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Analyzing Factors Promoting Students' Autonomous Motivation from the Perspective of Self-Determination Theory

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Abstract. In educational settings, the gap between students who actively engage in learning and those who only comply passively essentially stems from differences in motivation quality. Furthermore, previous gamification studies often treat gamification as a unified whole, ignoring the differentiated effects of specific elements—a gap that creates a void in targeted motivation promotion research. Using the literature review method, this paper takes the three basic psychological needs of Self-Determination Theory (SDT) as its core framework, integrates the empirical findings of Sailer et al., and explores targeted educational interventions—especially those incorporating gamification elements—to examine how these interventions satisfy students' basic psychological needs and promote autonomous motivation. Meanwhile, practical classroom cases are used to illustrate the implementation paths of these strategies. The study finds that feedback-based elements satisfy the competence need through visualized progress; meaningful choices and in-depth narratives support the autonomy need by constructing task significance; and collaborative roles and shared goals meet the relatedness need through functional interdependence. In contrast, superficial elements fail to produce effective motivation-promoting effects.

Keywords: Self-Determination Theory (SDT), Autonomous Motivation, Gamification, Educational Interventions

1. Introduction

In educational environments, the difference between students who actively engage in learning and those who comply passively often lies in the quality of their motivation. Autonomous motivation refers to the driving force for taking actions based on intrinsic interest or personal values, and it has been repeatedly proven to be associated with deeper learning, better academic performance, and long-term persistence in education [1]. Unlike extrinsic motivation, which relies on external rewards and punishments, autonomous motivation emerges when students perceive learning as meaningful, feel capable of achieving success, and sense a connection with others in the educational environment. However, traditional classroom practices—such as rigid curriculum design, one-size-fits-all teaching methods, and over-reliance on grades—often undermine these conditions [2]. Consequently, researchers and educators have turned to evidence-based strategies rooted in Self-Determination Theory (SDT), which identifies three basic psychological needs—competence, autonomy, and relatedness—as the foundation of intrinsic motivation [3].

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Previous studies have often treated gamification as a unified concept, neglecting the potential differentiated effects of different game design elements [4]. This research gap highlights the necessity of in-depth analysis of the roles of specific elements. Combining the empirical findings of Sailer et al.'s paper, this paper explores targeted educational interventions—particularly those integrating gamification elements—to examine how these interventions satisfy students' basic psychological needs and promote autonomous motivation. Practical cases are also used to illustrate the implementation paths of these strategies. This study provides reference for teaching methods, aiming to improve the effectiveness of education and enhance students' enthusiasm for learning.

2. The logical framework of the three core needs in SDT

To understand the mechanism of autonomous motivation formation, it is first necessary to take Self-Determination Theory (SDT) as an anchor and clarify its core three basic psychological needs—competence, autonomy, and relatedness. These three needs are not only the cornerstone of intrinsic motivation but also exhibit clear functional rules in educational settings, forming a positive "satisfaction-reinforcement" cycle with one another.

First, focusing on the competence need, its essence is an individual's desire to perceive efficacy, master challenges, and experience success when interacting with the environment [5]. Observations of classroom practice show that traditional teaching most easily overlooks the key dimension of "perceived progress": math teachers often only announce the "full-score list," causing average-performing students to gradually lose their sense of competence because they cannot see their growth trajectory (e.g., from 60 to 75 points). Rigby and Ryan also clearly point out that the core of a sense of competence lies in "controlling the learning process" rather than "surpassing others." For example, students who struggle with writing can gradually build the confidence that "I can write well" through progressive feedback on their drafts (from disorganized logic to clear structure) [6].

Second, turning to the autonomy need, it emphasizes an individual's experience of volitional freedom—that "behavior stems from self-approval rather than external imposition" [7]. A typical misunderstanding exists in practice: a Chinese language teacher once let students "choose the color of their homework cover" but required everyone to write the same essay; as a result, students still felt the task was "imposed by the teacher," and their sense of autonomy was not enhanced. This exactly confirms the view of SDT: effective choices must influence the learning process. For instance, allowing students to choose between "experimental reports" and "data visualization" to present scientific findings—where the former requires in-depth data analysis and the latter requires learning chart design—this kind of "choice as process difference" can truly activate a sense of autonomy.

Finally, focusing on the relatedness need, it refers to an individual's desire to establish connections with others, integrate into communities, and experience a sense of belonging [8]. Currently, group cooperation in many classrooms is reduced to "division and assembly" (e.g., "you search for information, I write the conclusion"), which can be completed without any single member, making it difficult to cultivate a sense of relatedness. In contrast, a true sense of relatedness stems from "functional interdependence." For example, in the task of "ecosystem modeling," the plant energy data calculated by the "producer group" is the basis for the "consumer group" to analyze animal consumption, and the material cycle results of the "decomposer group" rely on data from the previous two groups. This "indispensable" structure allows students to truly feel that "my existence is valuable to the team."

