

Machine Learning Empowering Language Acquisition: The Value and Application Path of Learning Motivation

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ABSTRACT

Machine learning (ML) has shown some good results in second language (L2) education, so many adaptive learning systems, intelligent tutoring platforms and other natural language processing (NLP) tools have been developed. The above technologies will help improve the efficiency of learning and inspire students to study more actively. Machine learning can create personalised learning paths for students, and by the means of a conversation-based system, motivate them more intrinsically; NLP can then be used to provide students with comprehensible input to maintain their motivation as learners. Self-determination theory (SDT), the L2 Motivational Self System (L2MSS), and Vygotsky's zone of proximal development (ZPD) provide theoretical support for studying the effect of machine learning on students' motivation to learn Chinese as a second language. At the same time, there are also the problems of technology anxiety, algorithmic bias and the digital divide in the use of this technology. Based on the previous studies, this paper proposes a motivation-oriented framework for integrating ML tools in L2 teaching.

KEYWORDS

Machine learning; Language acquisition; Learning motivation; Self-determination theory; L2 Motivational Self System; Willingness to communicate; Adaptive learning; NLP; Intelligent tutoring system; Digital divide.

1. INTRODUCTION

1.1. Research Background

With the progress of research on language acquisition, behaviourist models of habit formation have gradually been replaced by cognitive and sociocultural theories. Now, most people think that the study of language covers all areas of life, including identity, emotion and society. Therefore, learner motivation is now widely recognized as one of the primary factors influencing the success of second language (L2) learning. Meta-analysis has also shown that the motivation of learners and the environment they are in differ, so they will not necessarily have the same study results.

ML-based adaptive systems can provide learning materials and adjust task difficulty and other functions according to the progress of the learners. These systems are not old-fashioned classrooms and fixed digital tools; they have more personalised motivations. With the increase in the use of conversational agents and automated writing evaluation (AWE) systems, as well as adaptive vocabulary platforms, people's interest in the motivational effects of ML has also been rising. Therefore, the research of applied linguists and educational technology scholars needs to extend to explore whether and how these technologies affect learners' motivation to learn.

1.2. Research Questions

The three research questions are as follows. RQ1 investigates the sources of motivation for L2 learners in ML-based adaptive learning systems and the reasons for its persistence, as well as design features that can promote the latter. RQ2 investigates the evidence for intelligent conversational agents and chatbots in promoting extrinsic motivation and willingness to communicate during L2 learning, as well as learner and contextual factors that shape these outcomes. RQ3 investigates the problems posed by technology anxiety, algorithmic bias and digital inequality to the motivational benefits of ML-enhanced language learning, and proposes design and teaching strategies for combining ML with a motivation-oriented focus.

2. THEORETICAL FRAMEWORK

2.1. Self-Determination Theory and Autonomous Language Learning Motivation

Deci and Ryan were the first to propose self-determination theory (SDT), and since then, many kinds of motivation have been explained, including externally regulated behaviour, autonomous and intrinsically motivated behaviour, as well as intermediate forms such as introjection, identification and integration. Generally, an increase in autonomy motivates students to learn and study more willingly for a longer time. SDT is one of the systems of psychological needs supporting self-regulated learning, including autonomy, competence and relatedness.

SDT proposes that, in L2 learning, ML platforms can foster students' autonomous motivation and a long-term interest in learning by offering them choices in tasks and learning speeds (autonomy), providing prompt and non-threatening feedback (competence), and enabling communication with other learners and teachers remotely (relatedness). A multilevel meta-analysis of SDT in L2 learning has shown that autonomous motivation, which includes intrinsic motivation and identified regulation, is positively related to L2 achievement, but controlled motivation is not positively correlated with success [1]. Not all kinds of autonomous and self-regulated motivation are clearly distinguishable. A game-like or algorithmic division of labour may reduce a student's sense of initiative. This type of risk is more likely to occur on commercial ML language platforms; that is, an increase in user engagement may be the result of induced behaviour rather than genuine interest.

2.2. The L2 Motivational Self System

Dörnyei's L2 Motivational Self System (L2MSS) presents a new concept of L2 motivation called "possible selves". Motivation is thought to be the result of a difference between one's present self in L2 and the two ideal selves one hopes to achieve in the future. The ideal L2 self refers to the learner's desired future image as a successful L2 user, and the ought-to L2 self is the attributes and competencies that the learner believes they should have to meet external expectations and avoid negative consequences [12]. The third is L2 learning experience, which includes the classroom environment and relationships with teachers and classmates.

