

English Acquisition using Multiple Intelligences Supported Project-based Learning and ICT: The Role of Cognitive Factors

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Abstract: This paper has explored critical cognitive determinants affecting students' English learning process in context of blended learning based on information and communication technologies, especially through project-based teaching; it also identifies how these identified cognitive determinants contribute to the formation of students' cognitive profiles. Moreover, it has help designed a student-centred ICT-enabled English language learning/teaching process, and give the impact of blended learning based on information and communication technologies on student learning outcomes. In this paper, qualitative method was used to answer the research questions. The data used in this study are mainly derived from interviews of teachers and students in Chinese bilingual schools. The results identified several cognitive factors influenced students' learning outcomes in a blended learning environment, such as attention, memory, metacognition, and motivation. Moreover, the study identified four distinct cognitive profiles based on learner characteristics, covering attentive learner, memory-reliant learner, metacognitive learner, and motivated learner. Attentive learners benefit from highly interactive and graphical interfaces, such as virtual reality simulations or instantaneous quizzes. Results also indicate that co-design approach involving teachers and students was pivotal in creating a student-centered learning framework. Effective integration of ICT in education requires continuous professional development, peer mentoring, and access to online resources for teachers. Effective teacher training ensures educators are well-equipped to use ICT tools to enhance teaching and learning. The results show that employing multimedia elements and providing interactive activities introduced more significant learning experiences while enhancing language retention and learning. The outcome of project-based learning activities enhanced the problem-solving and analytical skills of the students.

Keywords: ICT; Multiple Intelligences Supported Project-based Learning; Cognitive Factors; Chinese Bilingual Schools.

1. Introduction

1.1. Problem Statement

The issues of school students with low motivation and poor English foundation have been widely discussed in the context of some countries, and relevant literature has mainly been focused on psychological research, health research, and education research (DuPaul, Gormley, & Laracy, 2013; Farrell, 2013; Reale, 2017). For instance, from the health research field, attention deficit hyperactivity disorder (ADHD) is usually related to and regarded to affect children's or school students' reading capability and academic performance (Pang et al., 2021). However, it is noted that the research focusing on this topic in the context of students upgrading from junior college to university has been relatively thin. Following that, a few studies were conducted in some Chinese-speaking countries and regions.

With the passage of time, China's ICT has made great progress (Bai et al., 2016). Nevertheless, the question that has not been properly addressed or solved is whether school teachers or schools are ready to integrate ICT into teaching, both can use ICT, but also make it into a comprehensive online curriculum or an effective toolkit to stimulate student learning, especially from tertiary to university. Neglect of ICT-supported instructional design will further lead to a lack of systematic instructional design knowledge, covering instructional methods and instructional content (Mu et al., 2018). It is worth noting that the key issues to be considered below threefold, such as how to integrate teachers' technical knowledge into teaching content knowledge and understanding teachers' technical knowledge (Hu & McGrath,

2011).

2. Research Objectives

In view of above issues, this study aims to investigate an effective approach to project-based learning supported by multiple intelligences, incorporating ICT to identify determinants that influence student performance and learning outcomes. Specifically, it tends to focus on students' cognitive characteristics in the learning process and further design a student-centred approach to bilingual middle school teaching in China. To achieve this, this study aims to understand:

- (1) Key cognitive determinants affecting students' English learning process in the context of blended learning based on information and communication technologies, especially through project-based teaching?
- (2) How these identified cognitive determinants contribute to the formation of students' cognitive profiles?
- (3) How to work with students and school teachers to design a student-centred ICT-enabled English language learning/teaching process?
- (4) What is the impact of blended learning based on information and communication technologies on student learning outcomes?

3. Literature Review

3.1. Blended Teaching and ICT

In academic, ICT's application in school teaching is not a new topic. In the past two decades, ICT has been widely used in different Chinese schools (Bai et al., 2016). Nevertheless, unlike the widespread and rapid spread of ICTs in education

system, school teachers face a lack of continuing and training professional development (e.g., Wang, Liu, Zhang, 2018; Hu & McGrath, 2011). During this period, several studies have explored the readiness of university teachers to use ICT in self-directed learning and classroom instruction. For an instance, Hu and McGrath (2011) argue that the main barrier to school teachers adopting ICT in their teaching is limited ICT teaching expertise and skills. While their attitudes towards the use of ICTs are positive, in general they are limited by inadequate training and support to fully understand ICT-based teaching. These findings are consistent with studies from other nations, showing that the integration of ICT into teaching and curricula is primarily inhibited by a number of barriers, such as the lack of effective and adequate technical training (Liu, Toki & Pange, 2014). Thus, both teachers and students need appropriate training to effectively use ICT for efficient learning purposes (Yang, 2011).

