, means of innovation, and its aim. When integrating innovations in higher education, educators may apply insights from the innovation research. Hence, future research should focus on testing and improving the existing innovative technologies. It will help to achieve a high degree of consensus on some core theories, methodological approaches, and important research problems to be addressed. In the meantime, the examination of innovative technologies in Chinese higher education complements and deepens the preliminary research.

Problem statement

The integration of innovative technologies into higher education could help to improve the general level of academic achievement in the country and reshape the very system of higher education in an attempt to meet the demands of the 21st century. This study aims to show the dynamic effects of innovative (FC and VR) technology integration on the academic performance of third-year Chinese students. The secondary objective of the study is to explore and compare the advantages and disadvantages of traditional and innovative learning.

Methodology

Study design and population

The study took place in the 2021/22 academic year and involved 407 third-year students (54 % male and 46 % female) enrolled in the Faculty of Tourism Management at Zhejiang University, China. The third-year students were selected as the sample group because they receive more (55-80 %) independent work assignments than those in other years. The mean age of the respondents was 20.81±0.94 years. All students were divided into 3 groups: students engaged in the traditional offline learning process (n = 135), students exposed to FC experiences (n = 128), and students enrolled in VR-based learning (n = 144). All participants studied Strategic Management for Sustainable Development of National and International Tourism.

Research tools

Data regarding the strengths and weaknesses of innovative teaching technologies were collected using a specially developed questionnaire. The survey was conducted with the help of Google Forms. Students received a link to an online questionnaire that consisted of 3 parts: Part 1 concerned Traditional Methods, Part 2 related to Flipped Classroom, and Part 3 related to Virtual Reality. Each part had two open-ended questions:

(1) What benefits does this learning technology bring?

(2) What are the disadvantages of this learning technology?

Students were asked to answer on their own. The link was active for 1 month (November 2021) and was accessible from any modern gadget.

Academic success was evaluated on a 200-point marking scale. Students can get a maximum score of 200 points, which consists of regular assignments (120 points) and final assessment (80 points). An overall score of 180-200 points indicates an excellent (A-level) result; 170-179 points, a very good (B-level) result; 160-169 points, a food (C-level) result; 141-159, a satisfactory (D-level) result; 122-140, an acceptable (E-level) result, 121 and less, a poor (F-level) result.

The online questionnaire was first used in this study to examine the effect of innovative technologies. The results have not been published in other papers or related studies.

Statistical data analysis

Statistical data were analyzed in Microsoft Excel. Quantitative parameters were calculated using the formula ($x \pm m$), where x is the arithmetic mean and m is the error of the mean. Statistical data analysis was performed using Student's t-test. Differences were considered as statistically significant at $p \leq 0.05$ and when the p-value ranged from ≤ 0.06 to ≤ 0.10.

The online questionnaire was tested for reliability using Cronbach's alpha. The values of Cronbach's alpha were interpreted as follows (George & Mallery, 2003): $\alpha \geq 0.9$, Excellent; $\alpha \geq 0.8$, Good; $\alpha \geq 0.7$, Acceptable; $\alpha \geq 0.6$, Questionable; $\alpha \geq 0.5$, Poor. The Cronbach's alpha for six items is 0.916, indicating high reliability of the questionnaire.

Study limitations

The study has several limitations associated with a small sample size and a small coverage of the study area. First, the study is limited to individuals learning strategic management in tourism. Second, all respondents were recruited from a single university. Therefore, the present findings cannot be generalized to other regions and specialties. Furthermore, the study looked into FC and VR and did not consider other interactive models.

Ethical issues

The study was performed according to the Declaration of Helsinki on Ethical Principles for Research Involving Human Subjects. All participants were informed about the goals and methods of the research. All subjects also gave their written consent to participate in the study. Complete anonymity was ensured and there was no conflict of interest. The Bioethics Committees of the university approved this research project in the 2021/22 academic year.

Results and discussion

When evaluating the academic success of students, the results showed that the VR group performed better compared to traditional learners and students in the FC group. The end-of-year results of the three groups are depicted in Table 1.

Table 1
Academic performance of university students in the 2021/22 academic year

Study subjects	Mean performance score, points		
	Traditional Learning (N = 135)	Flipped Classroom (N = 128)	Virtual Reality (N = 144)
Zhejiang University, Tourism Management (n = 407)	146±3.84	153±3.69	165±2.42
Performance level, letter grade	D	D	C
t	3.18	4.6	5.84

P-value: $p_{1-2} > 0.05$, $p_{1-3} < 0.05$, $p_{2-3} < 0.05$
* - p>0.05, means are not significantly different
** - p<0.05, means are significantly different

The traditional group and the FC group had similar levels of academic success (Figure 1), with the mean scores of 146±3.84 and 153±3.69, respectively; there was no statistically significant difference detected ($p > 0.05$). A significant difference was found between the FC and VR groups ($p < 0.05$), the mean scores were 153±3.69 and 165±2.42, respectively. There was also a statistically significant difference between traditional and VR groups ($p < 0.05$); the mean scores were 146±3.84 and 165±2.42, respectively.

