Journal of Organizational and End User Computing
Volume 36 • Issue 1

Enhancing Learners' Performance in Contest Through Knowledge Mapping Algorithm:

The Roles of Artificial Intelligence and Blockchain in Scoring and Data Integrity

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ABSTRACT

The fairness of vocational contest scoring is key to generating reliable competency assessments. This study examined the performance impact of the motivation of English-as-a-foreign-language learners in contests with vocabulary knowledge antecedents in the contexts of artificial intelligence (AI) and blockchain (BC). The sample comprised 185 participants of an oral English contest at higher vocational institution in China. AI-powered scoring of learners' contest performance and a survey were used to collect data. The findings revealed that learners' intrinsic drive was the main positive factor, outweighing their extrinsic motivation, and that AI and BC increased the trustworthiness and integrity of contest records, thus providing new opportunities to build learner trust and form psychological incentives. This study enriches foreign language motivation theory in the context of contest research and highlights the importance of using AI and BC to enhance the scoring accuracy and credibility of contests as authoritative evaluation instruments in vocational education.

KEYWORDS

Artificial Intelligence, Blockchain, Contest Research, End User, Learner Performance, Learning Motivation, Vocational Education

INTRODUCTION

Higher vocational English-as-a-foreign-language (EFL) learners face multiple challenges in learning English, which may arise from internal and external factors. Internal factors include psychological aspects such as motivation, levels of anxiety, and emotions (Dornyei, 2005, 2009). External factors include the environment, especially the technological support it provides (Jiang & Dai, 2018). Such support may come in the forms of artificial intelligence (AI) and blockchain (BC) (Mozumder et al.,

DOI: 10.4018/JOEUC.336277 *Corresponding Author

2023). Evidence shows that data on the psychological and learning situations of learners have not been deeply explored nor accurately obtained to enable teachers to make flexible adjustments during the teaching and learning process, and a heavy daily teaching load have made teachers untrustworthy graders (Elbow, 1997). Learners with a poor command of English (Liu, 2020) often lack motivation in language learning; consequently, their level of knowledge hardly improves over time (Yuan, 2007). To overcome this predicament, oral English contests are important as they help measure the practical competence of higher vocational EFL learners, which serves as basis for further enhancing English education reform to meet the demands of the future job market (Wang, 2021).

Though China is beginning to use AI and BC to facilitate learning the English language and attaches importance to the construction of vocational skill contests and competency evaluations, existing literature on spoken English contest research in the core Chinese journal databases (Engineering Index, core journals of Peking University, Science Citation Index, Chinese Science Citation Database, and Chinese Social Sciences Citation Index) rarely investigates contest performances in oral English. Articles (dated 2013–2022) mainly discussed the oral English learning of EFL learners' participation in oral English contests and provide suggestions for promoting reforms. In summary, contest research in China has mainly focused on experience descriptions and theoretical analyses. Relatively few studies have focused on the relationship between learners' psychological status and contest results; few have used educational and psychological theories integrating AI applications (Dogan et al., 2023), and no study has focused on the prospects of BC related to contest scoring and learners' performance; all these reflect the scarcity value of the present study.

As an authoritative evaluation tool in vocational education, performance scoring in contests reflects the fairness and impartiality of skills assessment. Evaluative data from contest further provide opportunities for designing innovative learning (Wu et al., 2021). The pursuit of scoring accuracy (Fabisiak, 2018), data trustworthiness, and integrity has always been the top priority in contest research. However, given that the subjective judgment of student performance in contests may lead to distrust in the results (Suk & Hee, 2018), this study proposes the use of integrative data based on learners' psychological motivation, knowledge, contest performance, and technical attitudes. In this regard, AI and BC may provide new opportunities to enhance learners' trust; psychological incentives; a fair, and innovative environment to compete; and a virtuous cycle of participation. Hence, this study aims to examine their effectiveness in the context of both AI and BC to contestants' psychology and ability. It contributes to foreign language motivation on how AI and BC shaping participants' motivations under the external context of contests. This study serves as reference for enhancing learners' oral English contest performance and for promoting the credibility and trustworthiness of contest scoring, as well as the integrity and authenticity of contest records, which are essential for end-users who rely on the results. This study also implies to promote a preferable educational evaluation mechanism and explore the effectiveness and sustainability of ubiquitous English learning (Chang, 2015).

Section One introduces the background, gaps, objectives, contributions, and the structure of this study. Section Two mainly expounds on the theoretical background, reviews related variables including psychological factors in the context of AI and BC and variable relations thus proposes hypotheses. Section Three describes the research methods, including research objects, scale selection, questions on the scenario of AI and BC, as well as data collection and integration. In Section Four, data analysis results are reported. Section Five discusses the presented results and the implication of AI and BC in English contest and outlines future reform directions regarding how English speaking contest better contribute to sustainable teaching, learning and practice. Section Six concluded the significance and limitations of this study.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Motivation has long been both a theory and a complex set of research variations. Motivation is important to the learning process as it activates behavior that fulfills specific goals and satisfies needs

(Syakur et al., 2020). Scholars from various fields have extensively studied the psychological concept of motivation (Chowdhury et al., 2021; Zhang et al., 2018), and the connotations of this term have gradually expanded to research on digitization in education. Learning motivation theory was derived from psychology studies in the late 1950s (Tao, 1981). The classic learning motivation model (Jin, 2016; Li & Liu, 2015; Yuan, 2007) was initially proposed by Gardner and Lambert (1959), who explained that the concept of motivation includes four elements: goals, desires, motivation intensity, and positive attitudes (Jin, 2013). Subsequently, the learning motivation theory was examined by Williams et al. (2001) and Dornyei (2003) who explored empirical research from the perspectives of physiology, behaviorism, cognition, and society. Further, the fact that the motivation to learn language qualitatively differs from the motivation to learn non-language subjects is found by Al-Hoorie and Hiver (2020). As emerging technologies reshape the learning environment in modern society, the types of motivation are becoming more complex, and other external situational factors that affect learners' English learning outcomes are being jointly considered (Rahman, 2005). The influences of internal, external, and comprehensive motivation; self-efficacy; goal orientation; and cultural factors on oral English learning ability have been discussed (Menggo, 2018). The aforementioned studies indicated that motivation theory can be applied to explain the awakening of learners' internal psychological states in the context of a specific subject, thus reflecting their subjective intention to pursue the expected goal consciously and the influence of external situational factors on their contest performance.

