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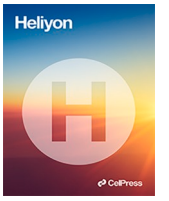

Research article

Analysing the influencing factors of on-line studying engagement of preparatory international students: A case study of the science and technology Chinese course

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ABSTRACT

With the rapid development of network technology, cross-regional on-line higher education is becoming one of the mainstream directions of distance education development. The effectiveness of on-line studying is significantly influenced by the level of learning engagement, and research on this topic can help learners by providing them with process-oriented learning support and targeted teaching interventions. Using the example of on-line Science and Technology Chinese Course for preparatory international students at four universities in China, this study collected self-reported data from 463 students using a survey method. The questionnaire was divided into two parts: the on-line studying engagement scale and the factors influencing on-line studying engagement. Descriptive statistical analysis and differential testing were conducted on the data using SPSS software, and the structural validity of the questionnaire was tested using AMOS software. With the assistance of Smart PLS, a model of the influencing factors of on-line studying engagement was constructed to explore the relationship between on-line studying engagement and its influencing factors. The study found that: The overall level of engagement in on line studying for preparatory international students is above average. In demographic factors, apart from gender, all other variables have a significant impact on on-line studying. Student-level factors will have a more significant positive impact on the degree of on-line studying engagement of preparatory international students. Among them, academic self-efficacy, basic psychological needs satisfaction, the difficulty of the on-line course, and completion of the assignment have a significant positive effect. The influence of teacher-level factors on behavioral engagement and emotional engagement is stronger than that of student-level factors. However, the emotional support of teacher-level factors, the on-line environment of environmental-level factors, and the perceived usefulness of technology of teacher-level factors have a certain negative impact on engagement in online studying. According to the research results, this paper puts forward the optimization strategies of accelerating the update frequency of Chinese learning materials, strengthening the input of on-line emotional support, and holding language learning activities with cultural characteristics. This study makes an in-depth analysis of the influencing factors of preparatory international students' on-line Chinese studying engagement, and puts forward the optimization strategies to improve the quality of on-line studying, to provide theoretical and practical reference for the development of cross-regional on-line higher education.

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Nomenclature

OCSE	on-line studying engagement
OCSE-BE	on-line studying engagement behavioral engagement
OCSE-CE	on-line studying engagement cognitive engagement
OCSE-EE	on-line studying engagement emotional engagement
SF	student-level factors
ASE	academic self-efficacy
BPNS	basic psychological needs satisfaction
PU	perceived the usefulness of technology
DOC	the difficulty of on-line course
CA	completion of the assignment
TF	teacher-level factors
TF-CS	teacher-level factors capacity support
TF-IS	teacher-level factors interaction support
TF-ES	teacher-level factors emotional support
CS	curriculum structure
EF	environmental-level factors
OE	on-line environment
FE	family environment
CFA	confirmative factor analysis

1. Introduction

With the rapid development of information and communication technology, on-line higher education has been widely applied, providing a possibility beyond time and space for teaching and breaking the temporal and spatial restrictions in traditional studying environments [1]. Since the outbreak of the coronavirus disease in 2019, there has been a continuous increase in studies examining on-line higher education. Researchers have investigated various topics, such as designing new on-line courses [2], updates in on-line studying platform technology [3], students' perspectives [4], innovative teaching methods [5], and the exploration of other factors influencing engagement in on-line studying [6]. Over the past three years, there has been a gradual increase in the documents regarding the experience of on-line studying. Research staff have started investigating the problem of student engagement and on-line studying. This involves the core of on-line studying, where student engagement is got extensive recognized as one of the crucial determining factors that affect on-line studying [7]. Research has shown that students' effective participation in on-line studying plays an important role in improving teaching effectiveness and quality [8]. Some researchers have pointed out that there is a portion of students in on-line studying who exhibit low autonomy and high dropout rates. They also experience psychological effects such as loneliness and irritability and gradually distance themselves from their peers. This presents a serious educational phenomenon [9]. However, due to the multidimensional structure of studying engagement, the concept and measurement of studying engagement in technology-mediated learning environments currently face numerous controversies. Researchers are very interested in the factors that influence students' engagement in on-line studying, which is an important breakthrough in on-line education research in recent years. Therefore, it is necessary to explore the factors that affect students' studying engagement in on-line learning. However, currently, there is limited research on the study engagement of preparatory international students in higher education. Only a small number of studies have compared domestic students with international student groups, focusing on their cultural and academic adaptation, and most of them have focused on current situation research. The study of influencing factors has focused on racial factors, lacking exploration of student-level factors and environmental-level factors for preparatory international students. On the contrary, the main characteristics and influencing factors of on-line learning should be explored from the students' perspective, through their level of engagement with online learning materials and activities. Preparatory international students are a unique cross-cultural learning group, facing challenges in cultural adaptation during their studies. Given their cross-cultural living and learning background, it is necessary to pay attention to the studying engagement and influencing factors of preparatory international students. Therefore, this study attempts to fill this gap.

To address the gaps in the existing literature and explore the factors influencing the on-line studying engagement of preparatory international students, this study conducted a literature review and, based on the theoretical foundation of on-line studying engagement, developed a questionnaire on on-line studying engagement from three dimensions. This study also constructed a model of factors influencing engagement in on-line studying and investigated the current situation of on-line studying engagement among reparatory international students. In addition, this study also uses the on-line Science and Technology Chinese Course in four universities in China as an example to explore the relationship between preparatory international students' on-line studying engagement and influencing factors. Science and Technology Chinese is an undergraduate introductory course aimed at preparatory international students. It has interdisciplinary properties and its contents are related to science, technology, and math. It adapts to the needs of the times, reflects the latest scientific research achievements, and plays a crucial role promoting the sustainable development of on-line higher education [10].