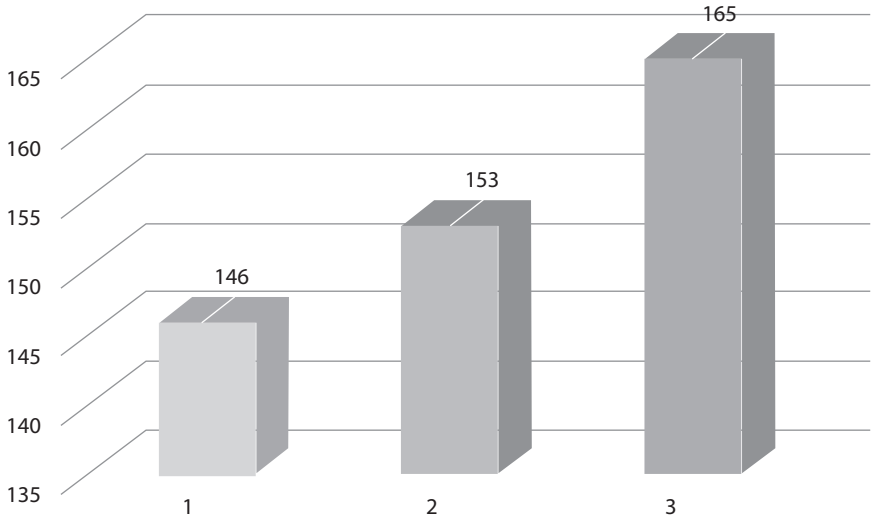

Figure 1. Student groups and their levels of academic success (in points)

Based on the above results, VR technology is more effective in enhancing student performance than traditional and FC learning programs. The performance score of the VR group was 7.84 % higher than that of the FC group and 13.01 % higher than that of the traditional group ($p > 0.05$). These results are in line with previous studies.

Turkish researcher investigating the impact of VR on academic success (Taçgın, 2020) found that it helps teachers boost student performance. The perceived effectiveness of competence acquisition, in this case, depends on the prior knowledge of students. Investigating the effect of immersive VR, Chinese scholars reported significant improvements in student achievements and learning motivation (Shi et al., 2022).

The FC group scored an average of 4.79 % higher than the traditional group ($p > 0.05$). This finding somewhat contradicts the Indian study comparing the effects of traditional and flipped classroom approaches (Vivek & Ramkumar, 2020). The researchers found that the flipped approach could potentially have a positive effect on academic attainment, but the lack of learners' adaptability prevented that from happening. In this study, however, no such problem was detected.

When identifying the advantages of traditional lecturing (Figure 2), 80 % of students (N = 325) noted the use of direct instructions; 75 % (N = 305) appreciated the small volumes of information being delivered logically and systematically; and 67 % (N = 272) enjoyed physical interactions. Regarding the disadvantages of traditional lecturing, 73 % of the respondents (N = 296) noted the lack of mobility; 66 % (N = 267) reported a little impact on the sense of independence and creative thinking; 23 % (N = 93) said that the format itself was not engaging.

When identifying the advantages of flipped learning (Figure 2), 90 % of students (N = 366) noted the accessibility of learning materials; 87 % (N = 353) pointed to flexibility; and 84 % (N = 341) enjoyed personalization. In addition, 76 % of students (N = 309) appreciated effective feedback and 54 % (N = 219) emphasized affordability. Regarding the disadvantages of flipped learning, 92 % of the respondents (N = 374) reported long screen time; 87 % (N = 354) complained that it requires a high level of self-discipline; and 83 % (N = 337) reported having insufficient digital literacy. In addition, 65 % (N = 264) pointed to the lack of practice-based learning and 48 % (n = 195) said that the format felt 'unnatural'.

When indentifying the advantages of *VR-based learning*, 92 % of students (N = 374) noted the presence effect; 87 % (N = 354) enjoyed interactivity and multisensory experience; 85 % (N = 345) noted the ease of use and comfortability; 82 % (N = 333) appreciated the lack of distractions; and 77 % (N = 313) reported the attainment of practical experience. Regarding the disadvantages, 90 % (N = 366) noted addiction to the virtual world; 81 % (N = 329) indicated high costs; and 75 % (N = 305) reported loss of human connection. In addition, 72 % of students (N = 293) noted the lack of flexibility and 69 % (N = 280) said that creating content was difficult (Figure 2).

According to Chinese researchers (Zhang et al., 2020), VR has the power to increase the social presence of learners, improve their learning interest and attention, and enhance interaction. There were no significant differences found in the transmission of well-structured knowledge between traditional and VR approaches. In addition, the researchers claim that VR can effectively enhance the student learning experience. Yet, this effect highly depends on both the teaching materials and VR technology.

According to scientists from Hong Kong (Wong et al., 2019), the current generation of learners shows increased interest in learning with innovative technologies, among which is 360-degree VR. The majority of students (88 %) noted that this technology benefited them in learning by providing a personalized learning space. In the present study, students also reported personalization as one of the advantages of the VR technology.