Motivation for modern learning involves complex confounding factors. Motivation is classified as intrinsic or extrinsic motivation, personal-psychological goals of achievement and affiliation, expectations of success, attribution of success and failure, attitudes toward English culture, and anxiety about foreign language learning (Schmidt et al., 1996). The examination of learners' foreign language learning motivations based on cognitive psychology and educational psychology models by the Center for Adult and Continuing Education indicated that motivations are related to emotions, goals, and expectations (Schmidt et al., 1996). Other classifications of learning motivation include drive, ambition, and enthusiasm that students have for learning and achieving their goals (Singh, 2011).

It is widely acknowledged that positive motivations, such as human beings' psychological needs (Deckers, 2018; Fernet, 2013), can improve academic records and outcomes. When considering factors that influence the oral competence of EFL learners, Leong and Ahmadi (2017) showed that the behavioral outcomes of human beings are related to their motivations. Specifically, in English learning, learners' motivation can improve their oral English skills by triggering their interest and inspiring them to learn more (Azeez et al., 2021; Bolifaar & Sinaga, 2020). Learners who are intrinsically motivated, have higher self-efficacy beliefs and set goals to improve their language level to have better speaking skills (Menggo, 2018). Therefore, internal and external factors should be considered to improve the oral English competence of higher vocational learners, motivate them to learn spoken English, and boost their oral English contest grades (Singh, 2020). Learning motivation in specific cultural and disciplinary contexts is worth exploring in future research.

As previously shown, a gap exists in contest research in Chinese core journals (i.e., PKU, CSCD, and CSSCI) examining higher vocational students' foreign language learning motivations (Yuan, 2007; Zhu, 2010). Designing a novel way to analyze these motivations in the context of modern society and technologies can facilitate an in-depth exploration of the formation mechanism behind the performance outcomes of end users and promote a more accurate and personalized assessment of language proficiency. Based on the main motivations of higher vocational learners in English learning, the relationship between motivation intensity and English grades, and external factors affecting learning motivations were further explored by Gao et al. (2003), Shi (2000), Zhu (2010), and Jin (2016)They found that Chinese higher vocational learners had far more negative motivations than positive motivations in English learning, and different factors affected the way they learned. Motivation is a key factor influencing the process and outcome of second- or foreign-language learning, and most current non-English-major university learners are instrumentally motivated (Chen, 2014).

The results of the aforementioned studies showed that learning motivation has rich connotations and a unique impact on vocational learners' oral English contest grades.

AI-Assisted Evaluation and BC-Powered Integrity of Contest Records

The roles of AI and BC in English learning and contests should be stressed as AI evaluation systems can increase people's learning performance through a better evaluation of their ability (Hernández-Orallo, 2017). AI scoring could further help learners increase their trust and intrinsic motivation, thus improving their learning performance (Yu & Wu, 2011). Furthermore, the penetration of BC into the education sector (Mahankali & Chaudhary, 2020) could offer transformative potential for the education sector. By addressing the challenges of fragmentation, untrustworthiness, and a lack of data integration, BC can contribute to the long-term sustainability and integrity of student records and achievements. BC can also be used to build an English learning database to improve learners' intrinsic motivation to learn English through an increase in their trust in the learning data (Zhao et al., 2023). These studies have found that AI and BC help learners increase their motivation to learn and thus enhance their English learning performance. Thus, we propose:

H0: AI scoring and BC-powered integrity of contest records enhance learners' motivation and performance in contests.

Vocabulary Knowledge

Learners' vocabulary knowledge is the key to language proficiency (Qian & Lin, 2019); hence, scholars have been optimizing the accuracy, trustworthiness, and integrity of vocabulary assessments. Intelligent tutoring systems (ITS) were first used in education in the 1960s, and gradually integrated computer assisted technologies into vocabulary scoring and learning in recent years (Şahin Kızıl & Savran, 2018). Among foreign language learning ITS applications, Baicizhan, a digital tutorial-based (Hwang et al., 2017; Kim et al., 2009) and game-based intelligent English vocabulary ITS (Li et al., 2021), was chosen for vocabulary testing in this study. It stressed the interactive relationships of vocabularies by digitizing the vocabulary knowledge map of each learner. A previous study suggested that the vocabulary test results obtained using Baicizhan were consistent with the Vocabulary Size Test of Paul Nation (Guo, 2019). In this study, English reading and listening vocabulary were used as indicators of learners' spoken English knowledge, and their direct impact on oral English contest performance was examined. A study on Chinese English major sophomores and results from a linear regression analysis suggested that both reading vocabulary and oral word knowledge can greatly affect oral English grades (Zhang, 2015); therefore, we propose:

H1: The vocabulary knowledge of learners positively impacts their oral English contest performances.