Starting from a theoretical basis, this paper is based on the Social Cognitive Theory proposed by American psychologist Bandura in the late 1970s [11]. This theory offered a theoretical framework for studying the determinants and mechanisms of human thought, emotion, and action, mainly at the individual level. Its core is the triadic reciprocal causation, which suggests that an individual's specific behavior is determined by the interaction of the individual's environment, internal cognition, and behavior [11]. These elements not only directly affect individual behavior but also have a second-order impact on individual behavior through interactions between different factors, as shown in Fig. 1 of the "triadic reciprocal model". Currently, regarding higher education, the evaluation paradigm has shifted from focusing on resource inputs to focusing on student studying inputs [12]. Therefore, studying the level of investment of students has become a new paradigm in the quality evaluation field and a hotspot topic of concern for the higher education community worldwide. Therefore, in the context of social cognitive theory, studying investment should be regarded as a component of behavior, consisting of three dimensions: behavioral investment, cognitive investment, and emotional investment. It is influenced by individual and environmental factors. Therefore, this study draws on the triadic reciprocal model to analyze the factors affecting the on-line studying investment of preparatory international students, explores how certain influencing factors promote or hinder students' on-line studying engagement, and provides practical strategies and suggestions. This study plays an important role in improving the learning quality of on-line higher education students and accelerating the development of international cultural exchange in colleges.

This research analyzes the factors that affect the input of preparatory international students' on-line studying from the perspectives of the learners themselves, teachers, and the environment, thus identifying the shortcomings of on-line higher Chinese teaching. Contributes to the improvement of on-line language studying and the sustainable development of on-line higher education. The specific research problem is as follows:

RQ1: What are the main characteristics of behavior, cognition, and emotion dimensions of preparatory international students in on-line Chinese language studying?

RQ2: Can demographic factors such as gender, length of on-line studying, and past on-line studying experiences before COVID-19 predict the level of engagement in on-line Chinese language studying among preparatory international students?

RQ3: Can SF, TF, and EF significantly influence the level of on-line studying engagement (OCSE) among preparatory study abroad students?

2. Literature review

2.1. Online studying

As a mode of distance education, on-line studying is defined as a network application program the studying main page, and correlated studying resources of the courses learned in the network to form a virtual studying space with shared traits, to achieve the effect of face-to-face studying [13]. During on-line studying, students can learn independently from anywhere and engage in interactive communication with teachers and other classmates [14]. On-line studying can make the teaching procedure more learner-centered, allowing students to participate more actively and flexibly in studying. With the instant development of technology, on-line studying has gradually become the mainstream mode of study. Meanwhile, the disadvantages of on-line studying are increasingly evident. On-line studying to a certain extent can hinder communication between teachers and students and lacks face-to-face interaction [15]. Teachers often encounter technical problems in on-line teaching that are difficult to solve promptly. The lack of systematic planning for students' independent studying can hinder normal studying progress, thus increasing the individual gaps among students [16]. Therefore, it is of utmost importance to enhance the quality of on-line studying for preparatory international students.

2.2. Preparatory international students

Preparatory students are a unique group, mainly aged between 18 and 20 years old. Before pursuing a bachelor's degree, it is necessary to attend a designated preparatory school in China for one to two years of Chinese language and basic subject knowledge studying. After passing the corresponding language proficiency exams and the National Unified Examination of core courses, students

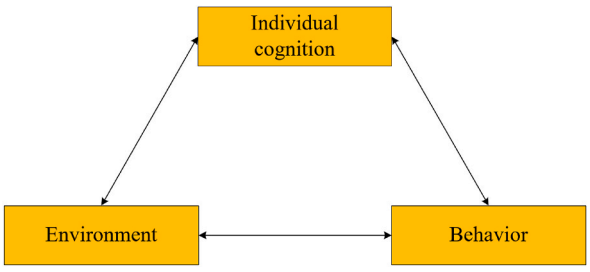

Fig. 1. Triadic reciprocal model.

can then proceed with a four-year undergraduate program in China. When studying Chinese, they face the dual pressure of cross-cultural challenges and language studying. Currently, there is a relative scarcity of research on the degree of involvement of preparatory international students in on-line studying, with studies on international students often focusing on language issues. Ramburuth's analysis found that 76 % of non-native English speakers in one department of Australian universities were identified as students in need of English language support, while only 20 % of native English speakers [17]. Ramsay and colleagues conducted a study and found that international students in their first year at college had difficulty in comprehension courses in terms of vocabulary and speed. This is attributed to the lecturers either speaking too quickly or not being fully engaged in the lecture [18]. Young conducted research on the factors that affect the academic adaptation and achievement of international students in English-speaking countries, and compared them to domestic students in the United States. It was found that the academic adaptation of international students is mainly influenced by language proficiency and culture [19].

2.3. Science and technology Chinese course

Tech Chinese is a Chinese for Specific Purpose course specifically designed for science and engineering international students in the preparatory education phase, with a focus on teaching specialized vocabulary and discourse related to technology [20]. The purpose of this course is to enable international students to overcome language barriers and smoothly transition into university study after completing their preparatory studies. It aims to facilitate the transition from language studying to professional studies for these students [21]. Science and Technology Chinese is a specialized Chinese language teaching that is built upon the foundation of basic Chinese language teaching and is categorized as the second stage of Chinese language teaching [22]. The language used in the textbooks for science and engineering preparatory students who enter universities belongs to the category of technical Chinese. Technical Chinese is a type of Chinese language used in the field of science and technology and thus is still considered a part of the Chinese language [23]. The importance of teaching the Chinese language for science and technology as a transitional course in university majors is evident in its role as a bridge and link to integrating the high school education of international students with undergraduate education in Chinese universities [24].

2.4. Studying engagement

With the development of distance education, the degree of investment in on-line studying has attracted the attention of scholars. The concept of studying engagement was first proposed by Taylor, who believed that the more time and effort people invest in their work, the greater their rewards would be. Subsequently, Skinner et al. argued that work engagement could also apply to the studying environment and thus extended the concept of work engagement to the field of education [25]. Schaufeli et al. proposed that studying engagement is a positive, fulfilling, and studying-related psychological state, which can be classified in three respects: vigor, dedication, and absorption [26]. Embarking the factors of the studying process, Martin classifies studying investment into two input dimensions: cognitive investment and behavioral investment [27]. Behavioral engagement means the students' commitment to the educational content and is reflected in their positive actions during the studying process [27]. Fredricks suggests that engagement in on-line studying refers to the active state exhibited by students during the process of on-line studying, and breaks it down into three respects: behavioral engagement, emotional engagement, and cognitive engagement [28]. Emotional involvement refers to the active and contented sensation in studying, as well as the relationship with teachers and learners [29]. Reeve and Tseng added the dimension of dynamic input based on the principles of mutual interaction [30]. Kuh developed the National Survey of Student Engagement in Higher Education, which measures student studying engagement from five respects: academic level, group collaborative learning, classroom interaction, teaching experience, and campus identity [31]. These five respects are the studying engagement standard constructed by the American NSSE survey and are extensively applied in practice.