According to Lam (2020), many studies have begun to view the integration of ICTs into teaching as an academic shift, suggesting that the use of ICTs will be the future of education for both out-of-class and in-classroom learning. These studies offer insights into the influence of online teaching. It is important to note that while existing research focuses mainly on higher education, its results reveal pain points of understanding blended student-centred teaching combined with ICT support. For an instance, based on a study of 13 EU universities, Misra and Chauhan (2020) report that surveyed students and universities adapted to and responded to the shift from face-to-face to online teaching with a mix of asynchronous and synchronous assessment and interaction methods. Students and teachers support that ICT, which was used during COVID-19 pandemic, has continued to be used for face-to-face teaching after the pandemic. Nevertheless, they argue that these adaptations are less effective than face-to-face teaching because of reduced interaction and passive delivery in online teaching. Maridiah (2020) also presents some undeniable changes in e-learning in Indonesia during COVID-19 pandemic. One challenge comes from technical limitations, such as the inability to use WIFI/Internet, and the other from low levels of user engagement. The results suggest that educational governments and institutions need to support and help address these issues.

3.2. Multiple Intelligence Supported Project-based Learning and ICT

Scholars have applied the theory of multiple intelligences in different aspects of education from preschool to university (Viana, Castro & Gadelha, 2019; Coffield et al., 2004). For example, the findings of Viana, Castro and Gadelha (2019) show that analysing students' cognitive and behavioural insights can help schools and teachers determine a comprehensive cognitive profile that can be used to determine school teaching strategies. Notably, this process is accompanied by identification of the roles of students and teachers and the key objectives to be obtained at project's different stages (Bas, 2008). In this area, Goodough (2001) points out that exploration of strategic and cognitive factors mapped in project-based learning processes supported by multiple intelligences can be related to the use of technology and may also consider the learner's experience with technology in school teaching. For an instance, scholars, such as Liu and Milrad (2010), have discovered that ICT-assisted graphing learning strategies improve reading skills of learners, although students with different comprehension levels may

have different effects. Wu et al. (2019) believes that ICT-based learning strategies can offer an immediate feedback mechanism to enhance learning performance of students.

Another significant advantage of using ICTs in project-based learning supported by multiple intelligences lies in specialization of each learner's needs. While traditional pedagogy tends to treat all students as the same (Twigg, 2003), combined technology can be tailored to the needs of individual students (Bai et al., 2016). For an instance, Hsu, Hwang and Chang (2013) experimentally tested the impact of specific mobile reading technologies, namely shared annotation and personal annotation, on students' reading comprehension. The results showed that the experimental groups had better academic performance than control group, but there was no difference in learning outcomes about academic performance among the two experimental groups. They argue that ICTs can enhance personalized referral-based mobile language learning, which is endorsed by their findings, that can help students improve reading comprehension and achieve learning outcomes. Similarly, Huang et al. (2016) recognized mobile learning tools in the context of situational English vocabulary learning, considered in the context of a five-step vocabulary learning strategy (FSVL). The results show that students using mobile learning tools and FSVL strategies have better performance and learning motivation than students using traditional learning tools and FSVL strategies in the context of situational English vocabulary learning.

3.3. Potential Contributions and Research Gap

Through a brief review of previous research articles, the below research gaps are found :1) few research attempts to investigate the integration of project learning and ICT under the support of multiple intelligences theory; (2) research on the application of ICT learning methods in the development of student-centred learning has mostly focused on universities and higher education, with little research on secondary teaching. Thus, this study will bridge the research gap by examining the potential of integrated ICT teaching in developing project-based learning on the basis of multiple intelligences theory. Moreover, the expected findings will offer practical reference value for Chinese secondary bilingual schools.

4. Research Design

The theoretical groundings of the proposed study will be mainly based on activity theory (Hu & McGrath, 2011), blended-learning pedagogical model (Bañados, 2006), and multiple intelligence theory (Goodnough, 2001). First, as was discussed in the literature review, the main issue during the online teaching has been teachers lacking of knowledge and training for the use of ICT, not just to target the technological issues (i.e., how to use the technologies) but to develop the course in the way fit into the online study or blended-learning environment. Thus, the blended learning and teaching model will therefore help students and teachers to develop a teaching framework in which ICTs are integrated into different stage of curriculum, curriculum design and teaching (Karkouti, 2020). Second, one of the obstacles that prevent schools from diving into "real" ICT-based teaching has been the lack of engagement and interaction among students and teachers, and amongst student. Activity theory will therefore be used as an analytical tool to explore relations in their teaching systems and identify contradictions that may lead teachers to

implement student-centred ICT pedagogy. Lastly, multiple intelligence theory has the natural-connection with the development of student-centred ICT pedagogy satisfying the individual needs of students from various aspects.