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3. The matching mechanism between gamification elements and needs

The experiment by Sailer et al. provides key empirical support for "how gamification elements accurately match needs." Using an "online order-picking task" (a task with high repetitiveness and low interest, highly consistent with students' psychological experience when facing "math problem drilling" or "vocabulary memorization"), the experiment randomly divided 331 valid participants into three groups: a control group (points only), Experimental Group 1 (badges + leaderboards + performance charts), and Experimental Group 2 (avatars + stories + virtual teammates). A single-variable design was used to isolate the mechanism of action of different elements [4].

From the perspective of experimental design logic, its strengths lie in two aspects: first, the control group (points only) rules out the "element omnipotence theory"—results showed that the control group had the lowest need satisfaction, proving that "not all gamification elements are effective." Points only quantify results without providing competence feedback or meaningful association, which also explains why many classrooms use points alone but struggle to improve motivation. Second, the two experimental groups isolate the independent effects of "feedback elements" and "social/narrative elements," avoiding the problem of "mixed elements with unidentifiable attribution" and providing a clear "element-need" corresponding basis for subsequent classroom applications.

Specifically, regarding the verification of the competence need, the results of Experimental Group 1 are the most convincing: the mean score of competence need in this group (4.19, SD=1.35) was significantly higher than that in the control group (3.76, SD=1.36). Although the effect size was only η_p^2=.020, this "small effect" exactly reflects the "cumulative" nature of the sense of competence [4]—students will not suddenly fall in love with math because of one "progress badge," but if they receive 1-2 times of visualized feedback per month (e.g., "10% increase in weekly quiz accuracy"), their sense of competence will be significantly enhanced after a semester. Further analysis shows that the effectiveness of Experimental Group 1 stems from the "complementary synergy" of three types of elements: badges provide a "sense of short-term goals" (e.g., "three consecutive full-score assignments"), avoiding confusion caused by overly distant long-term goals (e.g., "performing well in the final exam"); performance charts realize "visualized progress" (line charts showing changes in task time from 10 minutes to 5 minutes), which is more convincing than teachers' verbal praise; leaderboards provide "reasonable reference" (comparison with previous participants rather than concurrent competition), avoiding ranking anxiety while allowing students to perceive their own competence level.

Turning to the experimental findings on the autonomy need, the results of Experimental Group 2 are more cautionary: the avatars and stories in this group did not significantly improve the autonomy need (mean score of decision freedom: 2.87, SD=1.65, no difference from the control group's 3.10, SD=1.77) [4]. In detail, avatars only allowed appearance selection (e.g., clothing, hairstyle) without affecting the task process, belonging to "superficial choices"; stories were only presented in the form of "short pop-ups + single comics" and not linked to the order-picking task. This is highly consistent with misunderstandings in classroom practice: many teachers treat narratives as "pre-class appetizers" (e.g., telling the story of "endangered polar bears" but not using ecological knowledge to solve conservation problems), leading to a disconnection between stories and tasks. In fact, effective narratives need to complete a "three-step connection": first, raise a problem through the story (e.g., "endangered species lack food"); second, make learning knowledge a means to solve the story's problem (e.g., "learning food chains = formulating food supply plans"); finally, complete the story loop through task completion (e.g., "submitting a conservation plan = successful rescue"). Only in this way can true significance be endowed to the task.

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In the mechanism of satisfying the relatedness need, Experimental Group 2 performed the most prominently: the mean score of relatedness need in this group (1.77, SD=.98) was significantly higher than that in the control group (1.49, SD=.90) and Experimental Group 1 (1.45, SD=.74) [4]. The core reason lies in the "functionality" of virtual teammates—these roles could prompt order locations and share part of the tasks, allowing participants to truly feel that "they need each other to achieve the goal." The direct implication for classrooms is that group task design must abandon the "division and assembly" model and shift to "process-based interdependence." For example, in the task of "social problem analysis," roles can be divided into "discoverers (identifying problems), analysts (finding causes), designers (proposing solutions), and verifiers (testing effects)"; the output of each role is the input of the next role. This "indispensable" design can truly cultivate a sense of belonging.

4. Classroom transformation: practical strategies oriented by needs

Translating the conclusions of Sailer's experiment into classroom practice, the core is to design "precise and operable" strategies around the three needs while avoiding the trap of superficial application of elements.