2.5. Research on the factors affecting learning engagement

Research on factors influencing study engagement is mainly divided into student-level factors, environmental-level factors, teacher-level factors, language learning strategy, achievement emotions, and social support factors. Student-level factors mainly include two aspects: demographic characteristics and students' characteristics. In the field of demography, such as race, gender, parental occupation, family income, and socioeconomic status; student characteristics such as self-efficacy, learning fatigue, learning motivation, learning needs, and self-control. Environmental-level factors mainly include the impact of school, teachers, and peers on learning engagement. Teacher-level factors mainly include teacher-student relationships and teacher behavior. Language learning strategy mainly refers to the activities and methods adopted by learners to design, plan, organize, monitor, and provide feedback on the overall learning process in a purposeful manner based on their actual situation, to achieve the best learning effect when learning a language [32]. Achievement emotions refer to the emotion directly related to individual achievement activities or achievement outcomes [33]. Previous studies have shown that students' achievement emotion are commonly present in elementary, middle, and high school, and play an important role in the teaching and learning process in the classroom under academic background conditions [34].

From student-level factors, existing research has shown that students' level factors can have an impact on their studying engagement. For instance, Lee and Smith's research has indicated a strong correlation between the level of learning engagement and the family's economic and social status, with students from higher socioeconomic backgrounds displaying higher levels of learning engagement compared to students from average families [35]. Eileen [36] and Remolds [37] found that students' level of studying

engagement is positively correlated with their factors such as studying motivation and self-efficacy. Lee and Smith found through their research on American high school students that students at smaller schools were more engaged in their learning [38]. Finn proposed the participation identification model, in which he divided learning engagement into behavioral engagement and emotional engagement [39]. The four parts of behavioral engagement are: 1) Compliance with basic requirements, 2) Actively participating in class, 3) Actively participating in school-organized extracurricular activities, and 4) Participating in school governance.

In terms of environmental-level factors: Sociologist Tinto has demonstrated through social integration theory that the degree of academic and social integration between students and the school environment will affect students' learning engagement [40]. From the perspective of peer relationships, the acceptance of peers can influence students' satisfaction and sense of belonging to the school, as well as their academic efforts. In other words, peer relationships can have an impact on students' emotional and behavioral investment [41]. In contrast, Buhs & Ladd found that children who are rejected in elementary school are more likely to exhibit problem behavior and lower classroom engagement, as well as reduced interest in school, thus affecting their emotional investment [42]. However, peer relationships have not positive impacts on students' studying engagement. Some studies have shown that when students integrate into certain minority groups, they are influenced by some racial factors, such as the stereotype that white students are better at learning than black students. As a result, some students who join black peer groups will show negative learning commitment [43]. Lam constructed a model based on ecosystem theory, which delineates the relationships among environmental-level factors, student-level factors, studying engagement, and academic achievement. Environmental-level factors impact individuals, thereby influencing studying engagement. Learning engagement, in turn, affects academic achievement and the positive outcomes of students' studying can, impact environmental factors.

From teacher-level factors: teacher support behavior and care can have an impact on behavior engagement, promoting higher levels of behavioral investment [44] and reducing student disruptive behavior [45] and dropout rates [46]. Marks demonstrated that elementary, middle, and high school students who receive support from teachers and peers will all show higher levels of engagement in the classroom [47]. Research from ethnography has shown the importance of teacher support for student engagement in learning. When students feel they have not received positive support from their teachers or have not established a good teacher-student relationship, they are likely to drop out [48]. Furthermore, studies have shown that a decrease in the quality of the teacher-student relationship can lead to a decrease in students' interest in learning at this stage, resulting in reduced engagement in learning [49].

In terms of language learning strategies, due to different scholars' different definitions of language learning strategies, there is a great divergence in the classification of learning strategies. Generally speaking, language learning strategies can be categorized as metacognitive strategies, cognitive strategies, and social/emotional strategies [50]. Many factors influence language learning strategies, but they can mainly be divided into three aspects: learning motivation, learning style, and personal characteristics. Oxford and Erhman argue that neglecting learners' motivation in language learning strategy instruction can lead to the failure of strategy instruction [51]. Conversely, using appropriate learning strategies can enhance learners' engagement in completing language learning tasks. Research on second language acquisition at Oxford found that the choice of language learning strategies is often constrained by the learner's learning style. Griffiths's research shows that most teachers and learners believe that learners' personality factors play an important role in foreign language learning [52]. Introversion, extroversion, adventurousness, ambiguity tolerance, empathy, self-esteem, and other personality traits variables have different degrees of impact on the effectiveness of foreign language learning. Researchers have also found that certain personality traits are related to learners' strategy choices.

Previous studies have concluded that social support has an indirect correlation with students' academic engagement, despite there being no direct relation between educational funding and student engagement. Investing in education resources can improve and enhance the educational environment, as well as contribute to the implementation of educational practices [53]. Therefore, educational funding impacts student studying engagement via its influence on the teaching environment.

3. Research method

3.1. Participants and implementation procedures

This study uses a questionnaire survey method to explore the influencing factors of on-line studying engagement among preparatory international students. In this study, preparatory international students from four universities in eastern, central, and northeastern China were selected to participate in the survey, and the questionnaire was sent to preparatory international students electronically in Chinese and English through the teaching software used by the students in class. The title of the questionnaire is "A Questionnaire on On-line studying Engagement of Preparatory International Students and its Influencing Factors." " This study was reviewed and approved by the Ethics Committee of Science and Technology, Northeast Normal University, with the approval number 202302016. Before sending out the questionnaire, the research team explained the purpose of this survey, and that the survey was anonymous, there was no right or wrong answer, and promised to keep the participants' answers strictly confidential, and all the results were only used as project research. The questionnaire was distributed only after the consent of all participants was obtained. The authors sign the Human Participant Declaration Form to ensure the legitimate rights and interests of the participants. The questionnaire provides an introduction to the content of this study, interpretation of the investigated objectives, and emphasizing the adherence to the principle of confidentiality. The survey was conducted in stages from April 30 to May 30, 2022. A total of 530 questionnaires were collected, with 463 of them being deemed valid. The overall response rate of valid questionnaires was 85.6 %.

