Highlights in Art and Design
ISSN: 2957-8787 | Vol. 13, No. 2, 2026

Research on Emotional Experience Strategies of AI Learning Machines Based on Self-Determination Theory

Siqi Zhu, Rui Li *

School of Digital Technology & Innovation Design, Jiangnan University, Wuxi, Jiangsu, China
*** Corresponding author:** Rui Li (Email: lrcoolb@jiangnan.edu.cn)

Abstract: Aiming at the problem of insufficient user motivation caused by AI learning machines prioritizing functions over experience, this study conducts an in-depth analysis of the entire learning process based on Self-Determination Theory and User Experience Map. The research reveals three core pain points: lack of goal guidance, insufficient emotional companionship, and weak review mechanisms. Based on this, the paper constructs an emotional experience strategy grounded in Self-Determination Theory: meeting the need for autonomy through dynamic learning situation diagnosis and flexible goal setting, satisfying the need for relatedness via emotional interaction of virtual assistants, and fulfilling the need for competence by utilizing multi-dimensional attribution and visualized growth records. This strategy aims to promote the transformation of AI learning machines from a single tutoring tool to a personalized emotional partner, and effectively improve users' online learning experience.

Keywords: Self-Determination; AI learning Machine; User Experience Map; Emotional Experience Strategy.

1. Introduction

With the in-depth advancement of the double reduction policy and the generational leap in artificial intelligence technology, the forms of online education products in China are undergoing a profound transformation from single resource aggregation to intelligent services. As the core carrier of this transformation, AI learning machines have shown impressive market performance. Data from Lotu Technology shows that China's learning tablet market demonstrated strong growth resilience in 2024, with omnichannel sales exceeding 19.06 billion yuan, and this momentum continued in early 2025 [1]. Behind this explosive growth lies an urgent market demand for accurately reducing academic burdens.

However, beneath the prosperous market data, the contradiction of supply-demand mismatch still looms. Although after-school services have achieved widespread coverage, their service content remains at the level of basic homework tutoring. The lack of personalized and interest-oriented expansion courses has led to insufficient dependence of some families on on-campus services. This current situation of wide coverage but insufficient personalization and precision has precisely provided supplementary space for AI learning machines. Unfortunately, most mainstream products currently focus on academic improvement at the cognitive level, while often ignoring the crucial emotional experience in the learning process. This paper attempts to introduce Self-Determination Theory, starting from the origin of psychological motivation, to construct an operable and explanatory emotional experience strategy, helping AI learning machines evolve from a single question training tool to a learning partner with emotional interaction capability.

2. Theoretical Perspectives: Self-Determination Theory and the Evolution of AI Roles

2.1. Self-Determination Theory

Self-Determination Theory (SDT), proposed by American psychologists Edward L. Deci and Richard M. Ryan, represents a macro-theory of human motivation and personality that addresses the factors facilitating optimal functioning, social development, and well-being. At its core, SDT defines human beings as active, growth-oriented organisms with an innate tendency to integrate diverse experiences into a unified sense of self. The realization of this integrative capacity, however, depends on dynamic interactions with supportive or hindering factors within the social environment. Developed over nearly three decades of empirical research, SDT has expanded from analyzing micro-level motivational mechanisms to addressing broader issues of autonomous development and psychological health, establishing itself as a pivotal framework for interpreting the drivers of human behavior[2].A key tenet of SDT is that the persistence and quality of individual behavior are not determined solely by external rewards and punishments; rather, they are predicated on the satisfaction of basic psychological needs. Only when these innate needs are adequately nurtured can an individual’s internal drive be truly ignited, fostering active engagement[3].

The theoretical framework of SDT is supported by two core dimensions that underpin its practical application:

The first dimension is Basic Psychological Needs, which serves as the cornerstone of SDT and comprises three universal necessities: autonomy, competence, and relatedness:

Autonomy refers to the desire to self-organize experience and behavior and to act in accordance with one's own volition and values. This is exemplified by online learners adjusting their course pacing or selecting content, as well as mathematically gifted students choosing to explore advanced

topics[4].

Competence concerns the feeling of mastery and the confidence to act effectively to achieve goals. It emphasizes not only the actual ability to complete tasks but also the subjective perception of efficacy. For instance, students enhancing rigor through error analysis feedback or visualizing knowledge mastery via learning analytics are processes that reinforce the sense of competence[5, 6].