Research has shown that an ideal L2 self can be a stronger and more stable indicator of motivated learning behaviour than an ought-to L2 self, especially when learners have clear and positive aspirations for their L2 identity. A mixed-methods study of AI-mediated informal digital English learning among 690 Chinese undergraduates found that the ideal L2 self was positively correlated with both enjoyment and engagement, but the ought-to L2 self was only associated with enjoyment and not with engagement [2]. Enjoyment also moderates the relationship between the ideal L2 self and AI-supported engagement to a certain extent. Based on the above studies, ML platforms that can help learners experience their ideal L2 selves through conversational practice, cultural immersion and identity-aligned tasks may motivate them to learn more independently than those focused solely on external motivation.

2.3. Vygotsky's ZPD and ML Adaptive Scaffolding

According to Vygotsky's concept of the zone of proximal development (ZPD), it is the region in which a learner can achieve an objective with the assistance of a teacher or another individual with higher knowledge. It provides good theoretical support for adaptive scaffolding as a teaching strategy in machine learning-assisted language learning. Machine learning-based adaptive systems can use learning-experience data to identify each learner's Zone of Proximal Development (ZPD) and adjust the level of difficulty, specific feedback or teaching order. Therefore, learners will continue to receive learning tasks that are challenging but achievable.

Research on scaffolding in complex learning environments has shown that digital tools can support learning when they offer calibrated support, continuous diagnosis and gradual fading, rather than providing only general prompts [3]. Therefore, ML-based adaptive systems can be viewed as a form of technology-supported scaffolding that adjusts the difficulty of tasks and feedback based on the learners' development stage. Together, the competence requirements in SDT, the future selves shown in L2MSS, and the developmental scaffolding ideas of ZPD provide an all-round system for explaining how ML can support the motivation of language learning.

3. ML TECHNOLOGIES AND MOTIVATIONAL MECHANISMS IN LANGUAGE ACQUISITION

3.1. Adaptive Learning Systems and Intrinsic Motivation Activation

Machine learning-based adaptive learning systems can motivate students more by providing tasks that are at their optimal level of difficulty and offering immediate, customised feedback to help them gain confidence in learning and reduce anxiety. Traditional teaching generally covers the average level of a group, and such systems cannot create personalised models for learners' vocabulary, grammar and phonology. Therefore, the learning experience will be more personalised than what is generally offered by classroom teaching alone. A study by a university found that adaptive AI tools were positively correlated with both students' motivation and self-regulated learning. Regression analysis shows that the personalisation of teaching through artificial intelligence has raised students' self-esteem; further post hoc tests also indicate that the learners have developed stronger autonomous learning habits [4]. Therefore, personalisation will make learners feel that they are capable of completing the task and thus increase their intrinsic motivation for learning. An automated writing evaluation (AWE) system is a typical case of personalised motivation in the study of L2 writing. Grammarly, PigAI and Criterion have all been studied to some extent, and each system has different strengths for improving students' writing. Both the learners and the teachers are generally satisfied with the above systems. More research will be carried out to compare AWE feedback directly with human feedback, and the impact of both on motivation and the level of writing development will be examined [5].

3.2. Intelligent Conversational Agents and Willingness to Communicate

Willingness to Communicate (WTC) refers to a learner's willingness to speak in the target language in favourable circumstances. It is generally believed that this should be done to cultivate the communicative ability of students in a foreign language, and thus has long been a focus of communicative language teaching. Intelligent Tutoring Systems (ITS) and AI chatbots can offer learners a psychologically safe, non-judgmental space that encourages WTC. Research has shown that, for Chinese EFL learners, practising with AI chatbots and intelligent tutoring systems (ITS) can increase WTC; this improvement is often due to a reduction in anxiety and increased confidence in speaking [6]. Research on young EFL learners has also shown that after eight chatbot sessions, their WTC increased significantly, and according to interviews, reduced fear of making mistakes and

improved communication skills were likely the reasons [7]. Chatbots and intelligent tutoring systems can generally provide learners with a low-stress environment for practice that is free from the immediate pressure of face-to-face assessment.

