A Study on the Impact of Participation in Virtual Learning Communities on Middle School Students' Sense of Social Belonging and Learning Engagement

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Abstract: With the development of information technology, virtual learning communities have become an important platform for middle school students' learning and communication, exerting a significant influence on their sense of social belonging and learning engagement. However, research on its mechanism of action and improvement strategies is still insufficient. This research, through theoretical analysis and current situation investigation, explores the mechanism of participation in virtual learning communities in enhancing middle school students' sense of social belonging and learning engagement, aiming to provide theoretical basis and strategic suggestions for practice. The study finds that virtual learning communities, by enhancing interactive communication, stimulating a sense of identity, and providing support, effectively promote students' sense of belonging and learning engagement. In addition, strategies such as optimising community environment, promoting cooperative culture, providing personalised support, and inter-school cooperation help stimulate students' learning enthusiasm and strengthen their sense of belonging. This paper, combining social learning theory, belonging theory, and self-determination theory, reveals the key role of virtual communities in middle school students' growth, emphasises the importance of building safe, interactive, and personalised virtual learning spaces, and provides practical guidance for educators and administrators. Finally, it proposes future research directions, offering reference for the functional optimisation and user experience of virtual learning communities. This study enriches the theoretical system of virtual learning communities in middle school education and provides new ideas and approaches for improving students' learning outcomes and mental health.

1. Introduction

1.1. Research Background

Virtual learning community, as an emerging educational platform, is gradually penetrating into the daily learning of middle school students [1]. With the continuous progress of information technology, conventional classroom education is limited by time and space, and often difficult to meet the personalised and diversified learning needs of middle school students. Virtual learning communities create an environment of interactive communication, resource sharing, and collaborative learning, successfully broadening the scope of learning and improving its flexibility and autonomy. Especially under the background of the epidemic, online education has become the mainstream, and the utility of virtual communities has become more prominent. Virtual learning communities not only affect students' academic performance, but also have a significant effect on social behaviour and sense of belonging. Middle school students are in a critical stage of psychological growth and social identity. A healthy sense of social belonging helps enhance their self-confidence and self-cognition, while active learning participation is directly related to the quality of learning outcomes. Whether the participation and interaction quality of virtual learning communities strengthen middle school students' sense of social belonging and learning motivation remains to be explored. Studying the impact of participation in virtual learning communities on middle school students' social belonging and learning engagement provides theoretical basis and practical reference for building an online learning environment more conducive to student development, and is of extremely important value.

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1.2. Research Significance

This study has important theoretical and practical significance. From the theoretical perspective, previous research on virtual learning communities mostly focused on the application of technical means and the discussion of teaching methods, while research on the impact on middle school students' sense of social belonging and learning engagement is relatively scarce. This work enriches the theoretical accumulation in this field, provides useful reference and inspiration for subsequent related research, and helps build a complete theoretical framework of virtual learning communities.

From the practical perspective, the research conclusions provide concrete guidance for educators and parents. For teachers, the research results can be used to improve the construction and maintenance of virtual learning communities, enhancing middle school students' learning experience and effectiveness. For parents, it can more effectively guide their children to properly use virtual learning platforms, assisting in the dual improvement of their social communication ability and academic development. It can also point out the direction for designers of virtual learning communities, promoting the development of digital platforms that better meet the needs of middle school students and the process of educational informatisation.

2. Related Concepts and Theoretical Basis

2.1. Related Concepts

2.1.1. Virtual Learning Community

The virtual learning community supported by internet technology is a way of creating a digital education and communication field [2]. It breaks through the limitations of traditional education in terms of time and region, and constructs a free and interactive learning scenario for learners. In such virtual spaces, adolescent students can access a wide variety of learning materials, covering electronic texts, online courses, etc. Community members use forums, instant messaging, and other means to conduct interactive discussions, exchange their learning experiences and practical insights. The virtual learning environment promotes the diffusion and interconnection of knowledge, opens up a broader learning path for adolescent students, and is beneficial for shaping their self-learning literacy and sense of collaboration.