Intrinsic Motivation

Intrinsic motivation refers to behavior motivated by internal rewards such as personal enjoyment, interest, or pleasure (Lai, 2011). Becirovic (2017) revealed a correlation between achievement and motivation. Intrinsic motivation leads to improved concentration and deeper engagement. It fosters a sense of autonomy and self-determination and leads to a more active and self-directed approach to learning, resulting in better performance outcomes. Intrinsic motivation also promotes a growth mindset, which encourages learners to persevere, seek feedback, and continuously strive for mastery, ultimately leading to enhanced performance. Therefore, it has a significant positive effect on learners' performance (Bodkyn & Stevens, 2015). Intrinsic motivation was found to be positively correlated with the academic achievements of senior high school and college learners and related to higher academic grades (Taylor et al., 2014). These results highlight the importance of intrinsic motivation

for the academic success of both senior high school and college students. Notably, while intrinsic motivation generally positively influences performance, other factors, such as individual abilities and contextual factors, can also play a role. The lack of intrinsic motivation may impair contestants' effective use of their knowledge, especially in oral contests that rely on live performances. Based on the results of scholars studying the association between internal learning motivation and academic performance, we propose

H2: Intrinsic learning motivation positively moderates the relationship between vocabulary knowledge and oral contest performance.

Extrinsic Motivation

External motivation refers to behavior that leads to separable results and achieves instrumental value (Ryan & Deci, 2000). Because learning is not inherently enjoyable, promoting extrinsic motivation is an essential strategy for successful learning and teaching (Ryan & Deci, 2000). Moneta and Siu (2002) explored the influence of extrinsic motivation on the academic performance of learners aged 18–24 years at the University of Hong Kong and found that it was positively correlated with the grade point average (GPA). Adamma et al. (2018) investigated the impact of extrinsic and intrinsic motivation on learners' math scores, and revealed that motivation improved learners' academic records, although some outcomes varied between male and female learners. Wang (2008) found that autonomous extrinsic motivation is positively correlated with intrinsic motivation and achievement. While extrinsic motivation generally influences performance positively, other factors such as individual knowledge and contextual factors can also play a role. Extrinsic motivation may interfere with contestants' effective use of knowledge to achieve good results. Based on this previously proven association between extrinsic motivation and academic performance, we propose

H3: Extrinsic learning motivation positively moderates the relationship between vocabulary knowledge and oral contest performance.

Personal Goals

Personal goals refer to objectives, plans, and projects for individual growth (Brunstein, 1993), and achievable goals have a powerful influence (Schmidt et al., 1996). Handoko et al. (2019) that massive open online course (MOOC) end-users more frequently employed a self-regulated learning (SRL)-specific sub-process (goal setting). Their findings further verified the impact of SRL on learners' MOOC performance. Idowu et al. (2014) examined the effectiveness of goal-setting in improving English grades, concluding that notable gender differences affect learners' academic scores. Their data suggested that goal setting should be used as a strategy to improve students' academic achievement, especially English-related achievement. Schippers et al. (2020) indicated that learners' personal goals, whether academic or non-academic, could help improve their academic records. Complex and utilitarian personal goals may weaken knowledge utilization in live contests. Based on the aforementioned studies, we propose

H4: Learners' personal goals positively affect the relationship between vocabulary knowledge and oral contest performance.

Expectancy Control

Expectancy control refers to learners' higher expectations and self-evaluations of success as well as self-regulated and autonomous learning (Lai, 2011). According to Jamieson et al. (1987), expectations have a direct or indirect influence on learners' classroom behavior and academic performance.

Similarly, Friedman and Mandel (2009) claimed that expectations and goal setting could predict academic records and the retention rate of college learners, and that managing motivations and expectations could be a positive strategy for managing and improving cumulative GPA. Elborolosy and Al Thenyan (2020) concluded that the perception of learners' expectations is crucial for improving their academic records, and highlighted the need to examine further the influence of learners' expectations on spoken language skills. Other factors such as individual knowledge and contextual factors can also play a role. Excessive expectancy control may affect the outcomes from participants' knowledge. Based on these findings, we propose

H5: Learners' expectancy control positively moderates the relationship between vocabulary knowledge and performance.

Attitudes

Attitude refers to factors related to positive conceptions of and interest toward foreign cultures (Schmidt et al., 1996). Jawahar and Elango (2001) noticed inconsistencies due to a lack of correlation between the attitude measure, criterion, and end-user performance. Referring to Noguera's (2003) study on how environmental and cultural attitudes affect the academic records of black men, Niyifasha (2019) found that a lack of support, professional knowledge, and negative social and cultural attitudes can influence learners' academic performance. Students' attitudes toward English teaching strategies and approaches can affect their English grades (Nurhidayah, 2008). The results demonstrated that learners with more positive attitudes tended to achieve higher scores, whereas those with more negative attitudes tended to exhibit weak academic performance. Quijano Zavala (2017) examined the relationship between the attitudes, scores, and attitude changes of Mexican undergraduates in environments in which English was spoken as a foreign language. Their results showed that attitudes toward EFL, sociocultural aspects, language contact, and others indicated students' academic performance. In addition, attitudes may change over time owing to motivational factors. While attitudes generally influence performance, other factors such as individual abilities and contextual factors can also play a role. Thus, we propose

H6: Learning attitudes positively moderate the relationship between vocabulary knowledge and performance.

Anxiety

Anxiety is a psychological state that occurs when challenges are high and skills are low (Azeez et al., 2021). Anxiety is an important predictor of students' English grades. A small amount of anxiety may promote performance, whereas excessive anxiety may negatively affect it. The existing literature demonstrates a significant negative correlation between learning anxiety and prior English ability (Yang & Quadir, 2018), and that learning anxiety adversely affects learners' cognitive activities and academic records to varying degrees (Liu & Huang, 2011). Matsuda and Gobel's (2004) investigation of English classes at a Japanese university demonstrated that English proficiency and anxiety in speaking English significantly impacted student achievement. Astuti and Pusparini (2020) attempted to reduce students' anxiety in oral English classes by assigning course tasks. The large variation in research results was ascribed to differences in the selection of research objects and sources of learner anxiety. Considering that other factors such as individual ability and contextual factors can also play a role in learners' live performances, we propose

H7: Learners' anxiety negatively moderates the relationship between vocabulary knowledge and oral contest performance.