3.3. NLP Tools, Comprehensible Input, and Motivational Investment Maintenance

NLP tools in L2 learning environments implement Krashen's hypothesis of comprehensible input by adjusting the linguistic difficulty of reading and listening materials according to the learners' interlanguage stages. By keeping the input slightly above the learner's current ability, or at $i+1$, these tools can help maintain a motivating state for flow. NLP-based reading platforms can reduce the number of new words and complex grammatical structures at different levels of study to prevent cognitive overload and reading anxiety.

With the development of natural language processing, automatic writing assistance, dialogue systems, analysis of educational materials and personalisation of learning content have all emerged, and they can help sustain students' interest in L2 input at different stages of learning [8]. Motivation may be a reason that these applications help foster all-around language abilities. A recent meta-analysis of AI interventions in L2 learning has shown that, overall, AI tools positively affect language learning outcomes, and contextual, instructional and social-emotional moderators vary in the degree of this effect [9]. Therefore, it can be proposed that AI tools will be more effective in actual practice when integrated into pedagogical environments that are meaningful to learners and that foster their interest and motivation.

4. CHALLENGES TO MOTIVATIONAL BENEFITS OF ML-ENHANCED LANGUAGE LEARNING

The three linked problems may reduce the motivation for ML-enhanced language learning, and both the system design and teaching need to address them. First of all, technology anxiety refers to the fear and apprehension some students have when using ML systems, such as AI chatbots. The conversational demands and corrective feedback of these systems may cause evaluation anxiety for some learners, especially those already anxious, thus reducing their willingness to speak. Research on the application of artificial intelligence (AI) in English-language teaching has revealed that, due to system failures, a lack of emotional response, and students' reluctance to communicate with non-human objects, the motivational benefits of AI tools may be reduced; thus, support from teachers is still necessary [10]. Second, algorithmic bias in ML language systems often arises from imbalanced training data; as a result, the performance of learners from underrepresented linguistic and cultural groups may be lower, and their motivation for learning will also be weaker. Third, due to the uneven distribution of ML platforms, learners in well-resourced educational and technology-rich areas are more likely to have access to personalised learning. ML may increase, rather than reduce, the achievement gap in L2 learning in this case.

5. DISCUSSION: APPLICATION PATH FOR MOTIVATION-CENTRED ML INTEGRATION

Based on the above evidence, it can be concluded that ML can be used to improve the motivation of L2 learners in L2 classes if it is designed according to educational goals. RQ1: ML adaptive systems can foster intrinsic motivation more effectively by promoting autonomy through task selection, providing accurate and timely competence feedback, and adding social relevance. Narrative and conversational ML tools can help learners create their ideal L2 selves, as suggested by the L2 Motivational Self System (L2MSS), and motivate them to aspire to future language goals by imagining and striving for them.

RQ2: Chatbots and ITS platforms are more likely to increase WTC among learners with moderate or high levels of technology-use comfort, particularly when the use is voluntary, the interaction is sustained over time, and teachers provide reflective activities that help transfer chatbot-based confidence to real-life communication situations [6]. For RQ3, ML language tools need to be jointly developed with various linguistic and cultural training data, supported by teacher-led onboarding sessions to reduce anxiety before independent use, and accompanied by equity-oriented access policies for underserved learners [10]. Teachers still need to provide support, and for AI chatbots to be effective, both teachers and learners must be involved. Together, the above measures can help to build a human-machine cooperative teaching model to motivate students [11].

6. CONCLUSION

ML can extend the prospects for increasing motivation in L2 learning by providing personalised adaptive scaffolding, low-risk communicative practice via intelligent conversational agents, and comprehensible input calibrated according to the different stages of language learning. The three complementary theoretical lenses for these functions are SDT's need-satisfaction model, L2MSS's ideal-self guides, and ZPD-based scaffolding. The reasons for the rise in motivation include that the machine learning system can meet some of the students' basic psychological needs for learning, reduce communication anxiety, and align their learning experience with their ideal L2 self. Novelty effects, gamification and simple engagement strategies are not always motivating to people intrinsically. To create a motivation effect for ML in the future, various designs should be used; these designs should be linguistically rich, include pedagogical scaffolding that cultivates technological literacy and communicative confidence, and adopt equity policies to make personalised learning available to all.

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