Before the formal survey, a pretest was conducted on the questionnaire. 75 questionnaires were distributed through online learning software, and 60 valid questionnaires were finally collected. These 60 questionnaires were used as small sample data for analysis. The survey questionnaire underwent tests for normal distribution, item analysis, reliability analysis, and validity analysis. After the pre-

test, the questionnaire showed good reliability and validity, and the items in each factor scale did not need to be deleted, indicating high reliability and effectiveness, therefore, it can be formally distributed.

3.2. Measurement tool

The formal survey questionnaire consists of two parts. The first part of the questionnaire collects background information on preparatory international students, including gender, age, online learning experience, and the duration of on-line learning per week. The second part of the questionnaire is the OCSE scale and the OCSE influencing factor scale. OCSE was developed based on the Remote Learning Engagement Scale by Sun et al. with localization considerations taken into account [54]. It was designed specifically for on-line studying environments and the unique characteristics of students. This scale consists of three dimensions for measuring Chinese on-line studying engagement, including on-line studying engagement scale behavioral engagement (OCSE-BE), on-line studying engagement cognitive engagement (OCSE-CE), and on-line studying engagement emotional engagement (OCSE-EE), with a total of 16 items. As shown in Table 1.

The Scale of Factors Impacting Chinese Online Learning Engagement is analyzed based on a literature review, research foundation, and consultation with professors, taking into full consideration the uniqueness of research subjects and the on-line environment. The analysis is conducted from three aspects: student-level factors (SF), teacher-level factors (TF), and environmental-level factors (EF). Among them, SF includes five dimensions: academic self-efficacy (ASE), basic psychological needs satisfaction (BPNS), the difficulty of on-line course (DOC), completion of the assignment (CA), and perceived usefulness of technology (PU). TF consists of four dimensions: teacher-level factors capacity support (TF-CS), teacher-level factors interaction support (TF-IS), teacher-factor emotional support (TF-ES), and curriculum structure (CS). The EF Scale consists of two dimensions: on-line environment (OE) and family environment (FE). In this study, the SF Scale refers to the Student Engagement Scale [55], and the Student Engagement in School Four Dimensional Scale [58], and selects and integrates appropriate questions from the NSSE scale, including a total of 16 items. The TF Scale was adapted from the research of scholars such as Eom [56], Davis [57], and La Guardia [58], while the EF Scale was adapted from the studies of Standage [59], Amino [60], and other scholars. These scales were selected and integrated based on the characteristics of preparatory international students.

All projects have adopted the Likert scale, which consists of five points, where 1 to 5 represents "strongly disagree," "disagree," "generally," "agree," and "strongly agree," respectively [61]. To meet the objectives of this study, modifications were made to the original research questions. For example, the phrase "I can overcome the difficulties encountered in on-line courses" is revised to "I believe I can face the challenging aspects of the Chinese language course". Similarly, the phrase "I can complete the tasks in class" is modified to "I am capable of excellently completing on-line Chinese language course tasks".

3.3. Reliability and validity analysis of formal questionnaire

The article uses SPSS data analysis software to test the reliability of the formally tested questionnaire. When testing the reliability of the formally tested questionnaire, the coefficient values of each subscale are all greater than 0.7, meeting the standards for reliability analysis. This indicates that the items in each subscale are highly correlated, and the formal questionnaire in this study has high reliability, allowing for formal testing. Wong suggested testing the reliability of the combination of sample data, as relying solely on the measurement method of the clone Bach alpha coefficient is relatively limited and should be further tested [62]. The author conducted a compositional analysis of the items in the measuring scale. Statistical research indicates that the composite reliability of a measuring

Table 1
Measurement scale for on-line studying engagement.

Weight scale	dimension	identification number	Description of the topic
OCSE	OCSE-BE	BE-1	I adhere to the rules of on-line courses.
		BE-2	I completed my homework on time.
		BE-3	When I am studying on-line, I can consistently maintain my focus.
		BE-4	I have made note of all the key points covered by the teacher during the class.
	OCSE-CE	CE-1	Through on-line Chinese language studying courses, I can comprehend the majority of the knowledge being presented.
		CE-2	When I read textbooks, I ask myself if I can comprehend the content.
		CE-3	If I come across a concept that I am unfamiliar with while studying on-line, I will search for resources to clarify and understand it.
		CE-4	If I do not understand what I am studying on-line, I will go back and watch videos, and then study it again.
	OCSE-EE	EE-1	I enjoy on-line studying as it brings about a delightful studying experience for me.
		EE-2	After completing the tasks assigned by the teacher for the day, I will proceed to attend to other responsibilities.
		EE-3	I am very delighted to attend on-line classes.
		EE-4	I find on-line courses to be boring.

Note: OCSE = on-line studying engagement, OCSE-BE = on-line studying engagement behavioral engagement, OCSE-CE = on-line studying engagement cognitive engagement, OCSE-EE = on-line studying engagement emotional engagement.

scale should be above 0.8 [63]. According to Table 2, the composite reliability of the measuring scale meets this requirement, indicating that the overall reliability of the questionnaire is good. As shown in Table 2.

The article uses the SPSS data analysis software to conduct skewness and kurtosis tests on the items of the formal survey questionnaire. The article uses the SPSS data analysis software to conduct skewness and kurtosis tests on the items of the formal survey questionnaire. The skewness and kurtosis values of each dimensional item ranged from −0.502 to +1.446, within the reference range of −2 to +2. This indicates that the sample data meets the requirements of normal distribution and does not deviate significantly from it [64,65], and can be used for formal testing. Using AMOS to conduct confirmatory factor analysis to test the structural validity of the questionnaire. In this study, the validity analysis refers to the survey questionnaire to reflect the current state of on-line studying engagement among preparatory international students. Using "content validity" and "construct validity" to test the scale. For the second part of the questionnaire, the " OCSE influencing factor scale," because the structure of the scale is dimensional, in the process of analyzing the questionnaire's validity, not all the questions in the questionnaire were uniformly included in the confirmatory factor analysis but were tested dimensionally, that is, the questions in each dimension were verified separately by confirmatory factor analysis.