Motivational Strength

Motivational strength refers to the effort and intensity of motivation; it reflects how dedicated learners are to learn a foreign language. Lu et al. (2010) discovered a positive relationship between motivation intensity and learning attitudes by examining learners' academic records and expectations at the Army Medical University of China. Wen (2021) noted that motivation intensity significantly impacts academic performance and is the most convincing positive predictor. However, Hart and Gable (2013) found that motivational intensity alone did not affect performance. Since the early years of this research field, it has been suggested that learners who put more effort into foreign language learning have better learning attitudes and are more likely to achieve better grades (Atkinson, 1974) and that other factors, such as individual abilities and contextual factors, can also play a role. Based on the aforementioned studies, we propose

H8: Learners' motivational strength positively moderates the relationship between vocabulary knowledge and oral contest performance.

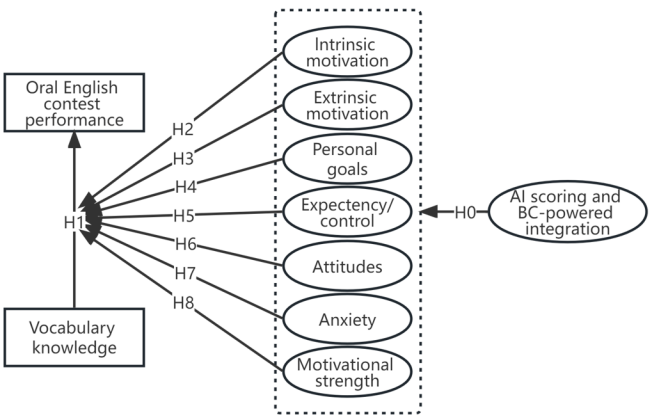
In summary, the aforementioned factors may affect learners' oral English contest performances at different levels. A hypothetical model was constructed, as shown in Figure 1.

RESEARCH METHOD

In China, the Practical Oral English Contest for Higher Vocational Colleges (hereinafter, the Contest) has officially become the most prestigious nationwide authorized language contest since 2011 (Min, 2015). Integrative data were collected from 185 learners in the Contest at a higher vocational college in China. The college reviewed and approved the data collection process. A random sequential number was sent to each respondent, and a designated research assistant created a QQ group (a widely used online social application in China) for the contest data collection. The subjects were fully informed of the research objectives prior to their participation and all principles of voluntary participation and subject anonymity were respected in the process.

Learners' oral English contest performance data were collected using grades as the dependent variable (Strang & Vajjhala, 2017). For a better understanding of the authenticity and consistency of learners' performance, each participant's oral contest performance was assessed independently by a committee consisting of a Canadian teacher and four English teachers with overseas study experience. Students' average oral contest performance was calculated and used as primary data in

Figure 1. Hypothesis model for factors influencing oral English contest performances



this study. To aggregate the scoring results from multiple sources, each respondent was assigned a random sequential number during the data collection process, in which the AI scoring results were counted and calculated manually.

Subsequently, the researchers collected reading and listening vocabulary data of learners who participated in this contest through the Baicizhan platform, the most widely used AI-aided vocabulary learning and evaluation application (Zhang, 2019), and calculated the averages as indicators of learners' English knowledge. Each learner's vocabulary was tested three consecutive times using the Baicizhan application, and the average of the three results was taken as the overall vocabulary score. The results obtained were consistent with those acquired through the Vocabulary Size Test-14000 developed by Paul Nation (Guo, 2019).

Learners' foreign language learning motivation was assessed using a questionnaire survey. The items were modified slightly to fit the actual learning context of the learners and the contest. Subsequently, back translation was performed. The scale included seven variables and 53 items in total (Schmidt et al., 1996). Each item was scored on a five-point Likert scale (1=strongly disagree to 5=strongly agree; see Appendix A). The reliability and validity of the questionnaire were successively tested to ensure that the data used for further analysis were as accurate as possible. Furthermore, exploratory factor analysis was conducted to check the validity of the questionnaire structure and items. In verifying the influencing factors, the average score of the items in each dimension was calculated and taken as the final score. Then, a correlation analysis was conducted to evaluate the relevance between the variables, and a regression analysis was conducted to explain the causal relationship between them and analyze the rationality of the phenomenon. A total of 185 valid questionnaires were collected through the Wenjuanxing platform, with an effective response rate of 92.5%.

Following an explanatory sequential design, the questionnaire survey included two structured questions to explain the results in depth (Di Gangi et al., 2017). One is on the experience and perception of using an AI-aided tool in scoring, and the other is on the prospective assessment toward BC in contest data integration (a potential scenario that can certify learning by converting participant data before, during, and after the contest into credit points or online achievement badges) and integration of learning data from different platforms. We consulted experts in the fields of education and science computing to seek interdisciplinary collaboration regarding the questions. A thematic analysis was conducted to identify and explain the entire framework. Through this analysis, we explored the learners' experiences and vision of new technology-related scenarios to support the argument. Discourses supporting AI and BC were captured; the repeated relevant ideas were recorded, and novel concepts were coded. The aims were to optimize data collection efficiency, protect privacy, and identify technical factors affecting contestant psychology and performance. The participants' demographic characteristics are presented in Table 1.

