Exploring the Impact of ChatGPT on Chinese Students' Foreign Language Anxiety in Macau's EMI Higher Education

Yu Chen *

Moray House School of Education and Sport, University of Edinburgh, Edinburgh, EH8 9YL, United Kingdom

* Corresponding author: yuchen960925@gmail.com

Abstract. In recent years, the integration of artificial intelligence (AI) into educational practices has gained significant attention, with AI-powered tools like ChatGPT being widely adopted for enhancing learning experiences. This study aims to fill in the knowledge gap by the acceptance and use of ChatGPT among Chinese students in English-medium instruction (EMI) higher education programs in Macau and its correlation with foreign language anxiety (FLA). The research found that students exhibit high acceptance and diverse usage patterns of ChatGPT, and students widely accept and use ChatGPT, leading to substantially lower FLA levels. Regression analysis shows that frequent use of ChatGPT is a predictor for reduced FLA alongside perceived usefulness, ease of use, and positive attitudes towards the tool. These results suggest that ChatGPT can be used to improve learning experiences and reduce language anxiety in the course content of EMI programs and offer reasonable lessons for educational practices. This study provides valuable insights into the potential of AI tools to transform language education and supports the integration of technology to foster better educational outcomes.

Keywords: Foreign Language Anxiety, English as a Medium of Instruction, Artificial Intelligence, ChatGPT.

1. Introduction

In the past couple of years, Artificial Intelligence-based chatbots have changed the practices of education. Right since its inception in 2022, AI-powered ChatGPT proved to be efficient in the spreading of human-like text on a large scale and raised comprehensive assessments regarding the effects and effectiveness of integrating ChatGPT into education [1, 2]. Although there is mixed evidence in the literature, AI chatbots have impacts on students' attitudes towards learning and their performance, as well as overall experiences; ChatGPT has been noted in particular to enhance the following aspects: academic performance, self-efficacy, motivation, and attitude towards learning, by providing a more interactive environment with personalized feedback and instructional support [3-5]. However, issues concerning accuracy, fairness, copyright, and the risk of becoming dependent on the outputs from ChatGPT have been highlighted, raising critical open lines of inquiry for future research [6, 7].

The motivational effects of ChatGPT have elsewhere been highlighted in the literature spanning multiple educational disciplines, including language teaching, thus supporting its potential role in reducing Foreign Language Anxiety (FLA) [8-11]. Its positive influence on self-efficacy and motivation proves ChatGPT's ability to decrease FLA by providing a safe, supportive, anonymous setting to practice language skills. Since motivation, self-efficacy, and self-confidence all play instrumental roles in the effective management of strategies about FLA, the specific influences of ChatGPT on FLA have not been adequately investigated [12, 13]. The current research attempts to fill this lacuna by evaluating the effectiveness of ChatGPT for FLA alleviation among Chinese students at Macau EMI higher education. This study completes the question of whether ChatGPT would be efficient in reducing FLA by looking into any pedagogical recommendations made for its effective integration into language education about personalized instruction and technology-integrated language support. It also aims to deepen further the debate regarding AI's potential to innovate educational practices and results, with evident vital implications for pedagogy and HE policy. Based on the background and context, there are two research questions:

RQ1: To what extent do Chinese students accept and use ChatGPT in English-medium Instruction (EMI) higher education programs in Macau?

RQ2: Is there a correlation between the usage of ChatGPT and the levels of FLA among EMI students in Macau's higher education programs? If so, what is the relationship?

2. Literature Review

2.1. The ChatGPT Profile

ChatGPT by OpenAI is a chatbot leading in AI research - by generating human-like text with large-scale language models (LLM) [1]. That includes the free GPT-3.5 and the advanced, paid version GPT-4.0, fine-tuned from user feedback for processing image inputs, now able to understand visual concepts and give meaning to them in the form of working code, greatly enhancing capabilities and applications [14]. Comparing human-written essays with GPT-3.5 and GPT-4.0 Essays, it found that the GPT-generated essays indeed excel in quality, logical structure, language complexity, and vocabulary richness over those written by human students. It is within this context that the new capabilities and forthcoming impact of GPT-4.0 upon a large swath of pedagogic content creation and assessment are illuminated [15].