4.1. Research Methods

In this paper, qualitative method was used to answer the research questions, such as conduct interview with teachers and students. This paper adopted the identified intelligences for designing projects across different subjects. It conducted a 6-12 months program to conduct the project-based teaching supported by multiple intelligences. The cognitive factors of students were recorded before and after the program. Notably, ICT-based teaching approaches were conducted through the experiment program. During the fieldwork, interviews were expected to be conducted with the target population, including school teachers and students. The interview was a one-on-one, face-to-face, semi-structured interview. It is noted that Chinese and English were used in the interview and so all the interviews were voice-recorded to ensure the bilingual transcribe. In addition, for those questions conducted in Chinese, the questions were translated using a triangular method (Jentoft & Olsen, 2019) to ensure all the interview questions were delivered accurately. Each interview token possibly 30-40 minutes. As was discussed previously, this research addressed potential difficulties or challenges in the engagement and interaction in the learning process, and thus the researcher used many open-ended questions (e.g., asking the questions of “Why” and “How”) to achieve the interviewees’ attitudes toward and perceptions of the interactions and their implications about the interactions. This can offer an opportunity to analyse these open-ended questions using computer-based analysis tools (e.g., Nvivo) and content analysis methods, thus forming a course design for a student-centred ICT teaching model and providing some insight into potential problems in ICT teaching in China.

4.2. Data

The data used in this study (qualitative data) are mainly derived from interviews of teachers and students in Chinese bilingual schools. Given the author’s work experience, it is relatively easy to access the different bilingual schools where the author has worked and bilingual schools in close contact.

5. Findings

5.1. Cognitive Factors Influencing English Learning in ICT-Based Blended Learning

Interviews with both teachers and students highlighted attention as a critical factor in ICT-based learning environments. One teacher noted, “*students often get distracted with traditional teaching methods. However, interactive multimedia content like videos and quizzes keeps them more focused and engaged*”. A student supported this by stating, “*I can focus better when we have things like, for example, quizzes or watching videos rather than just reading texts*”. The incorporation of game-like features was a definite success. On this front, one teacher remarked, “*by incorporating points and leaderboards, students are more inclined to sit up and participate, especially during the lessons*”. This concurs with the work by Pang et al. (2021), where students’ engagements were higher in ICT, which involved dynamic and game-like, than those based on text.

Moreover, teachers and students also agreed the relativity

of memory in language learning and teaching. One teacher noted: “*mnemonic and spaced repetition of flashcard applications have significantly improved student word usage retention. Others noted that “apps for daily quizzes improve word memory recall since they are repeated*”. Story and narrative in learning are effective in helping learners memorize. One teacher agrees that “*if the students learn something from stories, they tend to remember the content better because the narrative aids in their information retrieval*”. This affirms the argument for the tools that use mnemonic aids and repetition, such as flashcard apps and spaced learning concepts, that do improve vocabulary mastery and syntactical analysis.

The interviews also highlighted that strategic management and self-regulation are essential for successfully implementing blended learning. One learner said, “*since it allows me to set learning goals and monitor my performance, the learning management system (LMS) keeps me in check*”. Another learner said, “*The on-demand assessment of the LMS Dashboard keeps me informed of my mistakes and allows me to make corrections*”. Teachers also acknowledged the importance of these tools. One teacher said about the LMS: “*It makes students track their progress and get feedback, essential to student-developing metacognitive skills*”. This corroborates our assertion that ICT tools provide progress tracking and feedback, enhancing self-regulation and strategically managing learning processes.

5.2. Formation of Cognitive Profiles

Students who fell into the attentive learner profile demonstrated robust attention control and could focus on tasks without distraction. One of the teachers said, “*students who can interact with dynamic and effective content such as virtual reality simulations experience a remarkable enhancement of the English language*”. A student remarked, “*using the VR tools to practice English helped me to practice when there were no distractions*”. Another teacher said, “*the question and answer sessions keep these students keen as they cannot be passive*”. Such students benefitted from the ICT tools used in the class that provide dynamic.