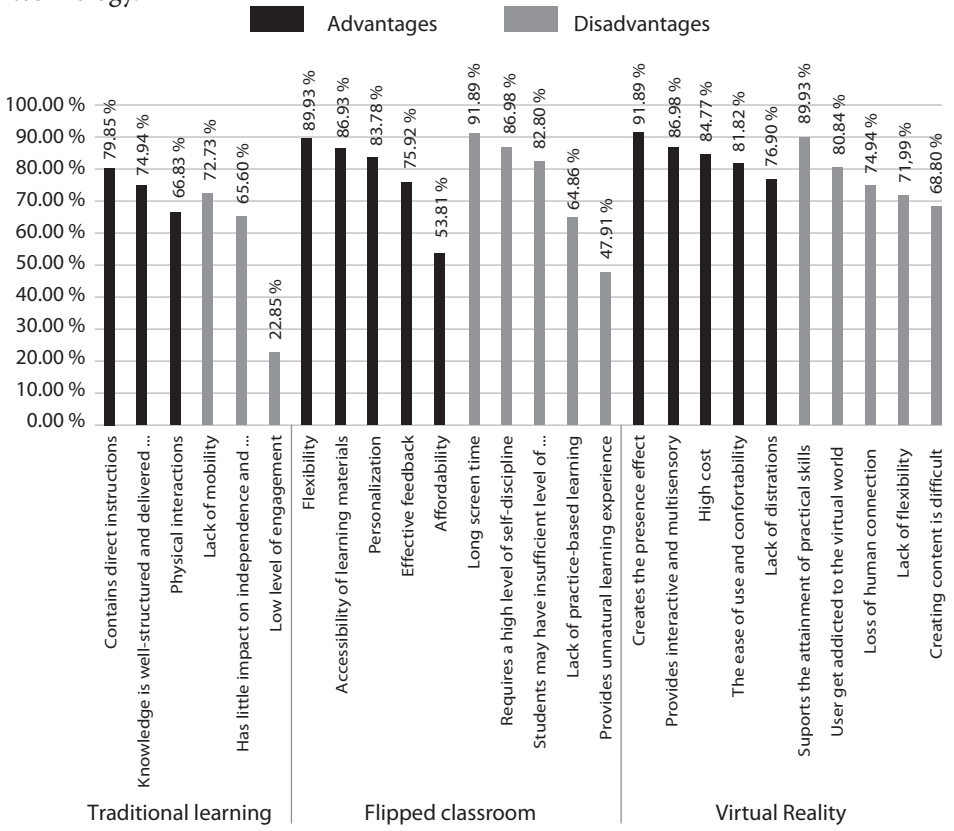

Figure 2. Students' perceptions of different learning approaches

According to 90 % of the respondents, one of the problems with VR is that users get addicted to the virtual world. This finding is of interest, considering that VR is used in addiction medicine (Langener et al., 2021).

In recent years, flipped learning has attracted much attention around the world (Huang et al., 2019). This approach has been proven very useful, especially during the pandemic period. As a co-creational model, the flipped classroom received positive feedback from the U.S. students (Uskoković, 2018), with 87.5 % liking it more than traditional lecturing.

Based on the results of the present study, innovative technologies play an important and unique role in modern education. They help to enhance academic performance and provide learners with flexible and personalized learning.

Conclusions

The aim of this study was to determine whether the integration of virtual reality and flipped classroom is able to increase academic performance of Chinese students. Based on the results of the study, VR is more effective in improving academic performance than the flipped classroom and traditional lecturing ($p > 0.05$). Students reported the following advantages of VR-based learning: the presence effect and full immersion, interactivity and multisensory experience, the ease of use and comfortability, lack of distractions, and practical training. The disadvantages are developing an addiction to the virtual world, high costs, loss of human connection, lack of flexibility, and the difficulty of the content creation process. Although new mobile device designs and investments in technological development are already making VR technology more accessible for daily use, other identified disadvantages of using VR technology still need to be overcome.

The advantages of the flipped model include the accessibility of learning materials, flexibility, personalization, effective feedback, and affordability. The disadvantages are a long screen time, lack of self-discipline, the insufficient level of digital literacy among learners, lack of practice-based learning, and 'unnatural' experience. The pedagogical model of flipped classroom is able to update the organization of activities before, during and after the lesson, and create new educational spaces through the use of technology. If the motivating mechanisms are properly considered, the problem of self-discipline will be solved. Each new round of technology development increases the level of users' digital literacy. Consequently, the problem of digital literacy becomes less relevant for a new generation of students. The combination of traditional training with the use of technology will solve the problem of insufficient practical training and long screen time. At the same time, the integrated approach is able to tackle lack of mobility, weak influence on the sense of independence and creative thinking, low involvement – the main identified problems of traditional learning methods. Thus, this study posits that IT technologies are an important tool for expanding and optimizing traditional teaching and learning methods that can improve students' academic performance.

The present findings can be useful to teachers who seek to integrate innovative technologies into the learning process and decide between VR and FC approaches. Future research will focus on investigating the impact of other innovative technologies by integrating them into an online course.