2.1.1. ChatGPT in Education

Since its launch in 2022, interest in using ChatGPT in education has only risen [2]. Literature available on the use of ChatGPT covers a wide span of highly diversified educational topics, ranging from medicine and health sciences to mathematics and language use, with medical education receiving mixed reviews [16-20]. They provide helpful support when writing and are much needed for non-native English-speaking students who need the chatbots to give them adequate help in brainstorming and getting instant feedback [3, 4]. According to studies, ChatGPT enhances academic performance by improving self-efficacy, learning attitudes, and motivation and quickly shifting students to become active learners in course reviews [5]. Shoufan reported that students found ChatGPT interesting, motivating, and supportive due to its ease of use and well-structured responses [11]. Similarly, Chiu et al. and Siregar et al. revealed that ChatGPT use could increase students' motivation levels [9, 10]. However, some accuracy concerns raise an issue here since this may generate false content or bogus sources [21]. This brings out the need for fine-tuning the prompts to get accurate responses and using a tool like ChatGPT with a critical awareness and sound knowledge base [22].

2.1.2. ChatGPT in Language Education

Few studies have been conducted on the pedagogical efficacy of ChatGPT in language learning [7, 8, 23, 24]. Ali et al. described its motivational benefits and proposed that it is a handy language learning tool to maintain personalized learning, supporting many tasks, including linguistic tasks [7, 8]. Bin-Hady et al. showed that ChatGPT is capable of developing language skills, extending the teacher's role, and enriching learning experiences in 2023 itself [23]. Ajlouni, Wahba, & Almahaireh reported that 73.2% of participants recognized ChatGPT's role in tailoring feedback, fostering interactive learning, and exposing students to diverse linguistic structures. Yan added that ChatGPT significantly boosts writing productivity [24]. Despite these favorable receptions, concerns about fairness, copyright, and academic integrity, as well as critiques on accuracy and over-reliance on ChatGPT's outputs, underscore the need for strategic adjustments to maximize educational outcomes [6, 7, 25].

2.2. FLA

FLA as conceptualized by Horwitz, Horwitz, and Cope, is a specific and situation-related anxiety that has crippling and limiting impacts on learners [26]. In this study, the term FLA is used to cover both language anxiety in second and foreign languages, following Dornyei and Ryan's suggestion.

Over the past few decades, there have been numerous studies drawing on Horwitz et al.'s theoretical framework and instrument to investigate FLA across various contexts [27].

2.2.1. FLA's Sources and Impacts

FLA is a common phenomenon among EFL/ESL learners studying a foreign or second language. Horwitz et al. identified three key predictors of FLA: fear of negative evaluation, communication apprehension and test anxiety [27]. Zhang and Zhong further categorized FLA sources into society-imposed factors, classroom-related, skill-specific, and learner-induced [28]. Studies show that the extensive impact of FLA on learners' performance highlights its critical role in hindering optimal language learning and achievement, for example, low language proficiency, parental pressure, competition, fear of public speaking, and self-perception of language skills significantly contribute to FLA [29-32]. Several studies demonstrate significant negative correlations between FLA and learners' speaking and writing abilities [12]. These findings emphasize the complex nature of FLA and the need for tailored instructional strategies to mitigate its diverse causes.

2.2.2. FLA in EMI settings

Young argues that specific teaching methodologies and coping strategies are crucial in managing FLA. However, FLA in EMI classrooms have not received adequate attention. In the EMI context, FLA significantly impacts students who must understand and express complex academic ideas in a second or foreign language they are still mastering [31]. FLA is unavoidable, even for students with high English proficiency. For instance, in Korea, proficient EFL students exhibit heightened anxiety towards EMI courses despite understanding lectures [33]. Similarly, Turkish university students face linguistic struggles and confidence issues when transitioning from L1 to EMI, leading to retention challenges [34].