Content validity refers to whether the content of the measurement items is appropriate and representative. Therefore, to ensure that the questionnaire for this study has good content validity, first, the items of each scale are adapted from a foreign on-line studying engagement scale with high reliability based on the specificity of preparatory international students and relevant theoretical research; second, to ensure the effectiveness of the questionnaire, after formulating the questionnaire items, multiple communications with the supervising teacher, discussions with classmates in the same major, and other teachers with online teaching experience were conducted to optimize the questionnaire based on the discussion results to ensure the professionalism and applicability of the questionnaire. In conclusion, the survey questionnaire used in this study demonstrates good content validity.

In this study, the construct validity of the questionnaire was analyzed by measuring the questionnaire in dimensions and examining the factor coefficients of each item within each dimension. Approximate root mean square error (RMSEA), comparative fit index (CFI), and non-normed fit index (NNFI) are used to test the goodness of fit of CFA.

According to Table 3, it can be seen that by fitting the model of each dimension of the questionnaire's scale, the indicator data are all above 0.8, indicating good validity of the questionnaire.

4. Results

4.1. Descriptive analysis of on-line studying engagement

As shown in Table 4, out of the 463 preparatory international students surveyed, females accounted for 57.88 % (n = 268), while males represented 42.12 % (n = 195). Since the age range is between 18 and 20 years old, no separate analysis of age is necessary. The author also surveyed whether the research subjects had previous experience with on-line studying. 86.61 % of the students (n = 401) reported having some experience with on-line studying before COVID-19, while 13.39 % (n = 62) had no previous experience with on-line studying. In addition, an investigation was conducted on the overall duration of weekly on-line Chinese language studying. Among all participants, 17.78 % (n = 80) reported spending a total of 1–5 h per week on on-line studying, 54 % (n = 250) spent a total of 6–10 h per week, 20.25 % (n = 95) spent a total of 11–15 h per week, and only 8.21 % (n = 38) reported spending over 16 h weekly on on-

Table 2
Reliability analysis of the questionnaire.

Weight scale	dimension	Each dimension α	Each component table α	Combination Confidence
	OCSE-BE	0.903	0.831	0.914
OCSE	OCSE-CE	0.902		
	OCSE-EE	0.914		
	ASE	0.196	0.894	0.929
SF	BPNS	0.905		
	PU	0.914		
	DOC	0.926		
	CA	0.942		
	TF-ES	0.901	0.854	0.910
TF	TF-CS	0.914		
	TF-IS	0.881		
	CS	0.902		
EF	OE	0.819	0.746	0.851
	FE	0.966		

Note: OCSE = on-line studying engagement, OCSE-BE = on-line studying engagement behavioral engagement, OCSE-CE = on-line studying engagement cognitive engagement, OCSE-EE = on-line studying engagement emotional engagement, SF = student-level factors, ASE = academic self-efficacy, BPNS = basic psychological needs satisfaction, PU = perceived the usefulness of technology, DOC = the difficulty of on-line course, CA = completion of the assignment, TF = teacher-level factors, TF-CS = teacher-level factors capacity support, TF-IS = teacher-level factors interaction support, TF-ES = teacher-level factors emotional support, CS = curriculum structure, EF = environmental-level factors, OE = on-line environment, FE = family environment.

Table 3
Presents the fitting results of the on-line studying engagement model.

metric	x^2	df	x^2/df	NFI	NNFI	CFI	IF	RMR	RMSEA
consequence	216.128	51	4.238	0.844	0.839	0.875	0.877	0.068	0.072

Confirmatory factor analysis was used to test the structural validity of the scale. The test results show that the goodness of fit index of the on-line studying engagement scale is better, among which (x2 = 216.128, d/f = 51, RMSEA = 0.068, CFI = 0.875, NNFI = 0.839).

Table 4
Descriptive statistical analysis of individual basic information.

Title of Basic Information	choice	frequency•	Percentage (%)•	Cumulative percentage (%)•
Gender	Male	195	42.12	42.12
	female	268	57.88	100.00
Do you have any experience with on-line studying before taking this course?	Yes	401	86.61	86.61
	No	62	13.39	100.00
What is the duration of your weekly on-line Chinese language study?	1–5 h	80	17.28	17.28
	6–10 h	250	54.00	71.27
	11–15 h	95	20.52	91.79
	16 h	38	8.21	100.00
Total		463	100.0	

line studying. This also suggests to some extent that the majority of participants have sufficient time to ensure a total studying duration of 6 or more hours per week.

4.2. Correlation analysis

Table 5 is the correlation matrix between the influencing factors and dimensions of OCSE. From Tables 5 and it can be seen that SF is significantly positively correlated with the level of OCSE. TF is positively correlated with the level of OCSE. EF is positively correlated with the level of OCSE. Specifically, in terms of three dimensions, SF is significantly positively correlated with OCSE-CE, OCSE-BE, and OCSE-EE. TF is positively correlated with OCSE-CE. EF is positively correlated with OCSE-EE.

4.3. Multivariate regression analysis

Using the method of multiple regression linear analysis, the study aims to explore the predictive capacity of several sub-variables related to student-level factors, teacher-level factors, and environmental-level factors on the degree of on-line studying engagement for preparatory international students. The determination coefficient R^2 represents the predictive accuracy of the model. The explanatory power of the model increases with the increase of the R^2 value. Three regression models were established to compare the predictive capacity of three groups of variables for OCSE. Model 1 simultaneously tested the predictive capacity of demographic factors and student-level factors. Model 2 testing assessed the predictive capacity of teacher-level factors. Model 3 examined the predictive capacity of environmental-level factors.

4.3.1. Multiple regression analysis of Student level factors and on-line studying engagement

As shown in Table 6, in Model 1, ASE, BPNS, DOC, and CA were used as independent variables, and OCSE was used as the dependent variable for multiple regression analysis. $R^2 = 0.645$, indicates that ASE, BPNS, DOC, and CA can explain 64.5 % of the variance in on-line studying engagement. The model passes the test and validated by the $F = 166.039$ ($p < 0.05$), which shows that the model is effective. The regression coefficient value of $B = 0.161$ ($t = 3.933$, $p < 0.01$) for ASE in the regression model, and the value for BPNS is $B = 0.334$ ($t = 6.910$, $p < 0.01$). Additionally, the value for PU is $B = -0.013$ ($t = -0.418$, $p = 0.676 > 0.05$), the value for OCD is $B = 0.203$ ($t = 5.357$, $p < 0.01$), and the value for CA is $B = 0.145$ ($t = 3.863$, $p < 0.01$). It can be seen that ASE, BPNS, OCD, and CA significantly influence the studying engagement of preparatory international students, whereas PU does not. In addition, according to the standardized coefficient values, it can be concluded that the ASE of preparatory international students has a higher influence on their degree of studying engagement than the impact of other variables. Under the joint influence of five factors, ASE, BPNS, OCD, and

Table 5
Correlation analysis.