2.1.2. Sense of Social Belonging

Sense of social belonging is the emotion of acceptance, recognition, and support that an individual experiences in a specific social group. For middle school students, sense of belonging is important, as it is directly related to their mental health and level of social adaptation [3]. When students establish good interactive relationships with other members in virtual learning communities and gain others' respect and recognition, sense of social belonging naturally arises. The enhancement of belonging increases their self-confidence and sense of security, prompting them to participate more actively in community activities, expand their social networks, and promote their overall personal development.

2.1.3. Learning Engagement

Learning engagement reveals the level of psychological and behavioural participation of students in the learning process [4]. This concept covers three dimensions: cognitive engagement, emotional engagement, and behavioural engagement. Cognitive engagement shows the thinking strategies and efforts students apply in learning, emotional engagement reflects students' interest, enthusiasm, and positive attitude toward learning content, and behavioural engagement describes students' actual participation in learning activities. In virtual learning communities, diverse learning resources and interactive communication opportunities stimulate middle school students' interest in learning, enhance their learning engagement, and optimise their learning outcomes.

2.2. Theoretical Basis

2.2.1. Social Learning Theory

Social learning theory was advocated by Bandura. This theory emphasises the significant influence of observational learning and role models on the individual learning process [5]. In virtual learning communities, middle school students observe the learning behaviours and outcomes of other members, and enhance their own academic skills through imitation and reference. The outstanding members in the community serve as models, prompting other members to participate more actively in learning. At the same time, the communication and interaction within the community create opportunities for middle school students to observe and learn how others solve problems, which promotes the progress of their social learning skills and enables them to integrate into the virtual learning environment more confidently.

2.2.2. Belonging Theory

Belonging theory points out that individuals have an intrinsic motivation to seek a sense of belonging. When this need is satisfied, the psychological state and behavioural performance of the individual will show positive transformation [6]. In the environment of virtual learning communities, middle school students, through interaction and communication with other members, gradually establish a sense of identity and belonging to the community. The enhancement of belonging increases their loyalty and active participation in the community, prompting them to invest more time and energy in learning and communication. Belonging is greatly beneficial in alleviating the feelings of loneliness and anxiety that middle school students experience in learning and life, and contributes to the improvement of their mental health level.

2.2.3. Self-Determination Theory

Self-determination theory emphasises that individuals' internal driving force and autonomous decision-making have significant effects on behaviour [7]. In virtual learning communities, middle school students select learning materials and methods freely according to their own interests and needs. Autonomy ignites their internal enthusiasm for learning. Once students' need for autonomy is satisfied, they will devote themselves more actively to learning tasks and improve the depth of learning. The mutual assistance and responses among community members help strengthen individuals' belief in self-efficacy and promote the continuous development of self-directed behaviour.

3. Analysis of the Current Situation of Virtual Learning Communities, Middle School Students' Sense of Social Belonging, and Learning Engagement

3.1. Development Status of Virtual Learning Communities

Driven by the wave of educational digitalisation, virtual learning communities show a significant development trend of diversification and intelligence [8]. From the perspective of platform attributes, they include official learning communities led by schools (campus cloud classrooms, subject-specific discussion platforms), comprehensive learning communities operated by the market (such as Zuoyebang community, Yuanfudao learning circle), as well as interest-oriented communities focusing on vertical fields (programming learning community, Chinese writing exchange platform). The platforms broadly cover multiple application scenarios such as subject learning, interest expansion, and exam preparation guidance. At the technical level, the application of algorithms, real-time interactive tools (online whiteboard, video connection functions), and data visualisation analysis effectively improves the efficiency of interaction and the level of personalised services in communities. Some communities even push corresponding learning resources and discussion topics accurately according to students' learning data. In terms of resource supply, community content has gradually expanded from traditional test questions and courseware sharing to diversified forms such as micro-course videos, practical cases, and inter-school cooperative projects, so as to meet the diverse learning needs of middle school students. Some virtual learning communities also expose problems such as uneven quality of content, interference of advertising information, and high

operational complexity of the platform, which to a certain extent limit the full play of their educational value.