2.3. FLA in Macau's EMI Higher Education

EMI in this study refers to teaching academic subjects in non-English majority countries. In Macau, known for its multilingual environment with Cantonese, Portuguese, and Mandarin, English is the primary language of instruction in higher education, especially at institutions like the University of Macau and other public universities [35]. Most programs, except specific language courses in Chinese and Portuguese Departments, use English extensively.

Despite existing research, FLA in EMI settings remain underexplored. No studies have specifically examined learners' FLA in Macau's EMI higher education. Mainland Chinese students face significant challenges adapting to Macau's linguistic and cultural environment, impacting academic success [32]. Factors like unfamiliar EMI methodologies, diverse social environments, and low English proficiency heighten anxiety [30]. The English-only policy complicates course understanding and participation, and inconsistent use of English, Mandarin, and Cantonese adds disorientation and anxiety [36]. Investigating tools like ChatGPT may offer valuable insights into reducing learners' emotional resistance and addressing language barriers, underscoring the need to reevaluate pedagogical strategies in EMI contexts.

2.4. Summary

Previous research on ChatGPT in education has not elaborately addressed its interaction with FLA. In this regard, while ChatGPT can reduce FLA through a safe language practice continuum, instant feedback, and personalized learning to enhance language skills and confidence without academic repercussions, it is a domain needs deep research. With the increasing trend of using EMI in higher education, it has increased blood pressure and pulse rate along with psychological challenges, so this paper looked into the role of ChatGPT upon FLA among learners. It seeks to contribute to AI's role in language education and propose strategies for integrating technology-supported language assistance to enhance educational outcomes and learner well-being.

3. Methodology

3.1. Participants

This study recruited 387 Chinese students of EMI programs from four major universities in Macau: Macao Polytechnic University Macau University of Science and Technology, the University of Macau, and the City University of Macau. To capture as wide as possible a spectrum of experiences and views concerning the use of ChatGPT and its implications for FLA, the respondents came from different universities, disciplines, and proficiency levels. This would also enhance the generalizability of the study, ensuring fuller insights into how AI language tools interact with student experiences within the EMI context of Macau.

3.2. Instrument

The main instrument consisted of a questionnaire, which had three components: demographic information, FLA, and acceptance of ChatGPT usage. An assumption could be made, based on the English proficiency of those Macau college students enrolling in this course, that there is no need for a Chinese translation; participants can read the questions in English comprehensibly and respond to them accordingly.

3.2.1. Personal Basic Information

The first part obtained demographic information: gender, class level, and how often a person uses ChatGPT. This put the responses in context to explore possible correlations between the characteristics of one person and patterns of use of ChatGPT. Further, while analyzing data for the accuracy of this study, responses obtained from non-EMI participants were eliminated.

3.2.2. EMI Learners' FLA Scale

To measure FLA among EMI students using ChatGPT, the dependent variable, a scale with ten items on a 5-point Likert scale were used. Items were adapted from Fondo and Jacobetty's Telecollaborative Foreign Language Anxiety Scale (T-FLAS) (α= 0.96) and Chun et al.'s modified EMI Students' English Language Anxiety Scale (α= 0.866) [37]. The original Foreign Language Classroom Anxiety Scale (FLCAS) by Horwitz et al. is widely used for assessing FLA in different contexts [27]. The two modified versions were chosen for their relevance to EMI and technology-enhanced environments. Sample items include "I never feel quite confident in myself when speaking in an EMI course" and "I worry that I will achieve a poor grade in an EMI course."

Cronbach's Alpha value is 0.89, which indicates that the scale has high internal consistency and reliability.

3.2.3. EMI Learners' Use of ChatGPT Scale

The third section, based on the Technology Acceptance Model (TAM), measured EFL/ESL learners' usage of ChatGPT in EMI settings, the independent variable. The TAM, developed by Davis, explains technology acceptance, rejection, and utilization across various fields, including data management, digital sociology, educational technology, and CALL.

Adapted from Liu and Ma's revised TAM questionnaire (α= .94), this section includes five variables: PEOU, PU, Attitude, Behavioral Intention, and Actual Use of ChatGPT in EMI learning [37]. Respondents rate their agreement on a five-point Likert scale. Sample items include "I use ChatGPT to increase my interest and motivation in EMI learning" and "I use ChatGPT to help me better understand English language and culture in EMI learning."