	OCSE	OCSE-SE	OCSE-CE	OCSE-EE
SF	0.781**	0.666**	0.708**	0.697**
TF	0.745**	0.631**	0.699**	0.597**
EF	0.538**	0.386**	0.436**	0.355**

*$p < 0.05$ ** $p < 0.01$.
Note: SF = student-level factors, TF = teacher-level factors, EF = environmental-level factors.

Table 6
Multiple regression analysis results.

Independent Variables	Model 1	Dependent variable: OCSE Model 2	B	Model 3
	B SE B β	B SE B β		SE B β
Constant	0.461 0.104	1.187 0.104	2.241	0.086
Gender	0.025 0.234 0.020	−0.008 -0.045 0.620	−0.042	0.039–0.069
Learning Experiences	0.026 0.176 0.079	0.023 0.168 0.093	−0.085	−0.096 0.096
Study Duration.	−0.03 -0.053 0.593	−0.134 -0.014 0.027	−0.032	−0.055 0.058
ASE	0.161 0.188 0.041			
BPNS	0.334 0.048 0.359			
PU	−0.013 0.031–0.017			
DOC	0.203 0.038 0.231			
CA	0.145 0.038 0.159			
TF-ES		0.068 0.038 0.100		
TF-CS		0.117 0,046 0.150		
TF-IS		0.258 0.036 0.337		
CS		0.201 0.026 0.297		
OE			0.021	0.029 0.040
FE			0.350	0.038 0.510
F	166.039	126.39		94.288
R2	0.645	0.525		0.291
△R2	0.641	0,521		0.288

Note: OCSE = on-line studying engagement, OCSE-BE = on-line studying engagement behavioral engagement, OCSE-CE = on-line studying engagement cognitive engagement, OCSE-EE = on-line studying engagement emotional engagement, SF = student-level factors, ASE = academic self-efficacy, BPNS = basic psychological needs satisfaction, PU = perceived the usefulness of technology, DOC = the difficulty of on-line course, CA = completion of the assignment, TF = teacher-level factors, TF-CS = teacher-level factors capacity support, TF-IS = teacher-level factors interaction support, TF-ES = teacher-level factors emotional support, CS = curriculum structure, EF = environmental-level factors, OE = on-line environment, FE = family environment.

CA can significantly predict the on-line studying engagement of preparatory international students and have a significant positive effect, while PU cannot. Moreover, the impact of ASE and BPNS on engagement in on-line studying is greater than the influence of DOC and CA. In terms of the influence on the three dimensions of studying engagement cognitive, behavioral, and emotional engagement, ASE, BPNS, DOC, and CA all have significant positive effects on these three dimensions of engagement. For behavioral and emotional engagement, ASE and BPNS have a significant positive influence on both. About cognitive engagement, the DOC and CA can have a significant impact on it.

4.3.2. Multiple regression analysis of teacher level factors and on-line studying engagement

As shown in Tables 6 and in Model 2, variables such as TF-ES, TF-CS, TF-IS, and CS were treated as independent variables, while OCSE was treated as the dependent variable in a multiple regression analysis. The entire effect was noticeable. $F = 126.391$, $p < 0.05$, showing that the model is valid. Analysis of individual variables showed that the R^2 for TF-CS was 0.525, meaning that the variability of 52.5 % in Chinese on-line studying engagement could be explained by ability support. Moreover, the standardized coefficient B for TF-IS was found to be 0.258 ($t = 7.195$, $p < 0.01$), showing that TF-IS markedly predicts the academic engagement of preparatory international students. The standardized coefficient B of TF-CS is 0.117 ($t = 2.524$, $p = 0.012 < 0.05$), and the standardized coefficient B of CS is 0.201 ($t = 7.767$, $p < 0.01$). This indicates that TF-CS and CS can markedly forecast the studying engagement of preparatory international students. The standardized coefficient B for TF-ES was 0.068 ($t = 1.789$, $p = 0.074 > 0.05$), indicating that TF-ES could not significantly predict the academic engagement of preparatory international students. Under the combined influence of four variables including TF-ES, TF-CS, TF-IS, and CS, TF-CS, TF-IS, and CS can have a significant positive impact on the studying engagement of preparatory international students. However, TF-ES does not have a significant impact on it. Under the joint influence of four factors, TF-CS, TF-IS, and CS they can significantly predict the on-line studying engagement of preparatory international students and have a significant positive impact. TF-IS, on the other hand, does not have a significant predictive effect on emotional engagement. About the three dimensions of studying engagement, namely cognitive and behavioral engagement, the impact of TF-CS, TF-IS, and CS exert significant positive influences on both behavioral and cognitive engagement. However, they fail to have significant effects on emotional engagement among preparatory international students. It has been observed that active interaction between teachers and students in the classroom leads to higher levels of support from teachers, resulting in greater behavioral and cognitive involvement of international students. However, TF-ES does not have a significant predictive effect on emotional involvement.

4.3.3. Multiple regression analysis of environment level factors and on-line studying engagement

As shown in Tables 6 and in Model 3, the OE and FE are included as independent variables, and the degree of OCSE is the dependent variable for multiple regression analysis. The entire effect was noticeable. $F = 94.288$ and $P < 0.05$ indicate that the model is valid. Analysis of individual variables $R^2 = 0.291$, indicates that the OCSE can be explained by 29.1 % of the variation in the OE and HE. The regression coefficient value for the FE is 0.350 ($t = 9.293$, $p < 0.01$), this shows that the FE will have a markedly active influence on studying engagement. The regression coefficient value for the OE is 0.021 ($t = 0.737$, $p = 0.462 > 0.05$), indicating that the impact of

the OE on the degree of investment of preparatory international students in on-line studying is not significant. Under the joint influence of two factors, FE and OE, FE can significantly predict the academic engagement of preparatory international students and exert a positive impact, while OE does not exhibit the same predictive or positive effects. Concerning the three dimensions of studying engagement, namely cognitive, behavioral, and emotional engagement, the influence of the OE is found to have a significant positive influence on both behavioral and cognitive engagement. However, it has no significant influence on emotional engagement. And the FE can have a markedly active influence on all three dimensions of investment.