Memory-reliant learners greatly depend on their memory skills for language acquisition, which contributes to the formation of cognitive profiles. A teacher observed, “*they can learn vocabulary and terms better with apps that use spaced repetition than other techniques like conventional ones such as Duolingo*”. A student said, “*Everyday flashcards and quizzes, as well as storytelling, assist me in learning new words and grammar more effectively*”. One teacher noted, “*I liked that narrative-based learning modules facilitated recall since the stories placed information into context*”. This supports the assertion that memory-enhancing ICT tools, which include flashcards and spaced repetition systems, are essential to students who depend on their memory abilities.

Metacognitive learners can plan, monitor, and evaluate their study processes. One student said, “*Google classroom as a method of goal-setting and analysing progress helps the student stay organized and mindful of the learning process*”. Another student added, “*The reflective journals and software for tracking progress help students recognize and adapt to patterns*”. A teacher said, “*students with high metacognition skills would appreciate the tools that offer feedback and reflect their progress*”. These insights confirm that metacognitive learners thrive with ICT tools that support self-regulation and strategic management, enabling them to

enhance their language processing skills effectively.

The study identified two types of motivated learners: extrinsically and intrinsically motivated. A teacher said, *“Extrinsically motivated students find learning in Kahoot! It is easy because they are motivated by games, competition, and incentives”*. A student remarked, *“Kahoot makes learning fun and fun through games and competition”*. That is why project-based learning activities and self-mastery modules were effective for intrinsically motivated learners. Another teacher said, *“independent learners perform well in projects as they can delve deeper into preferred areas for extended periods”*. This aligns with the findings that different motivational factors influence learning outcomes, and ICT tools should cater to intrinsic and extrinsic motivations.

5.3. Co-Designing Student-Centred English Learning with ICT

Teachers highlighted the necessity of ongoing training to integrate ICT effectively. One teacher noted, *“workshops on using interactive whiteboards and online collaboration tools have significantly improved my confidence in using these technologies”*. Another teacher shared, *“peer mentoring has been invaluable in sharing best practices and troubleshooting issues. Continuous workshops help us stay updated with the latest tools and methods”*. These findings support the need for continuous professional development, as Hu and McGrath (2011) emphasized.

Both teachers and students also pointed to engagement and interactivity as critical factors. A teacher revealed, *“with Nearpod, I can create quizzes and virtual field trips during my lessons; that stirs a lot of engagement”*. A student said, *“immersive storytelling tools make learning English enjoyable”*. Another student also pointed out, *“the use of interactive multimedia content in teaching makes me pay attention and stay interested in what I am learning”*. This is in line with the study that has observed that the use of interactions.

Some of the risks mentioned by interviewees relate to the use of personalized learning technologies. A teacher said, *“through Smart Sparrow, content is delivered at the student's level, thus enhancing the learning process”*. A current student said, *“personal learning pathways help to remove difficulties and keep me engaged”*. Another student said, *“Smart Sparrow means having learning paths based on the progress made, which helps to explain complex concepts”*. These are examples of the favorable effects of differentiated learning paths on motivation and performance.

Communication aids were influential in establishing a spirit of togetherness. A student said, *“Padlet for group assignment is helpful as it allows us to share ideas and knowledge”*. Another student noted, *“Microsoft Teams makes our group work more effective through collaborative activities”*. A teacher also said, *“the use of discussion forums and group projects improve students' communication skills and peer learning”*. The above insights show how ICT supports communication and promotes cooperative learning.

Feedback and assessment during or immediately after the lesson were instrumental in learning. One student said, *“the feedback from the Edmodo quizzes is helpful because I can see my mistakes at the moment and learn from them”*. A teacher said, *“the ‘real-time’ feedback from the quizzes enables me to know the students' problems simultaneously and assist them”*. Another student said, *“getting immediate feedback makes me more determined to correct my mistakes*

and study better”. These views show that synchronous feedback systems are beneficial to student.

Technological constraints were a significant concern. A teacher mentioned, *“organizing devices and internet for all students is essential for equal chances of learning”*. A student remarked, *“loaning of devices and Wi-Fi places have helped narrow down the digital section”*. Another teacher pointed out, *“there is a need for support from schools and governments to supply the necessary facilities for all students”*. Such viewpoints underscore the need for equal ICT access to reduce the digital divide.

5.4. Impact on Learning Outcomes

Interviewees reported significant improvements in English proficiency. One student remarked, *“when it comes to taking vocabulary flashcards, Quizlet made it easier to remember the words and their meanings”*. Another added, *“the use of multimedia aids in lessons made students comprehend better the lessons on grammar and composition”*. These are just some of how these tools contributed to improved memory, retention, and use of various concepts in language learning.