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Digitalna transformacija visokoga obrazovanja u Kini: načini poboljšanja akademskoga postignuća

Sažetak

Globalizacija ekonomije stvara potrebu za stručnjacima visokoga tehnološkog znanja, što stimulira digitalnu transformaciju obrazovne industrije. Cilj ove studije jest utvrditi može li integracija virtualne stvarnosti i obrnute učionice povećati akademski učinak osoba upisanih na kolegij Strateški menadžment za održivi razvoj nacionalnoga i međunarodnoga turizma. Istraživanje je provedeno u akademskoj godini 2021./22. na Odsjeku za menadžment u turizmu na Zhejiang University, Kina. Istraživačku populaciju činilo je 407 studenata treće godine (54 % muškaraca i 46 % žena); prosječna dob ispitanika bila je 20,81 ± 0,94 godine. Studenti u grupi virtualne stvarnosti (VR) pokazali su 7,84 % bolje rezultate od onih u grupi obrnute učionice (FC). Postotna razlika između VR i tradicionalnih grupa iznosila je 13,01 %. Studenti u grupi FC pokazali su 4,79 % bolje rezultate od studenata u tradicionalnoj grupi ($p > 0,05$). Prema mišljenju ispitanika, glavne su prednosti inovativnoga učenja u odnosu na tradicionalne obrazovne metode podrška personaliziranom učenju, fleksibilnost, razvoj vizualnoga i auditivnoga pamćenja, potpuna uronjenost u proces učenja i dostupnost obrazovnih materijala. S druge strane, korisnici su izjavili da postaju ovisni o virtualnom svijetu, troše velike količine novca na potreban softver i hardver, suočavaju se sa smanjenom međuljudskom komunikacijom i imaju problema sa stvaranjem sadržaja. Ovi nalazi mogu biti korisni nastavnicima koji žele integrirati inovativne tehnologije u proces učenja. Buduća istraživanja bit će usmjerena na ispitivanje utjecaja drugih inovativnih tehnologija njihovom integracijom u online predmet Analiza gospodarske djelatnosti turističkih poduzeća.

Ključne riječi: *akademsko postignuće; obrnuta učionica; tradicionalno obrazovanje; uronjenost; virtualna stvarnost; visoko obrazovanje.*

Uvod

U današnjem vremenu globalizacije i informatizacije, inovativne tehnologije prodiru u sve sfere ljudskoga života, uključujući i obrazovanje (Chang i sur., 2023). Digitalizacija je uzrokovala brzi prijelaz iz tradicionalnoga obrazovanja na nove metode učenja,

nove alate i nove tehnologije. Međutim, u ovoj novoj stvarnosti čini se da su studenti vještiji u korištenju tehnologije od njihovih nastavnika (Mikidenko i Storozheva, 2021).

Globalni trend porasta vrhunskih tehnologija nameće nove zahtjeve u obrazovanju učitelja. Točnije, budući nastavnici moraju steći digitalne kompetencije, biti digitalno pismeni i posjedovati vještine inovativnoga razmišljanja kako bi zadovoljili zahtjeve globalnoga tržišta rada (Frolova i Rogach, 2021). Stoga, obrazovni sustav teži integraciji naprednih tehnologija koje će poboljšati kvalitetu obrazovanja koje su dostupne i koje olakšavaju stjecanje kompetencija za 21. stoljeće (Morris i Rohs, 2023).

Učenje potpomognuto tehnologijom odnosi se na široki spektar obrazovnih iskustava obogaćenih digitalnom tehnologijom, uključujući ona stečena na daljinu, u virtualnom, mobilnom, *online* i *offline* okružju (Khutorskoy, 2019). Modeli nastave zasnovani na tehnologiji uključuju, iako nisu nužno ograničeni na, obrnutu učionicu (FC), VR/AR simulacije, masovne otvorene *online* tečajeve, videopredavanja, *online* konferencije, mrežne seminare i virtualnu nastavu u stvarnome vremenu (Kolykhmatov, 2020). Digitalna obrazovna okružja omogućuju učenicima stjecanje inovativnih vještina u različitim konceptualnim područjima poput STEAM-a (znanost, tehnologija, inženjerstvo, umjetnost, i matematika). Općenito, virtualne učionice su prostori gdje nastavnici mogu ponuditi više znanja, a učenici razviti svoje sposobnosti kreativnoga razmišljanja (Wannapiroon i Pimdee, 2022).

Pristup obrnute učionice (FC) jest pedagogija poboljšana tehnologijom koja se može implementirati u različitim predmetnim područjima poput matematike, medicine, jezika i drugih (Lo i Hew, 2020). Unutar FC pristupa, nastavnici mogu reorganizirati proces učenja prelazeći u novi prostor učenja te kod učenika razviti kreativne sposobnosti korištenjem videomaterijala, digitalnih prezentacija i *online* upitnika (Salas-Rueda, 2021).

Inicijative za tehnologijom potpomognutoga učenja također mogu integrirate i neke elemente računalnoga programiranja. Najčešće korišten softver za ovu svrhu je *Scratch*, program koji omogućuje stvaranje novih programskih konstrukata pomoću gotovih dijelova kao što su *puzle* (slagalice) (Ishihara i Rattanachinalai, 2022).