4.4. Construction of a model for factors influencing preparatory international students

The analysis of influencing factors in this study combines three factors: SF, TF, and EF. Based on the previous analysis, the influencing factors model has been adjusted accordingly. Firstly, in terms of OCSE-EE, the influence of TF is the greatest, followed by SF. Regarding OCSE-BE and OCSE-CE, SF has the greatest impact followed by TF. Regarding EF, the impact on the three dimensions is not significant. Based on this, this study constructs a model of influencing factors for preparatory international students. The ASE in the SF is significantly positively related to the level of engagement in on-line studying. It also exerts significant positive effects on OCSE-BE and OCSE-CE, while indirectly impacting OCSE-EE. As shown in Fig. 2.

According to the model and the analysis mentioned above, it can be concluded that SF is the most important influencing factor, followed by TF, and finally EF. The several sub-dimensions within SF are subject to alteration through the influence of TF and EF, subsequently impacting the level of engagement in on-line Chinese language studying. The influencing factors are positively correlated with the three input dimensions. Interfering with one of the influencing factors will affect the relationship among these three dimensions. Therefore, both SF and TF have a significant influence on the engagement of preparatory international students in on-line Chinese language studying. The SF is influenced by TF, resulting in differences in participants' level of engagement in on-line Chinese language studying.

5. Discussion

5.1. RQ1: characteristics of Chinese on-line studying engagement among preparatory international students

This study explores the on-line Chinese language studying the experience of preparatory international students during the COVID-19 pandemic. The first question of the study analyzed the features of preparatory international participants' on-line Chinese language studying engagement in terms of OCSE-CE, OCSE-BE, and OCSE-EE. Descriptive statistical results indicate that preparatory international students demonstrate a relatively high level of engagement in on-line Chinese language studying, which falls within the upper margin. Furthermore, their overall studying attitudes are proactive and positive. The research results reflect the learners' views on on-line studying: where course content is gradually introduced from basic to advanced levels, and the on-line studying platform provides a wealth of studying materials. Moreover, learners actively interact with the instructor during on-line studying [44,45]. Learners perceive teachers as caring about them, understanding the difficulties of on-line studying, and providing academic support. About the three dimensions of study engagement, both OCSE-BE and OCSE-CE levels are relatively high. This indicates that preparatory international students show a high level of external behavioral engagement in their studying process, as well as a high level of engagement in the challenges of studying Chinese and the adoption and implementation of studying strategies [51,52]. The level of OCSE-EE is relatively low, reflecting the lack of identification of preparatory international students with the values of the school. During on-line studying, students can only understand the campus and teachers through the Internet, making it difficult for teachers to provide emotional support to students, resulting in a lower level of emotional involvement from students [48,49].

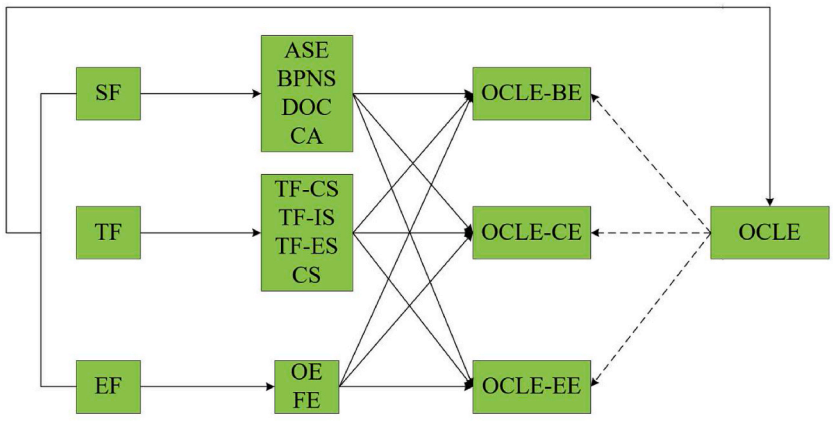

Fig. 2. Construction of influencing factors model.

5.2. RQ2: Population Statistics predict the level of investment in on-line Chinese language studying

The second research question investigated the demographic characteristics of preparatory international students, such as gender, previous experience with on-line studying before COVID-19, and the weekly duration of on-line Chinese language study, to determine if these factors significantly predicted their level of academic engagement. This result is different from the research findings on the weekly on-line studying duration but is consistent with the research findings on gender and on-line studying experience [66].

The research results indicate that there are varying degrees of differences in levels of engagement in on-line studying as reflected by the duration of the study. Specifically, gender does not cause a significant difference in the COLE of preparatory international students, which is consistent with previous research findings [67]. In terms of study duration, participants with different study durations will exhibit differences in their level of engagement. There will not be significant differences in behavioral and OCSE-CE, but significant differences will emerge in the dimension of affective engagement.

5.3. RQ3: significant effects of student-level factors, teacher-level factors, and environmental-level factors on the engagement of preparatory international students in on-line Chinese language studying

The third research question explores the factors influencing the level of engagement in on-line Chinese language studying among preparatory international students. Relevant analysis shows that SF are significantly positively correlated with the level of engagement in on-line studying, and they are positively correlated with OCSE-BE, OCSE-CE, and OCSE-EE. Among them, BPNS are the key factors that influence the level of engagement in on-line studying, and they have a significant influence effect. Meeting the basic psychological needs of students can enhance their focus on on-line studying to a certain extent [35,36]. Secondly, ASE, CA, and DOC will also affect the level of investment in on-line studying. DOC significantly affects the level of engagement of preparatory international students in their on-line Chinese language studying. The Chinese course is too difficult, and students may develop an aversion to difficulty, resulting in lower completion rates when faced with assigned tasks from their teachers [17]. Teachers should timely adjust their teaching strategies to enhance students' self-efficacy and assist them in overcoming challenges encountered during the studying process, thus encouraging students to actively engage in on-line studying. However, there is no significant correlation between the PU and the level of engagement in on-line Chinese language studying. This indicates that students are highly adaptable to applying on-line education platforms and have strong perceptions of studying support systems [51]. Furthermore, regression analysis indicates that ASE, BPNS, DOC, and CA positively influence the degree of involvement in on-line studying.