Subject-specific and generalized improvements in learners' cognitive accomplishments comprised critical thinking and problem-solving. A student said, *“Google Slides and Prezi prompted us to search for information and analyses it, which enhanced our critical thinking skills”*. Another student also opined that the various project-oriented activities enabled the construction of sound arguments in the class. The teachers noticed that these tools aided the class in studying intensely, thus enhancing the development of higher-order thinking skills.

ICT tools influenced student participation levels and interest in lessons in a very positive way. A teacher stated, *“with Class Craft, the students participated more in the classroom”*. A student observed, *“It was so much like playing a game that I wanted to learn more”*. These tools incorporated game aspects into the academic process, thus helping to motivate students and encourage them to engage with the content.

Collaborative ICT tools effectively developed group work and communication skills among the students. A student noted, *“Trello for group assignments made it easy to plan tasks and work with other team members”*. Another student pointed out, *“peer review systems enabled the students and the instructors to give and receive feedback, raising the quality of work produced”*. The teachers also supported these sentiments, saying that using these tools enhanced student teamwork.

6. Discussion

6.1. Cognitive Factors Influencing Learning Outcomes

The study examined several vital cognitive factors that play a crucial role in students' learning outcomes in a blended learning environment: cognitive components such as attention, memory, metacognition, and motivation. These findings concord with previous studies that address the linkage of different cognitive variables and language skills and achievement (DuPaul et al., 2013; Farrell, 2013; Reale, 2017). Attention was significant, especially when students were confronted with definite assignments. The multimedia content utilizing ICT tools captured students' interest, as supported by research on the effects of attention on academic

performance (Pang et al., 2021). However, as Deterding et al. (2011) indicated, the negative influences can be balanced by incorporating gamification and multimedia elements to improve learning and focus on tasks. In addition, working memory plays a central role in language learning. This observation can be explained by the spaced repetition revealed by Ebbinghaus (1885) and mnemonic support in the work of Roediger and Butler (2011). These techniques can be included in software programs, and by incorporating these techniques, one can quickly master the vocabulary and grammar which are fundamental in language learning.

Moreover, the planning, controlling, and assessing learning processes played an essential role in learning and dealing effectively with ICT-supported learning environments. This view is backed by Schraw (1998) and Zimmerman (2002), who asserted that metacognition influences success in learning. Thus, letting students organize the material, Azevedo and Alevan (2013) noticed that ICT tools with progress dashboards and self-assessment features promote regulatory skills as such tools and tasks prompt self-regulation actions. They enable learners to define their learning goals and expected outcomes, evaluate the results, and modify the learning approach. Motivation was another factor that influenced the results of the learning process. Interaction with the materials was different; the students with intrinsic interest exhibited a high understanding of information presented in video clips, while students with extrinsic interest scored better in the games. This assertion echoes the self-determination theory by Deci & Ryan (2000), arguing that motivation quality affects learning. ICT enhances intrinsic and extrinsic motivation and promotes positive learning outcomes, as noted in a study by Sailer and colleagues (2017). Applying game elements and using learning contracts may lead to a higher amount of motivation in the students and an increased interest in learning.

6.2. Formation of Cognitive Profiles

The study identified four distinct cognitive profiles based on learner characteristics: Attentive Learner, Memory-Reliant Learner, Metacognitive Learner, and Motivated Learner. Attentive learners benefit from highly interactive and graphical interfaces, such as virtual reality simulations or instantaneous quizzes. These tools help present content that conveniently captures the learner's attention and fosters interaction. Using such interactive ICT tools will not go against Gardner's multiple intelligences theory because it supports learning, which learners prefer (Gardner, 1983). Memory-reliant learners require repeated practice and meaningful context apparatus, such as flashcards and storytelling applications. Tools employing spaced repetition and mnemonics, as suggested by Ebbinghaus (1885) and Roediger & Butler (2011), help students review and reconsolidate information effectively. These methods enhance memory retention and are essential when learning and mastering vocabulary and grammar. Metacognitive learners perform well in the self-quiz and goal setting/ toward tools such as progress tracking and reflective diary. They support metacognition by encouraging learners to develop strategies for planning, controlling, and monitoring their learning endeavors. Metacognition has been described as the key to success by Schraw (1998) and Zimmerman (2002), and ICT tools that include a progress dashboard and self-assessment checklists are beneficial here. Motivated learners can be intrinsically or extrinsically motivated. Intrinsically

motivated learners benefit from personalized learning paths, while extrinsically motivated learners thrive in gamified environments. According to Deci & Ryan's self-determination theory (2000), motivation quality impacts learning, while Sailer et al. (2017) established in their study that ICT tools facilitate intrinsic and extrinsic motivation enhancing learning. They are interesting educational tools that allow students to choose their preferences and desired outcomes to enhance their learning motivation.