Inovativne tehnologije učenja u suvremenom obrazovanju također obuhvaćaju proširenu stvarnost (AR), virtualnu stvarnost (VR) i miješanu realnost (MR) (Artun i sur., 2020). Tehnologija virtualne stvarnosti omogućuje učenicima potpuno uronjavanje u virtualno 3D okružje koje u potpunosti zamjenjuje stvarni svijet. Učenici unutar toga okružja mogu ostvariti interakciju s umjetnim objektima pomoću elektroničkih uređaja kao što su naočale, kaciga i rukavice. Budući da VR tehnologija stvara učinak prisutnosti, omogućuje, između ostaloga, i učinkovitu praktičnu obuku (Sosnilo, 2021). Tehnologija proširene stvarnosti (AR) omogućuje nastavnicima stvaranje virtualnih objekata i njihovo uvođenje u stvarno okružje učenja (Qiu i sur., 2023). Hibridna tehnologija miješane stvarnosti (MR) predstavlja sustav u kojem fizički i digitalni objekti koegzistiraju i interaktivno djeluju u stvarnom vremenu (Ivanova, 2018). Ove tehnologije pomažu u promicanju kreativnosti u razredu, poboljšanju vještina logičkoga i analitičkoga razmišljanja kod učenika, stimuliraju njihovu maštu, motiviraju ih i

potiču na učenje te razvijaju kreativnu samoučinkovitost (Lin i Wang, 2021).

Unatoč brojnim istraživanjima o inovativnim tehnologijama u visokom obrazovanju, temeljite studije su rijetke. Cilj je ove studije utvrditi može li integracija virtualne stvarnosti i obrnute učionice poboljšati akademsko postignuće kineskih studenata.

Pregled literature

U današnje vrijeme, integracija inovativnih tehnologija u visoko obrazovanje služi za modernizaciju procesa poučavanja i učenja. Istražujući perspektive i izazove virtualnoga učenja (Matee i sur., 2023), znanstvenici naglašavanju da je to vrlo korisna i korisnicima prihvatljiva tehnologija, ali i da zbog niza problema može biti neučinkovita. To uključuje nedostatak resursa i jasnih uputa koje trebaju dati nastavnici, problem s povezanošću na internet, troškove interneta. Jedan od načina za prevladavanje ovih izazova jest poticanje učenika na sudjelovanje u procesu vrednovanja.

Pristup obrnute učionice sve je popularniji. Međutim, malo se zna o njegovoj učinkovitosti. Kineski istraživači tvrde da u kolegiju u kojem je 40 – 50 % nastave obrnuto, studenti mogu postići visoka postignuća u pogledu komunikacijskih vještina, kritičkoga mišljenja i vještina rješavanja problema (Ng i Lam, 2023).

Španjolski istraživači koji su proučavali tehnologiju obrnute učionice otkrili su da studenti uglavnom imaju pozitivan stav prema ovom modelu učenja (Latorre-Cosculluela i sur., 2021). Ispitanici su pokazali visoki stupanj slaganja sa sljedećim prednostima obrnute učionice: dostupnost nastavnoga materijala, autonomija učenja, podrška nastavnika. Uz obrnutu učionicu, studeni su mogli razviti sljedeće profesionalne kompetencije: građenje karaktera, suradnja, komunikacija, građanski odgoj, kritičko mišljenje i kreativnost. Obrnuta učionica poboljšava motivaciju studenata i obrazovne ishode (Meyliana i sur., 2022). Dimenzije angažiranosti u učionici uključivale su faktore učenja studenata, angažiranost s temama u kolegiju, osobne motivacije, odnose unutar skupine, akademsko postignuće i općenite obrazovne ishode.

Prema kineskim istraživačima (Wu i Liu, 2021), tehnološka inovacija u obrazovanju ima pozitivne učinke na poboljšanje strukture industrije i urbanizaciju. Ona podržava razvoj inovativnoga potencijala vodstva i poboljšava učinkovitost tvrtki. Uvođenje inovativnih tehnologija doprinosi akumulaciji kapitala, talenta i stranih ulaganja.

Primarno svojstvo VR je vizualizacija podataka. Istražujući utjecaj uranjajuće VR (Chan i sur., 2022), tim američkih znanstvenika otkrio je da složene informacije u kombinaciji sa slikama visoke rezolucije pružaju dobro iskustvo učenja. U VR okružju, informacije se studentima mogu dostavljati kao video i audioobjekti.

Digitalizacija ima važnu ulogu u strateškom razvoju obrazovanja u Kini. Kineski znanstvenici koji istražuju digitalnu modernizaciju u visokom obrazovanju (Xiao, 2019) otkrili su da gotovo 75 % sveučilišta koristi digitalne tehnologije za izgradnju zajednice i kulturnoga identiteta *online* kampusa. Primjerice, Zhejiang University pokrenulo je projekt izgradnje e-kampusa koji se sastoji od različitih medijskih platformi popularnih u Kini, poput mikroblogiranja, WeChata i Tencent QQa. Cilj

je projekta promicanje pozitivnih društvenih vrijednosti, stvaranje inovativne *online* kulture, promociji sveučilišta, poboljšanje njegove jasne slike i ugleda u društvu. Autor također napominje da se 56 % sveučilišta koristi digitalnim tehnologijama za jačanje studentskoga vjerovanja u socijalistički sustav i za poticanje domoljublja.