For the competence need, the key is to build a system of "dynamic feedback and difficulty adaptation." Specifically, the "80% accuracy principle" can be followed to adjust task difficulty: when students' task completion accuracy reaches 80%, the difficulty is appropriate; if it is lower than 80%, reduce the difficulty (e.g., from "fraction operations" to "integer operations"); if it is higher than 80%, increase the difficulty (e.g., from "integer word problems" to "decimal word problems"). This ensures that every student is in a state of "reaching with a slight jump." At the same time, it is necessary to match "multi-dimensional feedback tools": use badges to reward short-term progress (e.g., "two consecutive full-score assignments"), use line charts to show long-term growth (e.g., changes in weekly quiz scores), and use "personal best rankings" to provide reference (e.g., "surpassing one's past self"), avoiding anxiety caused by class rankings.

For the autonomy need, the core is to design "limited but meaningful choices." On the one hand, the dimensions of choice need to be controlled (fixed core goals, 2-3 limited choices). For example, in a "social studies" class, fix the core goal of "analyzing the causes of social problems" and allow students to choose the "theme (campus bullying/community waste sorting)" and "method (interviews/questionnaires)"; this provides autonomous space without leading to direction loss. On the other hand, it is necessary to deepen the connection between narratives and tasks. For example, "narrative writing" in English class can be designed as a "detective investigation" narrative: take "destruction of classroom green plants" as the story starting point; after students master the skill of "character portrayal," they obtain "witness description clues"; after mastering the skill of "plot conflict," they obtain "case turning point clues"; finally, complete the narrative loop by writing a "case-solving report," aligning learning goals with story goals.

In cultivating the relatedness need, the focus is to build "functional collaborative groups." First, role assignment must reflect "interdependence." For example, in the "ecosystem model" task in biology class, the "producer group" is responsible for calculating plant energy, the "consumer group" for analyzing animal consumption, and the "decomposer group" for studying material cycles; data from the three groups must be integrated to complete the model. Second, it is necessary to endow groups with "collective value goals." For example, design the "class convention formulation" task with the theme of "building a mutual-aid community"; students discuss in groups "how to help students with learning difficulties" and "how to listen to others' troubles"; the final convention must

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be linked to "the number of mutual-aid activities in the class," allowing students to feel the "practical impact of personal efforts on the collective."

In addition, two major challenges in implementation need to be addressed: first, ensuring the "visibility and participation" of elements, which can be achieved through a "three-step guidance"—let students "test-play" elements before class (e.g., unlock the first badge by completing a simple task), remind them of "task relevance" during class (e.g., "completing this question will bring you closer to the 'Logic Expert' badge"), and strengthen memory with "story-based summaries" after class (e.g., "this week, 5 students helped 'endangered species' obtain food through their efforts"). Second, maintaining the "long-term attractiveness" of elements: it is recommended to update designs by semester. For example, change badge themes from "Learning Star" to "Innovation Talent" or "Mutual-Aid Pioneer," and switch narrative backgrounds from "saving endangered species" to "space exploration" or "community transformation," combining seasons or social hot topics (e.g., focusing on environmental protection on World Environment Day) to avoid student aesthetic fatigue.

5. Conclusion

In summary, by sorting out the conclusions of Self-Determination Theory and Sailer's experiment, this study clarifies that "the core of gamification in promoting autonomous motivation is need matching"—feedback-based elements correspond to the competence need, meaningful choices and narratives to the autonomy need, and functional collaboration to the relatedness need; superficial elements cannot produce sustained effects. This conclusion not only fills the research gap of "differentiated effects of gamification elements" but also provides a "pitfall-avoiding" practical framework for teachers.

However, the limitations of this study must be acknowledged: first, it relies on the experimental data of Sailer et al., and the sample of this experiment is mainly adults (average age 22 years old); the applicability of the conclusions to primary and middle school students needs further verification. Second, it does not explore the "element combination effect"—for example, whether using badges and collaborative groups simultaneously will produce synergy or conflict. Third, it lacks the perspective of home-school collaboration; how parents can cooperate with classroom strategies to strengthen need satisfaction still needs research.

Based on these limitations, future research can advance in three directions: first, conduct "cross-grade empirical research" to compare differences in students' preferences for gamification elements across different age groups. Second, explore the "optimal ratio of element combinations," such as whether the combination of "1 feedback element + 1 social element" is most effective. Third, construct a "home-school collaboration model" to guide parents in using similar feedback logic (e.g., progress charts for homework) to strengthen classroom effects.

Finally, it is necessary to emphasize that gamification is not a "panacea for saving motivation" but a "tool for activating intrinsic motivation." Its true value lies in, through precise element design, allowing students to rediscover that "learning is something I want to do" (autonomy), "I can do this well" (competence), and "I am not doing this alone" (relatedness). The synergy of these three is the most lasting source of autonomous motivation and the key to cultivating lifelong learners.

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