

## Understanding Motivational Dynamics in Elementary Mathematics Extracurricular Activities from a Humanistic Education Perspective

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**Abstract** Mathematics education has increasingly embraced humanistic approaches that prioritize holistic student development over traditional computational skills. This study examined factors influencing elementary students' engagement in mathematics extracurricular activities in Chaoyang District, Beijing, from a humanistic education perspective, addressing significant gaps in understanding motivational dynamics within Chinese cultural contexts. A quantitative cross-sectional survey involved 200 elementary students (Grades 3-6) from selected schools. Data were collected using a structured questionnaire measuring motivational

factors, engagement strategies, perceived challenges, and student engagement levels. The instrument demonstrated satisfactory reliability with Cronbach's alpha coefficients exceeding 0.70 for all constructs. Results revealed significant positive correlations between motivational factors and engagement ( $r = 0.62$ ,  $p < 0.001$ ) and between engagement strategies and participation ( $r = 0.57$ ,  $p < 0.001$ ). Perceived challenges showed moderate negative correlation with engagement ( $r = -0.39$ ,  $p < 0.001$ ). Regression analysis identified motivational factors as the strongest predictor ( $\beta = 0.49$ ), followed by engagement strategies ( $\beta = 0.42$ ). Significant grade-level differences were observed ( $p = 0.003$ ). The findings demonstrate that student engagement emerges from complex interactions between intrinsic and extrinsic motivational factors, pedagogical approaches, and cultural influences. The dual influence of individual autonomy and collective support systems in Chinese contexts challenges Western individualistic frameworks. These insights inform development of culturally responsive, humanistic mathematics programs that foster intellectual growth while promoting equitable access to enriching mathematical experiences.

**Keywords:** Humanistic education; Mathematics extracurricular activities; Student motivation; Elementary education; Cultural responsiveness

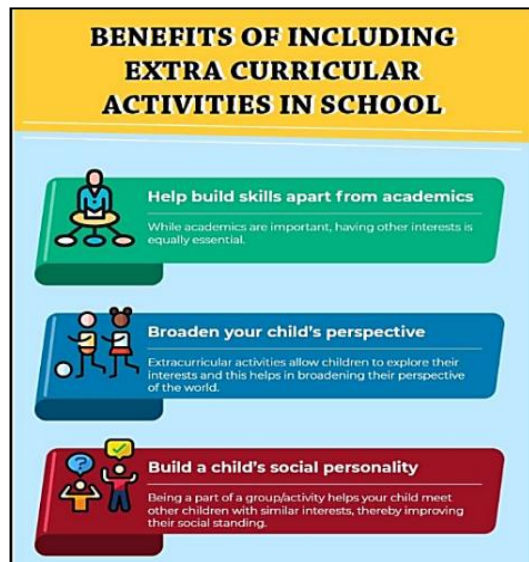
## 1 Introduction

The perspective of mathematics teaching has greatly changed from a traditional focus on number and computational skills to a more holistic approach of child-centered development [1]. This philosophical switch is suggestive of the influence of education theorists who argued that mathematics is a route to critical thinking, creativity, and emotional intelligence rather than the transmission of knowledge about mathematics [2] and a product of social constructivism-based thought on learning about mathematics as a metaphor rather than a concrete language based only on procedures [3]. Conversely, recent educational discourse has been increasingly privileging the need to cater to cognitive, affective, and social dimensions of learning to engage students' intrinsic motivation and personal connection to mathematical ideas [4].

Humanistic education principles have been seen as most useful in the extension classroom for the purposes of mathematics education [5]. Chapman et al. Methodological Programmes of Work These programmes offer students experiences of doing mathematics in risk-free, exploratory modes that are beyond the constraints of the typical classroom [6]. Studies show that well-designed mathematics ECAs can improve student problem-solving capability, cultivate peer collaboration, develop leadership capabilities, as well as build math ability (Figure 1) [7, 8].

In Chinese culture, the students' motivation is deeply influenced by the collective learning tradition and the family values of education [9], which makes the reasons for participating in mathematics out-of-class activities more indispensable. In this paper, the educational environment and conditions in Chaoyang District of Beijing are considered a typical educational model, and traditional Chinese educational ideas integrate with today's education reform in ways that generate special relationships between students and education workers [10, 11].

While awareness of the critical role that extracurricular mathematics programs play is increasing, how multifaceted motivational factors of Chinese elementary students shape their participation still falls short in the literature [12]. This void is filled by this research by investigating motivations, strategies to engage, as well as perceived barriers that impact elementary students' participation in mathematics after-school activities in Chaoyang District, Beijing. Through the lens of a humanistic education theorization, including Self-Determination Theory[13] and Expectancy-Value Theory [5], this research seeks to provide indications that can guide the design of more equitable and successful mathematics ECAs for diverse learners that meaningfully respect students' culture as they are included and promote a whole student approach to growth and development.