6.3. Co-Designing Student-Centred English Learning with ICT

The co-design approach involving teachers and students was pivotal in creating a student-centered learning framework. Effective integration of ICT in education requires continuous professional development, peer mentoring, and access to online resources for teachers. Effective teacher training ensures educators are well-equipped to use ICT tools to enhance teaching and learning (Hu & McGrath, 2011). Both teachers and students emphasized the need for more interactive content. Tools like Nearpod, which offers quizzes, polls, and virtual field trips, were highly engaging. These tools provide dynamic and interactive experiences that capture students' interest and make learning more enjoyable. Technologies that facilitate individualized learning based on student performance were effective. Tools like Smart Sparrow, which adapt content to learners' abilities, were particularly beneficial. This is in line with a study conducted by Liu, Toki, and Pange (2014), which notes that the sound integration of ICT in teaching and learning depends on both technical knowledge and the teaching experience. Teaching students according to their learning level makes it easier for every student to be taught in a way that they understand best. Discussion tools like discussion forums and group assignments improved student interaction and teamwork. This supports research studies showing that interactive media can enhance learning levels (Moreno & Mayer, 2007). However, effective real-time feedback options offered valuable information about students' comprehension and deficiencies. Some of the resources identified as helpful were those that provided instantaneous feedback, such as quizzes on Edmodo. Timely feedback enhances learning and reduces the time spent correcting mistakes (Pane et al., 2017).

6.4. Impact on Learning Outcomes

Employing multimedia elements and providing interactive activities introduced more significant learning experiences while enhancing language retention and learning. The outcome of project-based learning activities enhanced the problem-solving and analytical skills of the students. This aligns with Bell (2010), who pointed out that higher-order thinking skills are promoted through project-based learning. Engaging in research and analysis, as well as presenting assignments, helped me acquire these cognitive skills. Gamification and customization of instructional methods improved students' engagement. Hamari et al. (2014) argue that gamely and personalized approaches enhance the learners' engagement and motivation. For instance, students were more engaged in the lessons and completing activities that were interesting and related to the content delivered. Another benefit of using collaborative ICT tools is that it helps students to develop their social and communication skills. Cooperative learning activities such as group projects and peer review enabled the students to learn from each other.

They, therefore, enhanced the elements of cooperation and collaboration in their course works, as Johnson and Johnson (1999) supported. These experiences helped students to acquire relevant characteristics concerning academic and career development. In general, the results received in the context of the study concur with the literature evidence concerning the impact of the pinpointed cognitive factors and ICT tools on the results and effectiveness of learning activities. Applying ICT with an adequate understanding of cognition leads to enhancing the learning process to be more effective and entertaining.

7. Conclusion, Recommendations and Limitations and Future Research Directions

7.1. Conclusion

This study has investigated the key cognitive determinants affecting students' English learning process in the context of blended learning based on information and communication technologies, especially through project-based teaching, and identify how these identified cognitive determinants contribute to the formation of students' cognitive profiles. Moreover, it has help designed a student-centred ICT-enabled English language learning/teaching process, and give the impact of blended learning based on information and communication technologies on student learning outcomes. In this paper, qualitative method was used to answer the research questions. The data used in this study are mainly derived from interviews of teachers and students in Chinese bilingual schools. The study examined several vital cognitive factors that play a crucial role in students' learning outcomes in a blended learning environment: cognitive components such as attention, memory, metacognition, and motivation. Moreover, the study identified four distinct cognitive profiles based on learner characteristics: Attentive Learner, Memory-Reliant Learner, Metacognitive Learner, and Motivated Learner. Attentive learners benefit from highly interactive and graphical interfaces, such as virtual reality simulations or instantaneous quizzes. Results of this paper indicate that the co-design approach involving teachers and students was pivotal in creating a student-centered learning framework. Effective integration of ICT in education requires continuous professional development, peer mentoring, and access to online resources for teachers. Effective teacher training ensures educators are well-equipped to use ICT tools to enhance teaching and learning. The results show that employing multimedia elements and providing interactive activities introduced more significant learning experiences while enhancing language retention and learning. The outcome of project-based learning activities enhanced the problem-solving and analytical skills of the students.