RESULTS

Reliability, Validity, and Exploratory Factor Analysis

Cronbach's alpha, an internal consistency coefficient, was used to measure questionnaire reliability (Nye, 1991). In addition, a validity test was conducted to assess whether the comprehensive assessment system effectively reflected the evaluation objectives and requirements. Kaiser-Meyer-Olkin (KMO) values were first obtained and then, the one-to-one correspondence relationship between the items and factors was analyzed and found to be identical to the research expectations, thus indicating good validity. The reliability analysis of the questionnaires revealed that Cronbach's alpha coefficients for intrinsic motivation, extrinsic motivation, personal goals, expectations, attitude, anxiety, and motivation strength were greater than 0.8 (Table 2), indicating high reliability. Then, the KMO values of the questionnaires were calculated, and Bartlett's test was conducted. The KMO value was greater than 0.8 (the approximate chi-square value of Bartlett's test of sphericity and the significance

Table 1. Demographic characteristics of the participants

Indicator		Total Participants
Faculty	Vehicle Engineering	8
	Electronics and Internet of Things Engineering	15
	Rail Transit and Aviation Service	19
	Chemical and Pharmaceutical Engineering	15
	Mechanical Engineering and Automation	17
	Architecture and Engineering	6
	Economics and Management	45
	Artificial Intelligence and Big Data	35
	Design	25
Gender	Male	47
	Female	138
Award	The first prize	20
	The second prize	39
	The third prize	58
	The participation award	68

Note: N=185.

probability (s) was 0.000 at a degree of freedom of 1,378; see Table 2), indicating high overall validity of the questionnaire. Subsequently, principal component analysis was conducted to extract the factors, and the maximum variance method was used to estimate the loading capacity of these factors. Seven main factors were collected: intrinsic motivation (items 1–5), extrinsic motivation (items 6–20), personal goals (items 21–25), expectancy control (items 26–34), attitude (items 35–38), anxiety (items 39–46), and motivation strength (items 47–53). These seven factors are the same as those described in the previous sections of this study. It was concluded that the questionnaire had high structural validity (Table 2).

Descriptive Statistics and Correlation Analysis

The mean and standard deviation values of all items on the scale descriptively reflect participants' recognition levels (Table 3). The correlation coefficient represent the correlation between the variables. The correlation coefficient indicates the strength of the linear relationship between the variables. In quantitative analyses, two types of correlation coefficients can be used: the Pearson and Spearman coefficients, both of which are used to measure the degree of relevance, following the same criteria. Generally, an absolute value greater than 0.7 represents an extremely strong correlation, and an absolute value greater than 0.4 indicates a strong correlation. However, an absolute value smaller than 0.2 shows a weak correlation.

Table 3 shows Pearson correlation coefficients of vocabulary, intrinsic motivation, extrinsic motivation, personal goals, altitudes, anxiety, and motivation strength respectively. These numbers suggest that the grade was significantly positively correlated with all the variables. Moreover, the Pearson correlation coefficient of expectations was $r=-0.262$ ($p<0.05$), indicating a negative correlation between students' grades and expectations. After the correlations between the variables were preliminarily determined, a regression analysis was conducted for further verification.

Table 2. Questionnaire reliability, validity, and exploratory factor analysis results

Rotated Component Matrix a								
	Component							
	1	2	3	4	5	6	7	Cronbach's Alpha
Intrinsic motivation1	0.208	-0.137	-0.242	0.219	0.159	0.794	0.068	
Intrinsic motivation2	0.244	-0.03	-0.266	0.217	0.035	0.783	0.093	
Intrinsic motivation3	0.281	-0.093	-0.237	0.128	0.144	0.74	0.051	0.932
Intrinsic motivation4	0.282	-0.068	-0.201	0.288	0.153	0.775	0.049	
Intrinsic motivation5	0.286	-0.165	-0.171	0.291	0.059	0.736	0.147	
Extrinsic motivation1	0.804	-0.164	-0.016	0.158	0.135	0.1	0.101	
Extrinsic motivation2	0.865	-0.139	-0.019	0.074	0.047	0.108	0.028	
Extrinsic motivation3	0.862	-0.026	-0.035	0.05	0.1	0.147	0.09	
Extrinsic motivation4	0.876	-0.112	-0.009	0.117	0.088	0.032	0.038	
Extrinsic motivation5	0.862	-0.113	-0.084	0.022	0.064	0.083	0.019	
Extrinsic motivation6	0.834	-0.068	-0.097	0.091	0.06	0.098	0.056	
Extrinsic motivation7	0.824	-0.19	-0.106	-0.046	0.066	0.069	-0.008	
Extrinsic motivation8	0.904	-0.054	-0.132	0.077	0.04	0.145	0.025	0.978
Extrinsic motivation9	0.778	-0.06	-0.034	0.176	-0.037	0.105	0.066	
Extrinsic motivation10	0.89	-0.091	-0.159	0.041	0.054	0.095	0.016	
Extrinsic motivation11	0.778	-0.149	-0.068	0.289	0.092	0.039	0.122	
Extrinsic motivation12	0.858	-0.196	-0.063	-0.003	-0.01	0.144	0.012	
Extrinsic motivation13	0.89	-0.043	-0.099	0.038	0.039	0.19	0.053	
Extrinsic motivation14	0.866	-0.126	-0.074	0.125	0.068	0.041	0.046	
Extrinsic motivation15	0.868	-0.141	-0.18	0.008	0.079	0.091	0.007	
Personal goals1	0.145	-0.165	-0.239	0.163	0.805	0.114	0.042	
Personal goals2	0.043	-0.151	-0.149	0.24	0.745	0.118	0.151	
Personal goals3	0.199	-0.161	-0.215	0.102	0.803	0.159	0.087	0.927
Personal goals4	0.138	-0.09	-0.198	0.222	0.846	0.012	0.149	
Personal goals5	0.049	-0.136	-0.172	0.217	0.812	0.074	0.163	
Expectancy control1	-0.114	0.85	0.035	-0.155	-0.115	0.007	-0.106	
Expectancy control2	-0.088	0.854	0	-0.141	-0.106	-0.071	-0.146	
Expectancy control3	-0.166	0.846	0.064	-0.102	-0.088	-0.059	-0.156	
Expectancy control4	-0.258	0.832	0.001	-0.106	-0.098	-0.087	-0.078	
Expectancy control5	-0.161	0.844	0.01	-0.137	-0.077	-0.027	-0.043	0.964
Expectancy control6	-0.119	0.835	-0.085	-0.126	-0.062	-0.091	-0.079	
Expectancy control7	-0.163	0.88	0.015	-0.073	-0.067	0.039	-0.107	
Expectancy control8	-0.109	0.876	-0.008	-0.143	-0.085	-0.039	-0.137	
Expectancy control9	-0.115	0.827	-0.026	-0.125	-0.048	-0.148	-0.074	