3.2. Current Situation of Middle School Students' Participation in Virtual Learning Communities

In virtual learning communities, the proportion of middle school students participating increases year by year. According to relevant survey data, more than 70% of middle school students have used at least one virtual learning community. The participation frequency of junior high school students is mostly 2–3 times per week, while senior high school students, facing greater academic pressure, have fragmented participation time, usually choosing to log in on weekends or after class [9]. From the perspective of participation motivation, the needs of middle school students can be roughly divided into three categories. The first is academic support needs, using communities to ask questions to solve knowledge points not fully understood in class, and download exam preparation materials. The second is social needs, such as cooperating with classmates to complete learning tasks and participating in discussions on topics of interest. The third is self-improvement needs, learning professional skills in interest communities such as programming and writing, and obtaining evaluation and feedback from peers and teachers. In terms of participation behaviours, middle school students are more inclined to adopt the method of "passive reception + light interaction," which is manifested in a higher proportion of browsing resources, liking, and commenting, while the proportion of actively initiating topics and organising learning activities is lower. The types of communities middle school students participate in show obvious subject tendencies. Participation in science communities such as mathematics and physics is higher than in liberal arts communities such as Chinese and history, and the participation frequency of urban middle school students is significantly higher than that of rural middle school students.

3.3. Current Situation of Middle School Students' Sense of Social Belonging

The sense of social belonging of middle school students shows an imbalanced characteristic of "strong offline, weak online." The overall sense of belonging in virtual learning communities is at a medium to low level. From a positive perspective, some middle school students obtain a certain degree of belonging in virtual learning communities. In interest-oriented communities (technology innovation communities, literary creation communities), middle school students with common hobbies quickly establish emotional bonds, and continuous interaction forms stable "peer learning groups," gaining a sense of recognition and support [10]. In official school learning communities, most members are classmates from the same class or school, and offline interpersonal relationships are extended online, forming a stronger sense of group belonging. Some classes also carry out group cooperative learning in communities, enhancing class cohesion. However, the sense of belonging in virtual learning communities still has obvious deficiencies. The anonymity and mobility of community members are relatively high, and some middle school students choose to remain silent due to fear of "being ridiculed when speaking" or "their opinions not being accepted," making it difficult to establish deeper emotional connections. Most virtual learning communities position themselves with "learning resource sharing" as the core, lacking special designs for social interaction. Topics mostly revolve around academics, with insufficient emotional exchange, making it difficult to meet the social needs of middle school students in terms of "emotional support" and "self-expression." The sense of belonging of middle school students differs significantly in different communities. In smaller-scale communities with frequent member interaction, belonging is stronger, while in large-scale, information-complex comprehensive communities, the sense of belonging of middle school students is generally weaker.

3.4. Current Situation of Middle School Students' Learning Engagement

The overall situation of middle school students' learning engagement shows the characteristic of "selective participation under the influence of academic pressure." Learning engagement in virtual learning environments shows significant "motivation differences" and "behavioural dispersion." From the perspective of engagement level, "behavioural engagement" of middle school students in

virtual learning environments is relatively prominent, while "cognitive engagement" and "emotional engagement" are lower [11]. In terms of behavioural engagement, middle school students frequently visit communities to download materials and ask questions during key exam preparation stages (before midterm and final exams), investing an average of 1–2 hours per week. In terms of cognitive engagement, most middle school students are limited to "understanding resources" and "solving problems," lacking in-depth exploration and extension of knowledge. When asking questions in communities, they focus more on "what the answer is" rather than "what the problem-solving method is." In terms of emotional engagement, middle school students have insufficient "spontaneous interest" in community learning. Most participation behaviours stem from academic pressure or the requirements of teachers and parents, lacking intrinsic motivation, and prone to low-efficiency participation behaviours such as "browsing irrelevant content after logging in" and "completing formalised interaction." From the perspective of group differences, middle school students' learning engagement shows obvious individual and group differences. Middle school students with excellent academic performance are more willing to actively deepen learning in communities (such as participating in difficult problem discussions, sharing problem-solving methods), with higher "cognitive depth" of learning engagement. Middle school students with medium to low academic performance mostly aim to "solve basic problems," with engagement more biased toward "passive reception." Junior high school students' learning engagement in virtual learning environments is higher than that of senior high school students (as senior high school students face greater academic pressure and offline learning time accounts for a higher proportion), and urban middle school students are higher than rural middle school students (as rural middle school students have fewer ways to access high-quality community resources). "Interference elements" in virtual learning environments affect learning engagement. Some middle school students are attracted by advertisements and entertainment information after logging into communities, resulting in insufficient "effective learning time" and reducing the effectiveness of engagement.