7.2. Recommendations

Based on the research findings, several vital recommendations have emerged to enhance English acquisition using ICT and multiple intelligences-supported project-based learning. Firstly, there is the need to address the issue of adequate teacher training. Teachers need knowledge about the specific ICT applications to support teaching and learning processes and non-technical skills related to multiple intelligences and project-based learning. As Murthy et al. (2017) noted, it should incorporate hands-on workshops, peer mentoring, and continuous professional development for

teachers to effectively use instructional design strategies to facilitate and implement student-centred lesson plans for all students. According to Zmuda et al. (2015), it is necessary to recommend technologies such as adaptive learning platforms or learning paths that align each student to receive personalized learning support according to their learning progress.

In addition, improving interest with the help of project-based learning should be continued. Educators, by using ICT and valuing diverse intelligences, should plan assignments that facilitate students to dive into content knowledge, use their abilities, and build up skills in the domains in which they are weak. Grouping and classwork should be organized to utilize at least all intelligence, including linguistic, logical, mathematical, spatial, and interpersonal intelligence, depending on the strengths and weaknesses (Murthy et al., 2017). The use of ICT tools should have feedback mechanisms that run throughout the learning process. These tools should provide formative feedback that shows the students their possible weak points and keeps them on track. Immediate feedback from quizzes, assignments, and engaging activities can improve achievement by providing learners with timely information regarding their performance, which can help them make changes quickly and work towards achieving mastery (Ongozi, 2018).

Furthermore, it is suggested that collaboration and co-design in the context of developing a curriculum should be promoted. Teacher & student participation in curriculum development guarantees that the material taught is relevant, exciting, and suitable. Strategies like focus group discussions, co-design workshops, and collaborative planning sessions can build a purposeful curriculum that responds to students' concerns and passions. This also allows students to be involved in decisions regarding their learning and increases ownership and motivation among students (Cook-Sather et al., 2017). The presently outlined recommendations should be integrated within educational institutions to provide a more flexible, inclusive, and efficient learning environment that utilizes ICT and multiple intelligences to improve the learning of English and other subjects.

7.3. Limitations and Future Research Directions

Although the research method in the study provides a broad approach to research questions on the use of ICT and multiple intelligences in project-based learning, several limitations have been noted in the research method used. First, interviews made the studies richer in detail, but a small sample size confines them, and the data collection method is subjective. While this survey talked about employing a triangular method that is likely to enhance the accuracy of translated data, it fails to explain how intercoder reliability will be attained or how bias will be eliminated during data Collection and analysis. Another bias that may affect the results is social desirability bias, the tendency of participants to provide socially acceptable or desired responses. However, the study's 6-12 months project implementation duration may not be flexible enough to capture the ICT-based teaching approaches' long-term impact on students and sustainability measures. This gives rise to another limitation concerning the lack of a control group in the design of survey; it becomes difficult to place observed changes in some of cognitive factors and learning outcomes squarely on the intervention without blaming it on other extraneous variables.

Future studies should include a more extensive and diverse sample of participants to ensure broader applicability of results. Additionally, employing a mixed-methods approach that combines quantitative data with qualitative insights can provide a more comprehensive understanding of the impact of ICT on learning outcomes. In addition, using self-administered anonymous questionnaires can minimize the effect of social desirability bias, making the participants more truthful. The generalization of the study's findings is impaired by the relatively short period, 6-12 months. Future studies should incorporate long-term research design that observes the accomplishment and growth of learners over time. This would offer an understanding of the enduring impact of ICT interventions and their sustainability in student learning.