**Figure 1:** Benefits of extra-curricular activities

## 2 Theoretical Framework

### 2.1 Mathematics Education from a Humanistic Perspective: A Review

Rooting itself in human thought, education's philosophical foundation originated from those main educational theorists to give a good rejection of the traditional learning model. Dewey's [14]theory of experimental education turned mathematics into a thing to be lived, possessed, and mastered directly upon concrete problems, while Freire's [2] critical pedagogy turned mathematical learning from the passive reception of words into an active constructive process. Peters's [15]person-centered approach introduced a psychological dimension emphasizing student agency, emotional security, and personal connection to mathematical concepts. These converging theories placed mathematics education into a whole-person development perspective rather than just teaching procedural skills.

Contemporary research has tested these humanistic principles in the world and used empirical evidence to show that they are not only good for mathematics problems but also for the health of students themselves. Boyle's [16] work on mathematical mindsets spells out how humanistic approaches lead to very different kinds of relationships between students and mathematics: growth and creativity are emphasized over fixed ability. Attard's [17] studies of engagement confirm that students who gain a sense that what they are doing in math is meaningful to their own lives will go a lot further in their math studies. Hill et al. [3] have observed how student-centered pedagogies improve the ability of students of all backgrounds and learning styles to get on in life.

Despite sound theoretical underpinnings, considerable knowledge gaps persist regarding how humanistic principles operate in extracurricular mathematics settings. While classroom-based aspects of humanistic dialogue have been well-studied, areas such as voluntary math clubs are quite deserving of greater research attention by means of student-centered learning inquiry [7]. It is at this intersection of humanistic educational theory and extracurricular participation that lies an as-yet neglected field whose consequences for designing more attractive and equitable mathematical learning experiences, extending beyond the bounds of traditional classrooms, will be profound.

## 2.2 Extracurricular Activities and Student Engagement: Current Research

Research on extracurricular activities has consistently shown them to have a significant impact on student development, extending far beyond traditional academic outcomes. Iddrisu [18] found that while extracurricular activities do not necessarily lead to improved academic performance and achievement, they make a significant contribution toward developing a wide range of skills. In addition, they make an equally pronounced contribution to students' social competence and personal growth. Peer interaction and teacher involvement are factors that appear to be common to positive learning experiences in extracurricular activity settings, as we may ascertain from the conclusions of Fredricks et al. [19]. The supportiveness of social environments within which these experiences take place is stressed. In international comparative studies, it can be seen that various approaches to extracurricular programming exist: American models emphasize choice for the individual, while European systems attempt to provide community-based learning, and Asia incorporates extracurricular activities in concert with formal curriculum goals [18].

Mathematics extracurricular activities have special features that differentiate them from other discipline-based programs. According to Sun et al. [7], mathematics clubs, competitions, and interactive workshops afford students the means of joint problem-solving. This approach to mathematical work allows students to discover for themselves new facts—it is creative activity integrated into research. Bonsu et al. [6] said that these activities help students to acquire depth of knowledge and also to find their feet as independent researchers—breathing examples outside the womb-like atmosphere which materializes in traditional classrooms. Because the style of learning associated with extracurricular mathematics programs often lies somewhere between formal education and simple exposure to skills, it can best be individualized. It can also cater to a broad spectrum of diverse modes of learning that are not necessarily catered for in a conventional educational setting.

Besides all its attractions, there are still major obstacles that make it difficult for many students to take part in mathematics extracurricular activities. As shown by the Collins-Jones and Roberson index [20], socioeconomic factors, such as transportation charges or conflicting family obligations, have an unfair impact on student participation. In an environment that is extremely competitive academically, time constraints and pressures over the amount of work only compound matters further—taking into account also that students need to balance many demands upon them at one time. The problems of accessibility they bring under scrutiny create whole new channels for thinking about school fairness; both cognitive gains and personal development will be that much easier when all are engaged in rich learning environments.

### **2.3 Motivational Theories in Mathematics Learning Contexts**

A comprehensive understanding of student motivation in mathematics learning requires the interaction of multiple theoretical perspectives that address the multi-faceted psychological processes which underlie engagement and participation. In such a theory, Self-Determination Theory (SDT) provides formative patterns built on three basic human needs: autonomy, competence, and relatedness to generate intrinsic motivation for one's math curriculum [9]. Research shows that the distinction between autonomous and controlled forms of motivation leads to differences in participation patterns at all levels of voluntary activities, doing voluntary mathematics being no exception. Students who receive support for autonomy, who are mathematically competent, and who maintain positive relationships with their fellow students and teachers show signs of participating on a higher level [5].