4. The Mechanism of Virtual Learning Community Participation on Middle School Students' Sense of Social Belonging and Learning Engagement

4.1. Mechanisms Influencing Social Belonging

4.1.1. Interactive pathways that enhance the sense of belonging

Within virtual learning communities, diverse modes of interaction provide critical support for the development of students' sense of social belonging. Real-time discussion boards allow learners to engage in conversations on course-related difficulties or personal interests, overcoming the constraints of time and space in offline exchanges [12]. For instance, in mathematics problem-solving forums, students can share solution strategies through text input and formula-editing tools, building initial connections through mutual assistance. In task-oriented group collaborations, such as preparing a PPT analysis of classical literature in Chinese language studies, students must divide responsibilities, collect materials, and refine content together. This sustained process of cooperation nurtures a collective identity and gradually fosters the awareness of being "a family." Informal community spaces, such as "Campus Moments," further enable students to share daily anecdotes and emotional experiences. These non-academic exchanges help shorten psychological distance, generate emotional resonance, and consolidate a sense of acceptance and belonging within the community.

4.1.2. Factors that strengthen identification and community belonging

Multiple factors work synergistically in virtual learning communities to enhance adolescents' identity recognition and consolidate their community belonging [13]. Shared community goals act as a key driving force. When the community organises activities with specific objectives, such as "improving the average mathematics score together by the end of term" or "participating in a science and innovation contest in pairs," students clearly perceive their close ties with the community. The joint pursuit of goals deepens their sense of "being part of the group." The community's cultural environment is equally critical: if values such as "inclusiveness, mutual support, and exploration" are

promoted, and administrators continuously foster a positive atmosphere for exchange, students gradually internalise these orientations. Symbolic identifiers within the community—such as level-based titles or exclusive avatar frames based on activity levels—reinforce students' sense of uniqueness and belonging, thereby strengthening identification with the community.

4.1.3. The role of social support in the formation of belonging

For middle school students, social support plays a pivotal role in cultivating belonging within virtual learning communities. At the emotional level, when students encounter academic difficulties or express anxiety, the comfort, encouragement, and empathetic responses from peers enable them to experience care and understanding, mitigating negative emotions and fostering psychological reliance on the community as a source of emotional support. Informational support is also vital: when students post requests for help during preparation or practice tasks, others may provide shared resources, skill guidance, and experiential advice, which helps them efficiently overcome difficulties and strengthens trust in the community. Peer companionship is another key factor: activities such as "online study rooms," where students connect in real-time and synchronise study periods, create a sense of being accompanied despite physical distance, alleviating feelings of isolation [14]. Through continuous social interactions, students eventually cultivate a stronger sense of belonging to the community.

4.2. Mechanisms Influencing Learning Engagement

4.2.1. Enhancing learning motivation through interaction and collaboration

Interaction and collaboration within virtual learning communities effectively stimulate adolescents' enthusiasm for learning and improve their participation [15]. From the perspective of communication, activities such as "learning experience sharing sessions" and "knowledge Q&A" provide opportunities for students to showcase their achievements and help others resolve doubts. Receiving likes or recognition for their contributions generates strong feelings of accomplishment and self-worth, with positive feedback significantly boosting intrinsic motivation. From the perspective of collaboration, group tasks clarify individual roles and responsibilities. For example, in preparing a scientific experiment report, group members may take on distinct roles such as designing the experiment, recording data, or analysing results. The interdependence of tasks fosters accountability, motivating students to dedicate more time and effort. The intellectual exchanges during collaboration, such as debates and refinements of experimental designs, broaden students' thinking and ignite their curiosity, thereby strengthening motivation and engagement.