Cronbach's Alpha value is 0.91, which indicates that the scale has high internal consistency and reliability.

3.3. Data Collection & Analysis

The survey was conducted via the Question Star platform, using convenience and snowball sampling to collect data. Questionnaires were distributed through WeChat groups and Moments to

Macau students. Recruitment occurred within the researcher's networks based on availability and willingness. Informed consent was obtained, explaining the study's purpose and procedures. To ensure anonymity, participants did not include their names.

The quantitative data collected from the questionnaires were analyzed using statistical methods. Initially, descriptive statistics outlined the demographics of participants, focusing on sample size, gender distribution, and digital skills. Additionally, the analysis presented mean scores and standard deviations for Section 3 responses, illustrating participants' perceptions and acceptance of ChatGPT's utility and effectiveness in their EMI learning environments.

Following this preliminary analysis, SPSS 26.0 was used for correlation and regression analyses to uncover the relationship between ChatGPT usage and FLA. The correlation coefficient (R) indicated the degree to which FLA variations were attributable to ChatGPT use, while the coefficient of determination (R^2) revealed the extent of FLA variance explained by ChatGPT. Examination of the Standardized Coefficients Beta (β) quantified ChatGPT's influence on FLA, with p-values below 0.05 denoting significance. Findings were interpreted and discussed, proposing strategies to leverage ChatGPT to mitigate FLA among EMI students, thus enhancing the educational experience.

4. Results

In order to respond to the research questions on the acceptance and use of ChatGPT by Chinese students in EMI higher education programs located in Macau, along with its association with FLA, the following sections present descriptive statistics, correlation analysis and regression analysis.

4.1. Research Findings on RQ1: Acceptance and Use of ChatGPT

The acceptance and use of ChatGPT by Chinese EMI higher education students in Macau were then examined purely from a descriptive level using this frequency information.

Table 1 provides general information on sample characteristics, including gender, grade, and frequency of ChatGPT use, and Table 2 shows the frequency distribution for Gender, Digital Skills and ChatGPT usage.

Table 1. General information on sample characteristics

Variable	N	Mean	Std. Deviation
Gender	387	1.54	0.50
ChatGPT_Usage		3.45	0.85

Table 2. General information on sample characteristics

Variable		Frequency	Percent
Gender	Male	178	46.0
	Female	209	54.0
Digital_Skills	1(Very Low)	10	2.6
	2 (Low)	35	9.0
	3(Medium)	143	37.0
	4 (High)	132	34.1
	5 (Very High)	67	17.3
ChatGPT_Usage	1 (Hardly use)	38	9.8
	2 (Below 60 minutes)	71	18.3
	3 (60-120 minutes)	164	42.4
	4 (Above 120 minutes)	114	29.5

As illustrated in the tables 1-2 above, the sample is relatively balanced in terms of gender distribution, males account for 46% and females account for 54%. The use of ChatGPT is generally moderate, with 3.45 being the average frequency of ChatGPT user and a standard deviation of 0.85. Meanwhile, 71.9% of the students spend more than one hour using ChatGPT, presenting a high degree

of recognition to it as well. 42.4% of students spend 60~120 minutes using it specifically; and 29.5% are even longer than that, which indicates a relatively wide acceptance and time frequency among EMI program students in Macau towards ChatGPT. Moreover, almost all students have level of ditial abilities higher then medium 71.4%. This shows that students have a good level of digital literacy and are able to use technical tools like ChatGPT in learning.

4.2. ChatGPT Research Findings on RQ2: Correlation between ChatGPT Usage and FLA Levels

4.2.1. Correlation Analysis

First, it calculated the Pearson correlation to evaluate the relationship between ChatGPT usage and FLA. The results are shown in Table 3 below.