Finski istraživač razlikuje šest ključnih atributa inovativne obrazovne tehnologije (Cai, 2017): prirodu, tip, faze, društveni kontekst, načine inovacije i njezin cilj. Prilikom integracija inovacija u visoko obrazovanje, nastavnici mogu primijeniti spoznaje iz istraživanja inovacija. Stoga, buduća istraživanja treba usmjeriti na testiranje i poboljšanje postojećih inovativnih tehnologija. To će pomoći u postizanju visokoga stupnja konsenzusa o nekim osnovnim teorijama, metodološkim pristupima i važnim istraživačkim problemima koje treba riješiti. U međuvremenu, ispitivanje inovativnih tehnologija u kineskom visokom obrazovanju dopunjuje i produbljuje preliminarna istraživanja.

Istraživački problem

Integracija inovativnih tehnologija u visoko obrazovanje mogla bi pomoći u poboljšanju opće razine akademskoga postignuća u zemlji i preoblikovanju samoga sustava visokoga obrazovanja kako bi se zadovoljile potrebe 21. stoljeća. Cilj je ove studije prikazati dinamičke učinke integracije inovativne (FC i VR) tehnologije na akademsko postignuće kineskih studenata treće godine. Sekundarni je cilj studije istražiti i usporediti prednosti i nedostatke tradicionalnoga i inovativnoga učenja.

Metodologija

Istraživački model i uzorak ispitanika

Istraživanje je provedeno tijekom akademske godine 2021./22. na fakultetu za menadžment u turizmu, Zhejiang University, Kina. U istraživanje je bilo uključeno 407 studenata treće godine (54 % muškaraca i 46 % žena). Studenti treće godine odabrani su kao uzorak ispitanika jer primaju više (55 – 80 %) zadataka za samostalni rad u odnosu na studente drugih godina. Prosječna dob ispitanika bila je 20,81±0,94 godina. Svi studenti bili su podijeljeni u tri skupine: studenti uključeni u tradicionalni *offline* proces učenja (n = 135), studenti izloženi iskustvu FC nastave (n = 128) i studenti uključeni u VR-bazirano učenje (n = 144). Svi ispitanici uključeni su u kolegij Strateški menadžment za održivi razvoj nacionalnoga i međunarodnoga turizma.

Instrumenti

Podatci o prednostima i nedostatcima inovativnih nastavnih tehnologija prikupljeni su pomoću posebno razvijenoga upitnika. Istraživanje je provedeno pomoću Google Forms aplikacije. Studenti su e-poštom dobili poveznicu na *online* upitnik koji se sastojao od tri dijela: prvi dio odnosio se na tradicionalne metode, drugi dio odnosio se na obrnutu učionicu, a treći dio odnosio se na virtualnu stvarnost. Svaki je dio sadržavao dva pitanja otvorenoga tipa:

(1) Koje prednosti pruža ova tehnologija učenja?
(2) Koji su nedostatci ove tehnologije učenja?

Studenti su zamoljeni da sami odgovaraju na pitanja. Poveznica na upitnik bila je aktivna mjesec dana (Studenti 2021) i bila je dostupna s bilo kojeg modernoga uređaja.

Akademski uspjeh se ocjenjivao prema skali od 200 bodova. Studenti mogu ostvariti maksimalan broj od 200 bodova što podrazumijeva redovite zadatke (120 bodova) i završni zadatak (80 bodova). Ukupnim brojem bodova između 180 i 200 ostvaruje se odličan uspjeh (razina A); 170 - 179 bodova – vrlo dobar uspjeh (razina B); 160 - 169 bodova – dobar uspjeh (razina C); 141 - 159 bodova zadovoljavajući uspjeh (razina E) te 121 i niže – slaba razina (razina F).

Online upitnik prvi put je korišten u ovoj studiji kako bi se ispitao učinak inovativnih tehnologija. Rezultati nisu objavljeni u drugi radovima ili srodnim istraživanjima.

Statistička analiza podataka

Statistički podatci analizirani su u Microsoft Excel programu. Kvantitativni parametri izračunati su prema formuli ($x \pm m$), pri čemu je x aritmetička sredina, a m standardna pogreška sredine. Statistička analiza podataka napravljena je korištenjem studentskoga t-testa. Razlike su se smatrale statistički značajnima pri $p \leq 0,05$ i kada je p-vrijednost bila u rasponu od $\leq 0,06$ do ≤ 0.10.

Pouzdanost upitnika testirana je korištenjem Cronbachovim alfa koeficijentom. Vrijednosti Cronbachova alfa koeficijenta interpretirane su na sljedeći način (George i Mallery, 2003): $\alpha \geq 0,9$, izvrsno; $\alpha \geq 0,8$, dobro; $\alpha \geq 0,7$, prihvatljivo; $\alpha \geq 0,6$, upitno; $\alpha \geq 0,5$, slabo. Cronbachov alfa koeficijent za šest stavki iznosi 0,916, što ukazuje na visoku pouzdanost upitnika.

Ograničenja

Istraživanje ima nekoliko ograničenja povezanih s malim uzorkom ispitanika i malim obuhvatom područja istraživanja. Prvo, istraživanje je ograničeno na pojedince koji studiraju strateški menadžment u turizmu. Drugo, svi ispitanici dolaze s jednoga sveučilišta. Stoga se sadašnji nalazi ne mogu generalizirati na druge regije i područja specijalizacije. Nadalje, istraživanje se bavilo FC i VR te s nisu razmatrale druge interaktivne modele.