continued on following page

Table 2. Continued

Rotated Component Matrix a								
	Component							
	1	2	3	4	5	6	7	Cronbach's Alpha
Attitudes1	0.11	-0.247	-0.081	0.154	0.074	0.015	0.851	0.929
Attitudes2	0.094	-0.241	-0.049	0.163	0.186	0.051	0.822	
Attitudes3	0.077	-0.139	-0.049	0.106	0.148	0.137	0.857	
Attitudes4	0.096	-0.186	-0.116	0.099	0.119	0.099	0.878	
Anxiety1	0.002	-0.052	0.799	-0.199	-0.129	-0.163	0.002	0.938
Anxiety2	-0.125	-0.046	0.858	-0.07	-0.115	-0.108	-0.046	
Anxiety3	-0.18	0.023	0.797	-0.105	-0.17	-0.098	-0.021	
Anxiety4	-0.132	-0.087	0.781	-0.051	-0.077	-0.115	-0.074	
Anxiety5	-0.068	-0.042	0.778	-0.087	-0.274	-0.162	-0.002	
Anxiety6	-0.075	-0.012	0.792	-0.133	-0.039	-0.13	-0.003	
Anxiety7	-0.122	0.117	0.791	0.023	-0.063	-0.045	-0.087	
Anxiety8	-0.087	0.074	0.872	0.034	-0.095	-0.09	-0.088	
Motivational strength1	0.165	-0.121	-0.039	0.765	0.151	0.095	0.137	0.916
Motivational strength2	0.123	-0.165	-0.088	0.823	0.174	0.108	0.087	
Motivational strength3	0.065	-0.194	-0.035	0.8	0.054	0.088	0.111	
Motivational strength4	0.167	-0.183	-0.152	0.746	0.189	0.164	0.032	
Motivational strength5	0.178	-0.108	-0.147	0.741	0.155	0.189	0.018	
Motivational strength6	-0.045	-0.138	-0.092	0.754	0.076	0.116	0.072	
Motivational strength7	0.144	-0.117	-0.026	0.703	0.135	0.158	0.097	
KMO	0.905							
Approx. Chi-square	10258.779							
Sig	0.000							

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser normalization.
Rotation converged in six iterations.

Moderating Effects

Process Model 1-7 were employed to test moderating effects of learners' intrinsic motivation, extrinsic motivation, personal goals, expectations, attitudes, anxiety, and motivational intensity, respectively. The degree of model fit was assessed using R-square, and the models demonstrated statistical significance, indicating the effectiveness of the regression models. As shown in Table 4, Model 1 showed that the standardized coefficients of vocabulary and intrinsic motivation (moderate variable) are 0.3848 ($p<0.05$) and 0.3166 ($p<0.05$), respectively. Thus, vocabulary and intrinsic motivation had significant positive effects on performance. The standardized coefficient of vocabulary x intrinsic motivation (interactive variable) was $t=3.9769$ ($p<0.05$), indicating that the interactive variables had significant moderating effects and that intrinsic motivation moderated the positive effects of vocabulary on performance. Therefore, Hypotheses 1 and 2 are supported. Model 2 showed standardized coefficients of Vocabulary and Extrinsic Motivation (moderator variable) at 0.4112

Table 3. Descriptive statistics and correlation matrix

	Mean	Sd	1	2	3	4	5	6	7	8	9	10
Gender	1.75	0.44	1									
Oral English score	79.67	14.71	-0.119	1								
Vocabulary	3693.61	1084.22	-0.021	0.505**	1							
Intrinsic motivation	3.83	1.06	-0.008	0.404**	0.397**	1						
Extrinsic motivation	3.73	1.10	0.028	0.393**	0.421**	0.450**	1					
Personal goals	3.82	1.03	-0.034	0.402**	0.502**	0.385**	0.272**	1				
Expectancy control	2.32	1.11	0.081	-0.262**	-0.259**	-0.260**	-0.315**	-0.312**	1			
Attitudes	3.77	1.12	-0.051	0.342**	0.297**	0.283**	0.218**	0.361**	-0.380**	1		
Anxiety	2.27	0.99	-0.05	-0.409**	-0.509**	-0.438**	-0.237**	-0.402**	0.059	-0.181*	1	
Motivational strength	4.05	0.89	0.043	0.314**	0.333**	0.503**	0.288**	0.443**	-0.354**	0.312**	-0.260**	1

Note: N=185; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 4. Regression analysis of the moderating effect

	Mode1	Mode2	Mode3	Mode4	Mode5	Mode6	Mode7
Constant	0.1869	0.3431	0.2063	0.4167	0.4258	0.3049	0.2777
Vocabulary	0.3848***	0.4112***	0.3867***	0.4729***	0.4497***	0.3745***	0.4218***
Gender	-0.1653	-0.2283	-0.1826	-0.2208	-0.2264	-0.234	-0.2123
Intrinsic motivation	0.3166***						
Vocabulary×Intrinsic motivation	0.2434***						
Extrinsic motivation		0.2404***					
Vocabulary×Extrinsic motivation		0.1208*					
Personal goals			0.3347***				
Vocabulary×Personal goals			0.2189**				
Expectancy control				-0.0846			
Vocabulary×Expectancy control				0.1089			
Attitudes					0.1467*		
Vocabulary×Attitudes					-0.0914		
Anxiety						-0.3183***	
Vocabulary×Anxiety						-0.2059**	
Motivational strength							0.3837***
Vocabulary×Motivational strength							0.3141***
R	0.6095	0.5689	0.5746	0.5451	0.5607	0.5748	0.592
R-sq	0.3715	0.3237	0.3301	0.2971	0.3144	0.3304	0.3504
F	26.5961	21.5345	22.1786	19.0221	20.6393	22.2049	24.2757

Note: *p < 0.05; **p < 0.01; ***p < 0.001.