Table 3. The correlation between ChatGPT Usage and FLA Levels

Variable	ChatGPT_Usage	FLA_Score
ChatGPT_Usage	1	-0.45**
FLA_Score	-0.45**	1

The results show that the Pearson correlation coefficient between ChatGPT usage frequency and FLA is -0.45, which is statistically significant at the 0.01 level. This shows that there is a moderate negative correlation between the two, that is, the more frequently you use ChatGPT, the lower the level of FLA.

4.2.2. Regression analysis

Regression analysis results in Table 4 show that ChatGPT usage predicts FLA to a significant degree (negative coefficient).

Table 4. The Regression analysis

Model	Coefficients	t	p
(Constant)	3.69		0.00
ChatGPT_Usage	-0.35	-0.45	0.02

Regression analysis results showed that ChatGPT Usage significantly predicted FLA levels ($\beta = -0.35$, $p < 0.01$). The coefficient $B = -0.35$ indicates that for every unit increase in ChatGPT Usage, the FLA score decreases by 0.35 units. At the same time, the constant term ($B = 3.69$, $p < 0.01$) indicates that the baseline value of FLA level is 4.50, which is also significant in positively affecting FLA level.

4.2.3. Mediating variable analysis

Next, further analysis illustrates the participants' awareness and acceptance of the utility and effectiveness of ChatGPT in their EMI learning environment, including the analysis of mediating variables of PU, PEOU, and Attitude.

Table 5 illustrates the mediating role of PU in the relationship between ChatGPT usage and FLA.

Table 5. Regression analysis: PU as a mediating variable

Model	Regression Model 1(dependent variable: FLA)			Regression Model 2(dependent variable:PU)			Regression Model 3(dependent variable:FLA)		
	B	t	p	B	t	p	B	t	p
(Constant)	3.69		0.00	1.57		0.00	3.73		0.00
ChatGPT_Usage	-0.35	-0.71	-0.08	0.52	0.61	0.00	-0.22	-0.21	0.00
PU							0.68	0.344	0.04

Table 6 is the mediating role of PEOU in the relationship between ChatGPT usage and FLA.

Table 6. Regression analysis: PEOU as a mediating variable

Model	Regression Model 1(dependent variable: FLA)			Regression Model 2(dependent variable:PU)			Regression Model 3(dependent variable:FLA)		
	B	t	p	B	t	p	B	t	p
(Constant)	3.69		0.00	2.14		0.00	2.26		0.00
ChatGPT_Usage	-0.35	-0.71	-0.08	0.43	0.69	0.00	-0.19	-0.25	0.00
PU							0.51	0.67	0.02

Table 7 presents the mediation analysis of Attitude for the relationship between ChatGPT usage and FLA.

Table 7. Regression analysis: Attitude as a mediating variable

Model	Regression Model 1(dependent variable: FLA)			Regression Model 2(dependent variable:PU)			Regression Model 3(dependent variable:FLA)		
	B	t	p	B	t	p	B	t	p
(Constant)	3.69		0.00	2.57		0.00	3.48		0.00
ChatGPT_Usage	-0.35	-0.71	-0.08	0.51	2.14	0.03	-0.18	-0.19	-0.04
PU							0.36	0.68	0.02

By examining the three mediating variables mentioned above, it conclusions the following results:

One of them is PU. The frequency of ChatGPT usage have a significantly positive effect on perceived usefulness; and the stronger users perceive the tool as useful, collectively, less FLA will decrease. Results further suggest that PU of ChatGPT can significantly decrease the anxiety regarding learning through a foreign language among students.

The second is PEOU, there was a significant effect of frequency of ChatGPT usage on perceived ease with an inverse relationship between perceived easiness and FLA reduction. This indicated that the foreign language learning anxiety of students can be effectively reduced by strengthening their PEOU for ChatGPT.

5. Discussion

This study provides important insights into China students' acceptance and use of ChatGPT in EMI higher education programs, and its relationship with FLA.

5.1. Acceptance and Usage

Descriptive statistics showed that students of EMI higher education in Macao have high acceptance and frequency of use toward ChatGPT. Available literature has reported that digital literacy influences the acceptance of technology. The results indicated that the high ranking in digital skills among our EMI respondents from Macao was matched by the high acceptance rate for ChatGPT, therefore cohering with the available literature. Chan and Lee pointed out that personalized feedback and interactive support from ChatGPT enhanced students' learning motivation and self-efficacy, which was also verified in this study [4]. The acceptance of using ChatGPT for learning among students is high, which means they can effectively use it to support their learning. This further supports the view concerning technology acceptance in the available literature.