4.2.2. Providing personalised learning resources and feedback

Virtual learning communities offer customised learning materials and feedback, creating favourable conditions for enhancing students' engagement. In terms of resource allocation, platforms analyse learning data, test performance, error patterns, and browsing history to deliver targeted content. Students struggling with geometry may receive explanatory videos and problem sets, while literature enthusiasts may be provided with reading lists and expert commentaries. This "on-demand allocation" allows students to quickly obtain suitable materials, avoiding information overload, saving time, and increasing efficiency—thereby encouraging greater learning investment. Regarding feedback, intelligent evaluation systems promptly grade assignments and tests, generating detailed error analyses and suggestions for improvement. Teachers and peers also contribute personalised comments: for instance, after a composition submission, teachers may highlight strengths and offer improvement tips, while classmates may share reflections or editing ideas. Timely and precise feedback enables students to identify weaknesses, adjust strategies, and pursue purposeful learning, thereby raising engagement.

4.2.3. Promoting responsibility and academic self-efficacy

Virtual learning communities also reinforce adolescents' sense of responsibility and self-efficacy, both of which are essential for deepened engagement. Responsibility is cultivated through mechanisms such as "task claiming" and "group leader elections," which encourage students to take

ownership of academic duties. For example, students who claim the weekly "key point summary" task must regularly compile and share content, knowing that delays will affect peers' revision progress [16]. This responsibility toward others translates into motivation for more active learning. Regarding self-efficacy, communities provide repeated opportunities to experience success. Through progressively challenging "knowledge checkpoints," students advance from basic to complex problems, receiving rewards and recognition at each stage. These sustained experiences of achievement foster the belief that "I can master the knowledge," thereby strengthening learning self-efficacy. Once students recognise their own competence, they are more willing to embrace challenges and devote energy to overcoming difficulties, leading to significantly greater learning engagement.

5. Strategies to Promote Middle School Students' Enhancement of Social Belonging and Learning Engagement through Virtual Learning Communities

5.1. Optimising the Environment and Functions of Virtual Communities

The foundation for improving middle school students' sense of social belonging and learning engagement lies in optimising the environment and functions of virtual communities. At the environmental level, a safe and inclusive communication atmosphere should be created, and a strict content review mechanism should be established to filter harmful information, eliminate cyberbullying and malicious ridicule, and ensure students' physical and mental safety within the community. The establishment of a "feedback channel" helps encourage students to make improvement suggestions, allowing them to feel the importance of their opinions. At the functional level, both social and learning needs should be met. On the social side, an "interest group" module can be developed, allowing students to create or join themed communities such as reading, programming, or art based on personal hobbies, so as to accurately match social needs. On the learning side, resource integration functions should be improved to build a clearly classified resource library that includes courseware, exercises, and extended materials, and to add a "learning progress tracking" function to help students record their learning trajectories and clarify their learning goals. The interface design of the community should be optimised with a concise and bright style, simplifying operation procedures and lowering the threshold of use for middle school students, so that they can easily participate in community interaction and learning, thereby enhancing their acceptance and dependence on the community.

5.2. Promoting a Culture of Positive Interaction and Cooperation

Creating a positive atmosphere of interaction and a cooperative culture can significantly strengthen middle school students' social connections in virtual communities and improve their learning engagement [17]. In terms of interactive organisation, the community should regularly plan diverse participation activities. "Weekly knowledge competitions" can be designed to include interesting questions from different subjects to stimulate students' enthusiasm for answering and communication. "Online thematic seminars" can focus on popular learning topics and growth challenges, with teachers or outstanding students invited to host and guide the discussion, preventing interaction from becoming superficial. Regarding the cultivation of a cooperative culture, a "stable group collaboration system" can be implemented. Students should be scientifically grouped according to their learning levels and personality traits, and each group should be assigned long-term collaborative tasks, such as completing interdisciplinary research projects together. Through continuous cooperation, students can build stable partnerships. A "collaboration model" selection mechanism should be established to reward teams or individuals who perform excellently in cooperation with electronic certificates or community points, fostering a community atmosphere of "willing to cooperate and good at helping each other." Teachers should actively participate in the interaction process, responding promptly to students' shared content and questions, thereby stimulating enthusiasm for community participation and encouraging students to strengthen their sense of social identity and actively engage in learning activities through positive interaction and cooperation.