($p<0.05$) and 0.2404 ($p<0.05$), respectively, suggesting that vocabulary and extrinsic motivation had notable positive effects on student performance. The standardized coefficient of vocabulary x extrinsic motivation (interactive variable) was $t=2.03$ ($p<0.05$), implying remarkable moderating effects of this interactive variable. Therefore, extrinsic motivation moderates the positive effects of vocabulary on performance, thus supporting Hypothesis 3. Model 3 showed the standardized coefficients of Vocabulary and Personal Goals (moderator variable) were 0.3867 ($p<0.05$) and 0.3347 ($p<0.05$), respectively, indicating that vocabulary and personal goals had significant positive effects on performance. The standardized coefficient of vocabulary x personal goals (interactive variable) was $t=3.0495$ ($p<0.05$), indicating that the interactive variable had marked moderating effects. Therefore, personal goals moderated the positive effects of vocabulary on performance, supporting Hypothesis 4. Model 4 showed the standardized coefficients of Vocabulary and Expectations (moderator variable) at 0.4729 ($p<0.05$) and -0.0846 ($p>0.05$), respectively. This means that vocabulary had a significant positive effect on performance, whereas expectations had no notable influence. The standardized coefficient of vocabulary x expectations (interactive variable) was $t=1.8775$ ($p>0.05$), indicating insignificant moderating effects of this interactive variable. Hence, expectations did not moderate the effect of vocabulary on performance, thus invalidating Hypothesis 5. Model 5 showed the standardized coefficients of Vocabulary and Attitude (moderating variable) at 0.4497 ($p<0.05$) and 0.1467 ($p<0.05$) respectively, suggesting that vocabulary and attitude had a significant positive effect on performance. The standardized coefficient of vocabulary x attitude (interactive variable) was $t=-1.5453$ ($p>0.05$). Thus, attitude did not moderate the effect of vocabulary on achievement and hypothesis 6 was not supported. Model 6 showed the standardized coefficients of Vocabulary and Anxiety (moderator variable) at 0.3745 ($p<0.05$) and -0.3183 ($p<0.05$), respectively, meaning that vocabulary had a remarkable positive influence on performance, whereas anxiety had considerable negative effects on them. The standardized coefficient of vocabulary x anxiety (interactive variable) was $t=-2.8133$ ($p<0.05$), suggesting marked moderating effects of this interactive variable. These results showed that anxiety moderated the negative impact of vocabulary on performance; hence, Hypothesis 7 is supported. Model 7 showed standardized coefficients of vocabulary and motivational strength (moderator variable) at 0.4218 ($p<0.05$) and 0.3837 ($p<0.05$), respectively, demonstrating that these two factors positively affected performance. The standardized coefficient of vocabulary×motivational strength (interactive variable) was $t=3.9935$ ($p<0.05$), suggesting that the interactive variable had significant moderating effects. Hence, motivational strength moderated the positive influence of vocabulary on performance, and Hypothesis 8 is supported.

Results of Experience and Perception Toward AI and BC in Scoring and Data Integration

An open coding analysis was subsequently conducted. A total of 995 nodes were obtained during the primary theme coding process, and 60 initial categories were extracted. Among them, the most frequently used words, arranged from high to low, were high technical importance, strong human–machine interaction, learning convenience, intrinsic motivation, high technical importance, positive development trends, external motivation, and ubiquitous learning. Then, 21 subcategories were obtained through secondary theme encoding, including a smoother process of knowledge internalization, internal improvement, technical vulnerabilities, application popularity, technical trustworthiness, data trustworthiness, cross-platform data integration, cross-platform data sharing, motivational push, motivational pressure, high stickiness in use, improved learning efficiency, firmness in memory retention, vocabulary expansion, vocabulary comprehension, motivation type, content improvement, technical usability, ease of use, high credibility of ratings, and technical value. Finally, nine main categories were identified during the third-level theme-coding process: improved grades, lack of technological maturity, high trust in BC, data connectivity, improved motivation to learn, improved academic performance, improved motivation to learn, technological functional intelligence, and high trust in AI. The main categories reflect the roles of AI and BC in enhancing learners' positive

perceptions and support, which promote students' motivation in learning, and further improve their psychological and cognitive performance.

Learners' perceptions toward the AI grading were supportive (96%). The analysis revealed that manual grading would cause errors because of individual differences, and the raters' preferences affected learners' motivation and performance. Learners also believed that the AI scoring results were more reliable and could increase their trust in them. Here, AI improved grades by promoting the depth, breadth, efficiency, and firmness of vocabulary memory, while also potentially affecting learning motivation. The application of AI promoted learners' trust and satisfaction in learning data scoring and collection, demand analysis and recommendations, human–computer interaction, and ubiquitous learning.

Moreover, learner's perceptions toward BC prospects was also supportive. Approximately 99% of the learners in the survey had been exposed to BC, and 97% of them supported the idea that the cross-platform integration of data by BC would provide convenience, eliminate cumbersome authentication of identity information, protect personal privacy, and increase social trust. These learners looked forward to the application of BC in the information collection of the Contest. The application process also has a potential impact on learning motivation based on the characteristics of the BC itself.

DISCUSSION

The study results support Hypotheses 1–4, 7, and 8 (all at $p<0.05$) but not Hypotheses 5 and 6. Specifically, expectancy and attitudes toward British and American cultures had no significant moderating effects, reflecting that the vocational learners in this study were less influenced by foreign cultures. In addition, intrinsic motivation had a greater impact than extrinsic motivation; both were significant, and the correlation between the two was higher than that between other variables, except for vocabulary. Notably, all variables, except anxiety and expectancy, had positive effects on performance. Students' motivational strength had the largest impact on oral contest performance and the most notable moderating effect. These findings suggest that vocabulary knowledge plays a crucial role in language performance, particularly in EFL contests. A strong vocabulary enables learners to comprehend and express their ideas effectively and to understand contest tasks. In the context of the Contest, EFL learners with high motivation were more likely to invest time and effort in enhancing their language abilities and reserve vocabulary knowledge, which could positively impact their performance.