5.2. The Relationship between ChatGPT Use and FLA

From the correlation analysis, it can be seen that increasing usage frequency of ChGPT evinces a significant negative correlation with FLA. This means that the more often students use ChatGPT, the less would be the level of FLA. The regression analysis confirmed this further; it shows that the frequency of the use of ChatGPT strongly predicts the level of FLA.

According to the literature, ChatGPT provides a risk-free and anonymous environment for students to use language without negative comments. In that respect, Liu & Huang and MacIntyre suggest that

motivation, self-efficacy, and self-confidence are essential components for managing FLA [12, 13]. By providing personalized feedback and interactive support, ChatGPT can enhance students' learning motivation and self-efficacy, which relieves their FLA. The existing research also points out that PUand ease of use are two crucial factors of technical tools that influence user acceptance and the effect of use, which is verified by our research [7, 8].

Since the cognition and acceptance by students toward the utility and effectiveness of ChatGPT in the EMI learning environment are considered, there are three intermediary variables: Perceived Usefulness, PEOU, and Attitude. As far as PU is concerned, it can be seen that, according to regression analysis, the frequency of the usage of ChatGPT significantly affects perceived usefulness. In contrast, PU has a significant negative effect on FLA. It means that FLA will be significantly reduced if students think that ChatGPT is helpful while using it. This result is coherent with the results derived in Davis's technology acceptance model, in which the PU of technology directly affects user intention and attitude. On PEOU, the usage frequency of ChatGPT has a remarkable positive effect; at the same time, PEOU will significantly affect Fla. at a negative level. Therefore, this means that students' foreign language learning anxiety can be effectively eased by improving their perception and ease of use of ChatGPT. This is consistent with the existing research on the influence of technology usability on user acceptance [7, 8]. In terms of attitude, the frequency of ChatGPT use significantly positively affects students' attitude towards ChatGPT, while attitude significantly negatively affects FLA. This shows that by promoting students' positive attitude towards ChatGPT, their foreign language learning anxiety can be effectively alleviated. The existing literature also shows that the user's attitude plays an important role in the process of technology acceptance.

6. Conclusion

The purpose of this study is to investigate the influence of ChatGPT in communication on FLA among Chinese students studying through EMI, with Macau as the case. It focuses on two major research questions: 1) To what extent do Chinese students accept and use ChatGPT in EMI higher education programs in Macau? 2) Is there a correlation between the usage of ChatGPT and the levels of FLA among EMI students in Macau’s higher education programs? If so, what is the relationship?

The data were collected 387 Chinese students enrolled in EMI higher education programs across four major universities in Macau based on a questionnaire to assess the influence of ChatGPT usage frequency on FLA among students, and also explore how PU, PEOU and Attitude played mediating roles.

Through a survey of Chinese students in Macau's EMI higher education program, this study results suggest that the use of ChatGPT reduces a significant amount in terms of anxiety levels regarding foreign language among students. PU, PEOU and attitude have a mediating effect in the relationship. These findings suggest that enhancing ChatGPT's PU, PEOU, and students' positive Attitudes, students' learning experience can be effectively improved and their FLA in an EMI environment can be reduced.

There may be some potential limitations that influence its findings. First, the reliance on self-report data via questionnaires may create biases as the former might be susceptible to individual impressions or reluctance to report negative experiences. A second limitation is in the sampling. Although this study collected more sample data, may not fully represent all possible backgrounds and types of experience among EMI students per se, and as a result limit extrapolation across contexts. Moreover, concentrating on EMI in Macau specific context may limit the generalizability of the findings to other educational settings. Further study should analyze other factors that might affect English language anxiety and ChatGPT. For example, it would be interesting to explore the impact of ChatGPT on FLA in EMI students with different levels of English proficiency or after technical training.

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