Etička pitanja

Istraživanje je provedeno u skladu s Helsinškom deklaracijom o etičkim načelima za istraživanja koja uključuju ljude kao ispitanike. Svi sudionici bili su obaviješteni o ciljevima i metodama istraživanja. Također su svi ispitanici dali svoj pisani pristanak za sudjelovanje u ovome istraživanju. Potpuna anonimnost bila je osigurana i nije bilo sukoba interesa. Bioetički odbor sveučilišta odobrio je ovaj istraživački projekt u akademskoj godini 2021./22.

Rezultati i diskusija

Prilikom procjene akademskoga postignuća studenata, rezultati su pokazali da VR skupina postigla bolje rezultate u usporedbi sa studentima iz skupine tradicionalnoga poučavanja i studenata iz FC skupine. Rezultati dobiveni za kraj godine za sve tri skupine prikazani su u Tablici 1.

Tablica 1

Tradicionalna skupina i FC skupina imale su sličnu razinu akademskoga postignuća (Slika 1), s prosječnim brojem bodova 146 ± 3,84 i 153 ± 3,69, pojedinačno; nije uočena statistički značajna razlika ($p > 0,05$). Statistički značajna razlika uočena je između skupine FC i VR ($p < 0,05$), prosječni rezultati bili su 153 ± 3,69 i 165 ± 2,42, pojedinačno. Statistički značajna razlika također je uočena između tradicionalne i VR skupine ($p < 0,05$); prosječni rezultati bili su 146 ± 3,84 i 165 ± 2,42, pojedinačno.

Slika 1

Na temelju navedenih rezultata, VR tehnologija je učinkovitija u poboljšanju uspjeha studenata od programa tradicionalnoga i FC učenja. Rezultat uspjeha VR skupine bio je 7,84 % viši od rezultata FC skupine i 13,01 % viši od uspjeha tradicionalne skupine ($p > 0,05$). Ovi rezultati se slažu s prethodnim istraživanjima. Turski istraživač koji je proučavao utjecaj VR na akademsko postignuće (Taçgın, 2020) otkrio je da VR pomaže nastavnicima poboljšati uspjeh studenata. Percipirana učinkovitost stjecanja kompetencije, u ovome slučaju, ovisi o prethodnom znanju studenata. Istražujući učinak uronjenoga VR-a, kineski znanstvenici izvijestili su o značajnom poboljšanju u postignućima studenata i motivaciji za učenje (Shi i sur., 2022).

FC skupina imala je u prosjeku 4,79 % viši rezultat od tradicionalne skupine ($p > 0,05$). Ovo otkriće donekle proturječi indijskoj studiji koja je uspoređivala učinke tradicionalnoga pristupa i pristupa obrnute učionice (Vivek i Ramkumar, 2020). Istraživači su otkrili da pristup obrnute učionice potencijalno ima pozitivan učinak na akademsko postignuće, ali je nedostatak prilagodljivosti učenika to je spriječilo. U ovome istraživanju, međutim, takav problem nije uočen.

Pri identificiranju prednosti tradicionalnoga poučavanja (Slika 2), 80 % studenata (N = 325) istaknulo je upotrebu izravnih uputa; 75 % (N = 305) studentima je odgovarao manji obujam informacija koje se prezentiraju logički i sustavno i 67 % (N = 272) cijenilo je fizičke interakcije. Što se tiče nedostataka tradicionalnoga poučavanja, 73 % ispitanika (N = 296) izjasnilo se o nedostatku kretanja; 66 % (N = 267) izjasnilo se o malom utjecaju na osjećaj samostalnosti i kreativnoga mišljenja; 23 % (N = 93) reklo je da format, sam po sebi, nije bio zanimljiv.

Identificirajući prednosti obrnute učionice (Slika 2), 90 % studenata (N = 366) navelo je dostupnost materijala za učenje; 87 % (N = 353) navelo je fleksibilnost; a za 84 % (N = 341) studenata zanimljiva je bila personalizacija. Nadalje, 76 % studenata

(N = 309) cijenilo je učinkovitu povratnu informaciju a 54 % (N = 219) naglasilo je cjenovnu pristupačnost. Što se tiče nedostataka obrnute učionice, 92 % ispitanika (N = 374) navelo je dugo vrijeme provedeno pred ekranom; 87 % (N = 354) požalilo se da ovakav način rada zahtijeva visoku razinu samodiscipline; a 83 % (N = 337) izvijestilo je o nedovoljno razvijenoj digitalnoj pismenosti. Osim toga, 65 % (N = 264) ispitanika ukazalo je na nedostatak praktičnoga učenja, a 48 % (N = 195) reklo je da je format „neprirodan".

Identificirajući prednosti učenja zasnovanoga na VRu, 92 % studenata (N = 374) istaknulo je efekt prisutnosti; 87 % (N = 354) uživalo je u interakciji i multisenzornom iskustvu; 85 % (N = 345) naglasilo je lakoću korištenja i udobnost; 82 % (N = 333) cijenilo je izostanak distraktora, a 77 % (N = 313) prijavilo je stjecanje praktičnoga iskustva. Vezano uz nedostatke, 90 % (N = 366) ih istaknulo je ovisnost o virtualnom svijetu; 81 % (N = 329) prijavilo je visoke troškove, a 75 % (N = 305) istaknulo je gubitak ljudske povezanosti. Osim toga, 72 % studenata (N = 293) zabilježilo je nedostatak fleksibilnosti i 69 % (N = 280) reklo je da je stvaranje sadržaja bilo teško (Slika 2).