This study further indicates that the application of AI in scoring promotes learners' potential motivation and performance in English contests. In traditional contest scoring, owing to learners' incomplete contest information and uncertain expectations of future outcomes, it is more difficult for them to trust judges on the scoring of contests. The survey on AI shows that most of the respondents deemed AI scoring to be more objective and accurate and avoids the negative influence of personal subjective judgment in scoring. Most of them believe that the application of AI achieves multidimensional measurements and avoids the negative influence of personal subjective judgment on scoring, thus making learners trust of the contest results. Learners benefited from AI scoring by receiving vocabulary knowledge automatically recommended according to their ability (vocabulary test results), habits and preferences. Their learning data was recorded and corresponding learning rewards was obtained (Li et al., 2021).

Notably, BC-powered contest data recording enables learners' potential motivation and performance in contests. The findings show that 99% of the learners had a certain understanding of BC and perceived the positive prospect and expectation of the transparency, fairness, and integration of competition data collected from multi-dimensions, which reflected their trustworthiness motivation in BC to promote competition fairness and performance. This finding aligns with Anwar et al. (2022), who established BC-based higher education trust using an iLearning model approach and stated that students will value an overall, influential, and effective educational program in validating industry-to-

community approved data. Saadati et al. (2021) further explored how a BC-based LMS (self-regulated learning system) facilitates learners with transparent and immutable records of learning activities, achievements, and progress. In addition, the data dissemination mode of "cobtest–bookkeeping–reward" of BC and the scoring of AI form a psychological incentive for individuals to compete fairly, create independently, and innovate themselves. This enhances the learners' trust and self-efficacy in learning and contests, leading to a virtuous cycle of participation. Owing to the limitations of time, this study only used AI scoring and did not apply BC for information collection. The study results provide useful reference for college learners' sustainable English learning and competitiveness development, as well as theoretical and empirical guidance for improving learners' oral English contest performance. Future work could focus on empirical research on the relationships among social trust brought about by BC applications, learning motivation, and English contest performance.

The study findings have theoretical and practical implications for improving learners' oral English contest performance. First, high-quality evaluation of student grades should be strengthened from multiple dimensions and formulate a feasible teaching program using AI and BC to stimulate learners' cognitive expectations. Notably, raising assessment standards and excessively pursuing talent cultivation are likely to lead to anxiety. Curricula should be evaluation-oriented and based on resource integration (Liu et al., 2020). It is also important to mention that modern learning environments should embrace electronic education, for it holds great potential as a novel means of management innovation (Han et al., 2021). Departments at all levels and frontline teachers should take the initiative to employ AI, BC, and diverse technology-related teaching methods. Doing so would help create an open, positive, harmonious, and interesting learning context, and thereby promote a fluid knowledge flow to encourage learners to cooperate, share knowledge, and be constantly stimulated to develop their cognitive skills. Additionally, schools should apply AI scoring and BC to overcome time and space limitations. This would not only facilitate the management and supervision of parents and school management, but also help learners increase their trust in the contest and scoring to improve their learning and motivation.

Second, AI and BC should be further applied to explore and recognize learners' dynamic learning motivations and knowledge antecedents in order to provide personalized and adaptive recommendations of learning paths and promote the sustainability of learning. Specific action points include: educators need to ensure data integrity to eliminate concerns about fraudulent alterations; control student access under cryptographic techniques to protect student privacy and prevent unauthorized access; standardized learning data to avoid fragmentation and ensure secure exchange across different educational platforms, thus streamlining administrative processes; provide shared and auditable records of student data to improve trust and transparency in the educational system, and increasingly empower students in matters concerning their own data and potentially monetize their educational achievements through secure and verifiable digital credentials.

CONCLUSION

Higher Chinese vocational learners constitute a large group, accounting for 52.9% of the total number of college students in China. With the deepening of globalization, oral English performance has played an important role in maximizing the use of human resources and in promoting the reform of China's opening up to the outside world. This study used integrative data to determine the moderating effect of foreign language learning motivations on Chinese higher vocational EFL learners' oral contest performance with vocabulary knowledge antecedents in the context of AI and BC. It not only demonstrates the relationship between learning motivation, vocabulary knowledge, and contest performance, but also stresses the potential prospects of AI and BC in improving the credibility and completeness of contest participant data. Most learners in this study believe that cross-platform data integration under BC can protect personal privacy, improve integrity, and thereby achieve sustainability in student data management. As the originality and honesty of the records promote learners' trust and

thus enhance their motivation, AI- and BC-powered contest platforms could generate sustainable value in ubiquitous learning over time by documenting the individual's learning progress. As AI-assisted scoring has been rarely used in previous contest research, this study emphasizes the importance of promoting learners' sustainable development through the integration of emerging technologies and educational practices. This study showcases its interdisciplinary nature by incorporating elements of learning motivation theory, AI, BC, and sustainable development in education.

AUTHOR NOTE

Author Contributions: Conceptualization, Z.L. and X.M.; methodology, Z.L.; analysis, X.S.; investigation, Z.L.; data curation, Z.L. and X.S.; writing-original draft preparation, Z.L.; writing-review and editing, Z.L. X.S. and X.M. All authors have read and agreed to the published version of the manuscript.

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INFORMED CONSENT STATEMENT

Informed consent was obtained from all subjects involved in the study.

COMPETING INTEREST

The authors of this publication declare there are no competing interests.

FUNDING

Hubei Education Science Planning 2022 Annual general project: Research on the deep integration mode and practice Path of "Five-dimensional Integration", Production and Education in application-oriented undergraduate colleges (2022GB088). Funding for this research was covered by the author(s) of the article.

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