References

- [1] Bai, Y., Mo, D., Zhang, L., Boswell, M., & Rozelle, S. (2016). The impact of integrating ICT with teaching: Evidence from a randomized controlled trial in rural schools in China. *Computers & Education*, 96, 1-14.
- [2] Bañados, E. (2006). A blended-learning pedagogical model for teaching and learning EFL successfully through an online interactive multimedia environment. *CALICO Journal*, 533-550.
- [3] Bas, G. (2008). Implementation of Multiple Intelligences Supported Project-Based Learning in EFL/ESL Classrooms. Online submission.
- [4] Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, 3(1), 1-20.
- [5] Coffield, F., Moseley, D., Hall, E., Ecclestone, K., Coffield, F., Moseley, D., ... & Ecclestone, K. (2004). Learning styles and pedagogy in post-16 learning: A systematic and critical review.
- [6] Cook-Sather, A., Bovill, C., & Felten, P. (2014). *Engaging students as partners in learning and teaching: A guide for faculty*. John Wiley & Sons.
- [7] Hu, G. (2008). The misleading academic discourse on Chinese-English bilingual education in China. *Review of Educational Research*, 78(2), 195-231.
- [8] Hu, Z., & McGrath, I. (2011). Innovation in higher education in China: Are teachers ready to integrate ICT in English language teaching? *Technology, pedagogy and education*, 20(1), 41-59.
- [9] Gao, X. (2012). The study of English in China as a patriotic enterprise. *World Englishes*, 31(3), 351-365.
- [10] Gao, X. A., & Wang, W. (2017). Bilingual education in the People's Republic of China. *Bilingual and Multilingual Education*. Encyclopedia of Language and Education. 3rd ed. Cham, Switzerland: Springer, 219-232.
- [11] Goodnough, K. (2001). Multiple intelligences theory: A framework for personalizing science curricula. *School Science and Mathematics*, 101(4), 180-193.
- [12] Hsu, C. K., Hwang, G. J., & Chang, C. K. (2013). A personalized recommendation-based mobile learning approach to improving the reading performance of EFL students. *Computers & Education*, 63, 327-336.
- [13] Huang, Y. N., & Hong, Z. R. (2016). The effects of a flipped English classroom intervention on students' information and communication technology and English reading comprehension. *Educational Technology Research and Development*, 64(2), 175-193.
- [14] Jentoft, N., & Olsen, T. S. (2019). Against the flow in data collection: How data triangulation combined with a 'slow ' interview technique enriches data. *Qualitative Social Work*, 18(2), 179-193.
- [15] Karkouti, I. M. (2020). Technology Integration Into Instruction in the United States: A Policy Brief on Accountability in Higher Education. In *ICT-Based Assessment, Methods, and Programs in Tertiary Education* (pp. 322-335). IGI Global.
- [16] Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, 3(1), 1-20.
- [17] Liu, C. C., & Milrad, M. (2010). Guest editorial—One-to-one learning in the mobile and ubiquitous computing age. *Journal of Educational Technology & Society*, 13(4), 1-3.
- [18] Liu, X., Toki, E. I., & Pange, J. (2014). The use of ICT in preschool education in Greece and China: A comparative study. *Procedia-Social and Behavioral Sciences*, 112, 1167-1176.
- [19] Mardiah, H. (2020). The Use of E-Learning to Teach English in the Time of the Covid-19 Pandemic. *English Teaching and Linguistics Journal*, 1(2), 45-55.
- [20] Misra, P. K., & Chauhan, P. S. (2020). Online Teaching and Learning Experiences during COVID-Lockdowns: Ten Lessons for Higher Education Institutions. *UNIVERSITY NEWS*, 58, 31.
- [21] Mu, G. M., Liang, W., Lu, L., & Huang, D. (2018). Building pedagogical content knowledge within professional learning communities: An approach to counteracting regional education inequality. *Teaching and Teacher Education*, 73, 24-34.
- [22] Murthy, S., Warriem, J. M., & Iyer, S. (2017). Technology integration for student-centered learning: A model for teacher professional development programs. *Emerging practices in scholarship of learning and teaching in a digital era*, 55-74.
- [23] Ndia, L., Solihatun, E., & Syahrial, Z. (2020). The Effect of Learning Models and Multiple Intelligences on Mathematics Achievement. *International Journal of Instruction*, 13(2), 285-302.
- [24] Ongoz, S. (2018). The use of ICT tools in e-mentoring: A case study. *Turkish Online Journal of Distance Education*, 19(4), 76-89.
- [25] Twigg, C. A. (2003). Models for online learning. *Educause review*, 38, 28-38.
- [26] Vandeyar, T. (2020). The academic turn: Social media in higher education. *Education and Information Technologies*, 1.
- [27] Viana, L., Castro, T., & Gadelha, B. (2019, October). Identifying Cognitive Profiles in Blended Learning using the Multiple Intelligences Theory. In *2019 IEEE Frontiers in Education Conference (FIE)* (pp. 1-7). IEEE.
- [28] Wang, Y., Liu, X., & Zhang, Z. (2018). An overview of e-learning in China: History, challenges and opportunities. *Research in Comparative and International Education*, 13(1), 195-210.
- [29] Wu, P., & Qin, J. (2014). Constructing a study model of pedagogical content knowledge (PCK) for business English. *Foreign Language World*, 2.
- [30] Wu, D., Li, C. C., Zhou, W. T., Tsai, C. C., & Lu, C. (2019). Relationship between ICT supporting conditions and ICT application in Chinese urban and rural basic education. *Asia Pacific education review*, 20(1), 147-157.
- [31] Yang, Y. F. (2011). Engaging students in an online situated language learning environment. *Computer Assisted Language Learning*, 24(2), 181-198.
- [32] Zmuda, A., Curtis, G., & Ullman, D. (2015). *Learning personalized: The evolution of the contemporary classroom*. John Wiley & Sons.