Slika 2

Prema kineskim istraživačima (Zhang i sur., 2020), VR ima moć povećati društvenu prisutnost učenika, poboljšati njihovu pažnju i interes za učenje te poboljšati interakciju. Nisu uočene značajne razlike u prijenosu dobro-strukturiranoga znanja između tradicionalnoga i VR pristupa poučavanju. Nadalje, istraživači tvrde da VR može učinkovito poboljšati učenikovo iskustvo učenja. Međutim, ovaj učinak uvelike ovisi i o materijalima za učenje i o VR tehnologiji.

Prema znanstvenicima iz Hong Konga (Wong i sur., 2019), trenutačna generacija učenika pokazuje povećani interes za učenjem pomoću inovativnih tehnologija, među kojima je i VR s 360 stupnjeva. Većina učenika (88 %) istaknula je da im je ova tehnologija bila korisna u učenju jer im je omogućila osobni prostor za učenje. U ovome istraživanju, studenti su također naveli personalizaciju kao jednu od prednosti VR tehnologije.

Prema 90 % ispitanika, jedan od problema s VR tehnologijom jest što korisnici postanu ovisni o virtualnom svijetu. Ovo je otkriće zanimljivo s obzirom na to da se VR koristi u liječenju ovisnosti (Langener i sur., 2021).

Proteklih godina, obrnuto učenje privlačilo je podosta pažnje diljem svijeta (Huang i sur., 2019). Ovaj pristup pokazao se vrlo korisnim, pogotovo tijekom pandemijskoga razdoblja. Kao sustvaralački model, obrnuta učionica dobila je pozitivne povratne informacije od američkih studenata (Uskoković, 2018), od kojih je 87,5 % više voljelo ovaj pristup od tradicionalnoga poučavanja.

Na temelju rezultata ovoga istraživanja, inovativne tehnologije imaju veliku i jedinstvenu ulogu u modernom obrazovanju. One pomažu u poboljšanju akademskoga postignuća, a učenicima omogućuju fleksibilnost i personalizirano učenje.

Zaključci

Cilj ovoga istraživanja bio je utvrditi može li integracija virtualne stvarnosti i obrnute učionice povećati akademsko postignuće kineskih studenata. Prema rezultatima istraživanja, VR je puno učinkovitiji od obrnute učionice i tradicionalnoga poučavanja ($p > 0,05$). Studenti su naveli sljedeće prednosti VR učenja: efekt prisutnosti i potpuna uronjenost, interakcija i multisenzorno iskustvo, lakoća korištenja i udobnost, izostanak distraktora i praktična primjena znanja. Nedostatci su stvaranje ovisnosti o virtualnom svijetu, visoki troškovi, gubitak ljudske povezanosti, nedostatak fleksibilnosti i poteškoće u stvaranju sadržaja. Iako novi mobilni uređaji i ulaganja u tehnološki razvoj već čine VR tehnologiju dostupnijom u svakodnevnom životu, neke druge identificirane nedostatke korištenja VR tehnologije još uvijek treba prevladati.

Prednosti obrnute nastave uključuju dostupnost nastavnoga materijala, fleksibilnost, personalizaciju, učinkovitu povratnu informaciju i cjenovnu pristupačnost. Nedostaci su dugo vrijeme provedeno ispred ekrana, nedostatak samodiscipline, nedovoljna razina digitalne pismenosti među studentima, nedostatak praktičnoga rada i „neprirodno" iskustvo učenja. Pedagoški model obrnute učionice može ažurirati organizaciju aktivnosti prije, tijekom i nakon nastave te stvoriti nove obrazovne prostore upotrebom tehnologije. Ako se motivirajući mehanizmi pravilno razmotre, problem samodiscipline može se riješiti. Svaki novi krug razvoja tehnologije povećava razinu digitalne pismenosti korisnika. Posljedično, problem digitalne pismenosti postaje sve manje relevantan za nove generacije učenika. Kombinacija tradicionalnoga poučavanja i korištenja tehnologije riješit će problem nedostatnoga praktičnog rada i dugog vremena provedenoga ispred ekrana. Istodobno, integrirani pristup može se nositi s nedostatkom kretanja, slabim utjecajem na osjećaj samostalnosti i kreativno mišljenje, nisku uključenost – glavnim identificiranim problemima tradicionalnih metoda poučavanja. Stoga, ovim se istraživanjem tvrdi da su IT tehnologije važan alat za proširivanje i optimizaciju tradicionalnih metoda poučavanja i metoda učenja koje mogu poboljšati akademsko postignuće učenika.

Ovi rezultati mogu biti korisni nastavnicima koji žele integrirati inovativne tehnologije u proces učenja i odlučiti između VR i FC pristupa. Buduća istraživanja bit će usmjerena na ispitivanje utjecaja drugih inovativnih tehnologija njihovom integracijom u *online* kolegij Analiza poslovne aktivnosti turističkih poduzeća.