Relatedness pertains to the desire to feel connected to others—to love and care, and to be loved and cared for. This manifests in collaborative seminars within academic communities, teacher-student interactions in MOOCs, or even personalized Q&A support from AI assistants, all of which can satisfy the need for relatedness and mitigate learning isolation[7].

The second dimension is the Continuum of Motivation, wherein SDT categorizes motivation based on the degree of autonomy, ranging from low to high: amotivation, extrinsic motivation, and intrinsic motivation. Amotivation represents the lowest level of self-determination, where individuals perceive no contingency between actions and outcomes and lack the intention to act. Extrinsic Motivation is driven by external factors and possesses lower autonomy. Examples include studying to avoid failing exams or completing tasks solely for credits or rewards, where the locus of causality is external to the behavior itself. Intrinsic Motivation is the most autonomous form, stemming from the inherent interest and value found in the activity itself, such as exploring calculus out of a love for mathematics or participating in English seminars for the enjoyment of academic exchange[2, 3].

It is important to note that extrinsic motivation is not static, through supportive environments characterized by autonomy support and precise feedback, it can be internalized into higher forms of autonomous motivation. This internalization process is illustrated by gifted students who may initially train for competition rewards but eventually engage in exploration for the sheer enjoyment of the problem-solving challenge[8].

2.2. The Development of Learning Machines

The developmental trajectory of AI learning machines reveals a clear evolution from a tool-oriented morphology to a partner-oriented one. In the early era of electronic dictionaries and point-reading machines, products served merely as static containers for content. With the introduction of knowledge graphs and adaptive technologies, learning machines entered an intelligent phase characterized by data-driven operations, realizing personalized path recommendations.

Today, with advancements in affective computing and multimodal technologies, future learning machines are attempting to transcend the boundaries of pure cognitive tutoring. By identifying micro-expressions and voice intonations, they can capture learners' emotional fluctuations in real-time . This technological evolution provides the infrastructural foundation for the implementation of Self-Determination Theory in product design, making it possible to satisfy users' deep psychological needs through technological means.

3. Pain Point Analysis Based on User Experience Map

Adopting a whole-process perspective on new knowledge acquisition, this study utilizes the User Experience Map as a visualization tool to deconstruct the user's learning journey into three continuous stages: pre-learning, during-learning, and post-learning. Through a superimposed analysis of typical user behaviors and emotional curves, the shortcomings of current AI learning machines in affective experience design are fully exposed (Figure 1).

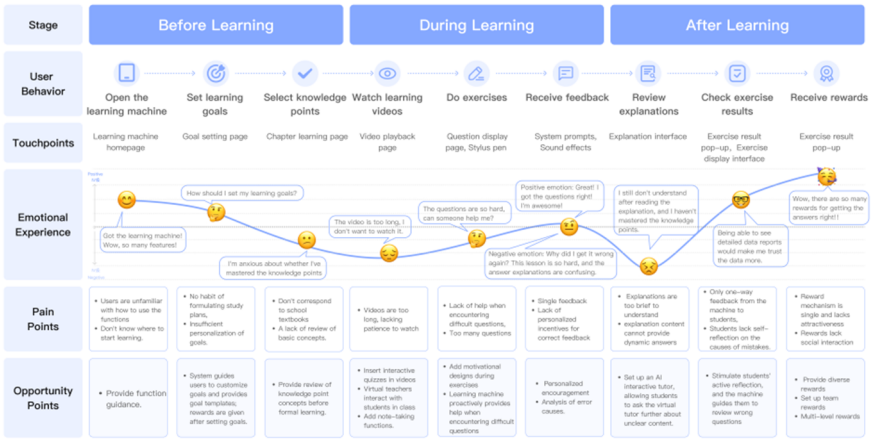


Fig 1. User Experience Map

The core shortcoming in the learning initiation stage is the lack of goal orientation. This deficiency is directly manifested as a lack of systematic guidance tailored to the user's specific academic profile when they begin learning. Consequently, learning behaviors easily descend into aimlessness, and the need for autonomy fails to be effectively met, which directly diminishes the efficiency of learning initiation.

The learning process stage highlights the prominent issue of scarcity of emotional support. Throughout the prolonged process of exercise training and coursework, users receive only unidirectional screen outputs, lacking immediate emotional resonance and humanistic care. This sense of isolation, devoid of peer-like interaction, is prone to triggering learning burnout, ultimately severely undermining the user's sense of relatedness.