Relevant analysis shows that TF is positively correlated with three dimensions: OCSE-BE, OCSE-CE, and OCSE-EE. In the TF, TF-ES, TF-CS, TF-AS, and CS are significantly positively correlated with OCSE. Among these factors, TF-CS has a significant predictive role in OCSE. TF-CS can promote students' motivation for on-line studying. Teachers provide support at the teaching level, making students feel the teacher's concern for them and increasing students' intrinsic studying goals. To some extent, this will promote students' engagement in on-line studying, which is consistent with previous research [44]. Meanwhile, in the on-line studying process, teachers can alleviate students' negative emotions related to academic performance and increase their confidence by providing emotional support [46]. Regression analysis shows that TF-CS, TF-IS, and CS have significant positive effects, whereas TF-ES cannot have remarkable influence. When students are engaged in on-line studying, it is evident that the teacher's appropriate feedback can influence their level of engagement. This also indicates that students appreciate timely guidance from teachers during the studying process.

EF can be divided into two categories: OE and FE. OE can be further subcategorized into two dimensions based on network status and satisfaction with network tools. The results of the relevant analysis indicate that there is a marked correlation between EF and the level of on-line Chinese language studying engagement among preparatory international students. Additionally, these factors exhibit positive correlations with the OCSE-BE, OCSE-CE, and affective dimensions of engagement. However, the average values of the OCSE-BE OCSE-CE, and OCSE-EE involvement are all at a moderate level, indicating that preparatory international students have a poor experience of attending classes in an on-line environment. The network environment is the foundation for on-line studying, and the quality of the network environment directly affects the status of students' on-line studying. Insufficient internet infrastructure and poor network conditions can negatively impact students' classroom experience and further limit teacher-student interaction in on-line classes, resulting in students' emotional anxiety and hindered studying progress [40]. Preparatory international students often come from complex family environments with many members. The environment around their homes can also be noisy and lacking in a quiet study space, leading to difficulties in concentrating during on-line Chinese language classes. As a result, this can negatively impact their overall engagement in the studying process. Multiple regression analysis indicates that the FE has a markedly active impact on the OCSE-BE of preparatory international students. However, the OE has a weak influence on OCSE-CE and OCSE-EE, and cannot significantly impact these factors.

6. Conclusions

This study investigated the characteristics and influencing factors of on-line Chinese Studying engagement of preparatory international students in online higher education. Data was obtained from a survey conducted in April 2022, which involved 463 international students enrolled in on-line Chinese language courses. The relevant analysis demonstrates that in terms of OCSE-BE and OCSE-EE, the influence of TF is remarkable. In OCSE-CE, SF not only directly influences the degree of engagement in on-line studying, but can also affect studying motivation through TF, thereby significantly influencing the degree of engagement in on-line studying. The results of regression analysis indicate that SF is markedly actively correlated with the overall on-line studying investment of

preparatory international students, followed by TF. Among the TF, the sub-variable of support from teachers has a more markedly influence. Although EF accounts for a relatively small proportion, they also affect the on-line studying investment of preparatory international students.

According to the research findings, the following recommendations are put forward. Firstly, to support the studying of the Chinese language by students, the school needs to optimize the level of investment in on-line tools support and ensure that the Chinese language resources within the system are constantly updated, providing corresponding Chinese language materials for learners at each stage of proficiency. Furthermore, there is a need to strengthen investment in on-line emotional support to provide students with studying tasks that are both challenging and within their ability. Attention should also be paid to any difficulties students encounter when completing their assignments so that timely support can be offered. Thirdly, organizing language-studying activities with cultural characteristics can be supported by social media platforms to promote communication and interaction among peers. Meanwhile, teachers should build a good teacher-student connection with students, create a pleasant studying atmosphere during on-line studying, and ensure that students participate actively in classroom activities and language acquisition.

This study has the following limitations. Firstly, the number of samples in this paper is relatively less, hence the reliability of the research data and findings, as well as the generalizability of study conclusions, may be restricted. Future research can expand the selection range of research subjects and study the degree of investment in on-line studying by integrating various higher on-line education or different on-line studying platforms. Secondly, in exploring the factors that affect the level of OCSE for preparatory international students, the selection of these factors is based on the review of existing research and related theories. Therefore, there is no innovation or breakthrough in the choice of dimensions of the influencing factors, and due to the limitations of the research hypotheses, the interpretive power of the research results is insufficient. The factors studied are not comprehensive enough. In future research, qualitative and quantitative research methods can be added through interviews to improve accuracy, explore macro-level issues reflected in the data, and conduct in-depth and dynamic analysis of the factors influencing on-line studying engagement, rather than just limiting the analysis to surface-level data results. This can further enrich the study of factors in the on-line studying engagement of preparatory international students. Thirdly, in terms of the selection and usage of research data, this study mainly adopts the questionnaire survey method, and the data are all derived from the self-perception of the research subjects' studying experience during on-line studying processes, with the possibility of errors still present. Future research can conduct analyses on the studying behavior data recorded by on-line studying platforms, expand data sources, and thus gain a multi-perspective understanding of the actual situations. Fourthly, there are relatively few issues with the environmental factor scale, which is inadequate to cover the elements to be measured and cannot reflect participants' real studying environment. Future research could focus more on the factors that affect this aspect. Fifth, due to the potential interaction effects between student factors, TF, and EF, future research should explore the relationships between predictive influencing factors to deepen the simulated research on the level of engagement in on-line Chinese language studying for preparatory international students through the use of structural equation modeling and path analysis.

Ethics statement

This study was reviewed and approved by the Ethics Committee of Science and Technology, Northeast Normal University, with the approval number 202302016.

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Data availability statement

Data will be made available on request. Authors are willing to share any data that are used in this work. All the data that support the findings of the study are provided in the Supporting Data file.

CRediT authorship contribution statement

Baoqian Yang: Writing – review & editing, Writing – original draft, Resources, Data curation, Conceptualization. **Lifang Tang:** Funding acquisition, Formal analysis. **Ming Lv:** Visualization, Project administration, Methodology. **Jia Cong:** Software. **Ziqiao Wang:** Data curation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Lifang Tang reports financial support was provided by National Office for Education Sciences Planning, Ministry of Education, PRC. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e31761.

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