5.3. Enhancing Personalised Support and Incentive Measures

To meet the specific needs of middle school students and enhance their enthusiasm for participating in community activities, it is crucial to implement personalised support programmes and incentive mechanisms. Personalised support should be based on big data technology to explore students' learning behaviours and social tendencies. For students with weaker academic foundations, "one-on-one online tutoring" can be arranged, with outstanding students or teachers providing specialised guidance. For more introverted students, they can be guided to participate in interaction themes or groups that match their interests and encouraged to share related content, using this as a starting point for their social engagement. The incentive mechanism should include both material and spiritual rewards. Spiritual motivation can be realised through a "growth level system," which promotes levels based on students' participation, academic achievements, and cooperative behaviour, unlocking honours such as exclusive avatars and community privileges. Material incentives can be provided in cooperation with schools, offering practical rewards such as learning supplies or extracurricular activity opportunities. The distribution of rewards should emphasise timeliness and fairness, ensuring students receive feedback quickly after achieving goals, and clear evaluation criteria should be established so that students understand their efforts are recognised, thereby becoming more active in community social and learning activities.

5.4. Strengthening Collaboration among Families, Schools, and Communities

Deepening collaboration between families, schools, and communities can build a comprehensive support network for middle school students and enhance the positive effects of virtual communities. At the level of home–school cooperation, a "home–school interaction platform" should be created to regularly inform parents about students' participation in virtual communities, learning duration, and frequency of social interactions, and to invite parents to join community activities. A "parent–child co-learning programme" can encourage parents and students to complete community learning tasks together, deepening parent–child communication and guiding students to use community resources appropriately. Schools should provide guidance to parents to help them understand the significance of virtual communities and avoid excessively restricting students' use. In terms of community cooperation, offline community resources can be integrated, such as inviting professionals and university volunteers to participate in virtual communities to hold lectures and learning guidance, enriching community content. "Online and offline integrated" activities can be planned—for example, virtual communities initiating knowledge competitions, with offline communities providing venues and prizes—allowing students to enhance their sense of social identity through the interaction of virtual and real engagement. Through multi-party collaboration, educational strength can be consolidated to ensure the growth of middle school students in virtual communities and promote their progress in social and learning abilities.

6. Conclusion

This study focuses on the impact of participation in virtual learning communities on middle school students' sense of social belonging and learning engagement. Through comprehensive and in-depth analysis, several important conclusions are drawn.

Regarding the current situation, the development trend of virtual learning communities is good, and the participation of middle school students is continuously increasing. However, there is still room for improvement in their sense of social belonging and learning engagement. Further exploration of the influencing mechanisms reveals that virtual learning communities effectively enhance middle school students' social belonging through interactive communication, strengthening identity, and providing social support; and significantly improve learning engagement through promoting communication and cooperation, offering personalised resources and feedback, and enhancing a sense of responsibility and self-efficacy.

Based on the above research results, a series of targeted strategies are proposed to promote middle school students' enhancement of social belonging and learning engagement through virtual learning

communities. Optimising the environment and functions of virtual communities can create a good atmosphere for learning and socialising; promoting positive interaction and a cooperative culture can strengthen their sense of participation and teamwork ability; enhancing personalised support and incentive measures can meet individual differences and stimulate learning motivation; and strengthening collaboration among families, schools, and communities can form educational synergy to comprehensively guarantee students' growth and development.

In the future, it is expected that educators, parents, and communities will work together to fully leverage the advantages of virtual learning communities, create a higher-quality learning and social environment for middle school students, help them gain a stronger sense of social belonging and learning engagement in virtual learning communities, and achieve all-round development.

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