The critical issue in the learning conclusion stage lies in the failure of the attribution mechanism. Feedback following learning tasks often halts at simple binary judgments of correctness, lacking a deep synthesis of learning outcomes and positive attribution. This makes it difficult for users to clearly perceive their knowledge increments and capability enhancements. Moreover, the resulting deficit in the sense of competence prevents learning motivation from being effectively sustained into the next learning cycle.

4. Strategy Construction

Targeting the pain points in the affective experience of AI learning machines identified earlier, this study constructs a progressive affective experience strategy. By interweaving the three basic needs of Self-Determination Theory with the entire learning process, the strategy aims to awaken self-drive, consolidate a sense of belonging, and reinforce self-efficacy, thereby achieving a deep alignment between psychological need satisfaction and the learning workflow.

4.1. Awakening Self-Drive

To address the issue of goal ambiguity in the pre-learning stage, the core approach involves empowering users with choice through technical means, promoting a shift from passive task executors to active path planners. Traditional mechanical rote-drill diagnostics must be replaced by multidimensional AI academic assessments. The system should locate knowledge blind spots through lightweight questions and generate visual academic profiles based on historical behavioral logs, providing a scientific basis for setting goals that are both challenging and feasible.

Considering the fluctuations in learning states, the goal system requires elastic adjustment capabilities. When users encounter setbacks, the system should guide them to adjust their plans via inquiry-based pop-ups rather than simply adjudicating failure. Conversely, if tasks are too easy, micro-challenges should be pushed in real-time. This effectively avoids the frustration or boredom caused by rigid goals, maintaining stable learning initiative.

4.2. Consolidating the Sense of Belonging

In the during-learning stage, an anthropomorphic virtual assistant can be constructed to transform tedious exercise training into an interactive process with social attributes, thereby satisfying the user's need for relatedness. The virtual assistant should not be limited to Q&A functions but should be deeply embedded in learning details. Through personalized startup greetings, heuristic questioning when thinking is blocked, and fun interactions after prolonged study, users can continuously perceive a sense of companionship.

The assistant requires emotional perception capabilities, offering differentiated affirmation for successes of varying difficulty. Faced with errors, it should adopt an "empathy-first, analysis-second" approach to build a sense of alliance. Furthermore, utilizing memory-based interaction to record and naturally recall specific details, such as subject strengths/weaknesses and preferred incentive methods, enhances the user's feeling of being valued and bridges the human-machine distance to consolidate the sense of belonging.

4.3. Reinforcing Self-Efficacy

The review in the post-learning stage is key to constructing a closed loop of competence. Effective feedback must transcend binary correct/incorrect judgments and focus on the value of the learning process and capability growth. The system should guide users to excavate the deep-seated reasons behind their performance. Beyond knowledge mastery, it is necessary to analyze the innovation of problem-solving approaches and improvements in learning habits, helping users establish a positive cognitive association between effort, strategy, and results.

Regarding weak areas, the system should not merely provide a collection of errors but must be paired with concrete, actionable guidance. Whether recommending targeted micro-courses or suggestions for improving exercise habits, these should be accompanied by execution plans of moderate difficulty. This ensures users continuously receive positive feedback during actionable improvements, forming a sustainable cycle of learning motivation.

5. Conclusion

In terms of research value, at the theoretical level, this study deeply integrates Self-Determination Theory with AI learning machine product design, enriching the application scenarios of SDT in intelligent education and expanding the research boundaries of affective experience design in educational technology. At the practical level, it breaks the current "technology-first" design inertia of AI learning machines. The proposed affective experience strategy effectively guides the transformation of products from singular tools to personalized affective partners, tangibly addressing core issues of insufficient user motivation and poor experience. This aids in enhancing the effectiveness and sustainability of online learning while providing a valuable reference for product innovation in educational technology enterprises.

It should be noted that this study has certain limitations. The strategies are primarily constructed based on the experience analysis of typical users and have not yet been verified through empirical research. Subsequent studies should select specific product scenarios and conduct user experiments to optimize strategy details and feasibility. Meanwhile, with the rapid development of technologies such as affective computing and multimodal interaction, the affective experience design of AI learning machines faces new opportunities and challenges. Future research should combine frontier technologies to further enhance the precision and naturalness of affective interaction, deeply exploring the personalized emotional needs of users across different ages and learning levels. This will drive the iterative upgrade of affective experience strategies, allowing AI learning machines to truly realize the bidirectional fusion of technological empowerment and emotional care, injecting new momentum into the high-quality development of online education.

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