Expectancy-Value Theory is particularly useful in working with SDT because it looks at how students' beliefs about their own capabilities in mathematics learning—as well as the classroom incentives associated with different math activities—affect whether or not they will participate. Students' success expectancies based on their self-concepts and self-efficacy beliefs, as well as the task values intrinsic to

math-learning experiences (pleasure, attainment value, utility value), are keys to their patterns of participation [4]. Social Cognitive Theory provides another layer of understanding through its emphasis on the reciprocal relationships among personal factors, environmental influences, and behavioral outcomes in a learning context [21].

Achievement Goal Theory goes one step further by distinguishing between mastery goals focused on learning and understanding versus performance goals oriented towards demonstrating one's worth compared with others. In general, students with mastery orientations are more persistent than those with other orientations, tend to use better learning strategies, and show a more positive attitude towards mathematics[22]. Taken together, these frameworks provide a solid foundation for understanding the multi-faceted nature of student motivation in mathematics intramural contexts.

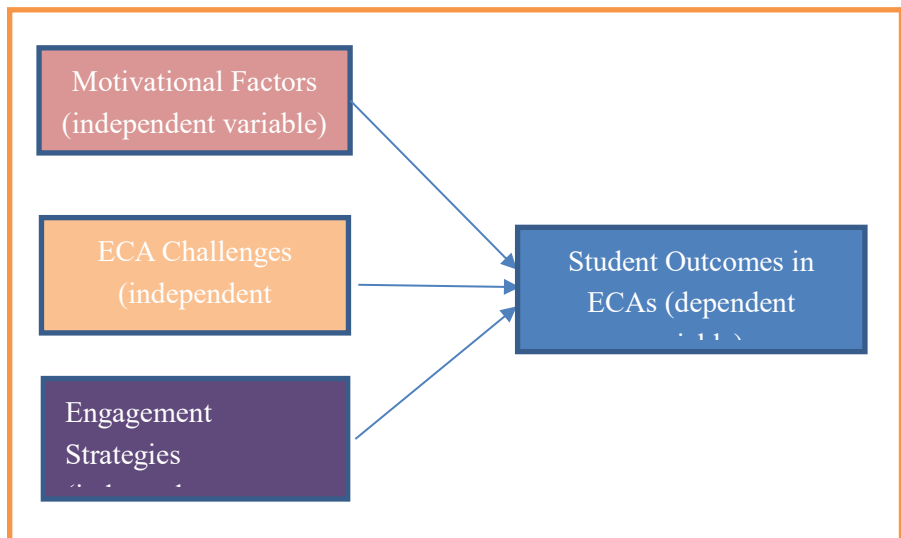
## **2.4 Integrated Theoretical Framework**

This conclusion combines human educational principles with classical motivational theories and therefore creates a comprehensive framework that is applied to all students participating in mathematics extracurricular activities. Drawing from Dewey's [14] experiential learning, Freire's [2] critical pedagogy, and Rogers's [15] person-centered education, the framework places student agency and meaningful engagement at its core. These are therefore central to effective mathematics experiences and experiences with mathematical language. The humanistic underpinnings of the model are consistent with Self-Determination Theory, which emphasizes autonomy, competence, and relatedness as its three root drivers of intrinsic motivation [13]. And it is this susceptibility to intrinsic motivation that most pleases the human heart.

The conceptual framework includes the Expectancy-Value Theory on students' expectancy that they will do well and value of tasks. This theory holds—as noted in Expectancy-Value and Motivation In Mathematics [23]—that one's investment

in performing any activity will depend on self-assessed ability to carry out the task and personal judgment about its worth. Because academic achievement is of great social significance in Chinese cultural contexts, the balance between intrinsic enjoyment and acquisition value becomes even more important for deep involvement [24].

The structural framework for the theoretical mode of action is provided by Social Cognitive Theory's reciprocal determinism model, which examines how motivational factors, strategies for engaging, and perceptions of challenges together mold student outcomes in dynamic interaction [25]. The special contribution of the integrated framework is that it explicitly links humanistic educational values with empirical research on motivation conducted within a particular cultural environment — thus providing a delicate outline of how extracurricular mathematics can satisfy student needs while nurturing their intellects (Figure 2).



**Figure 2:** Conceptual framework  
(Source: Self-Made)

### **3. Methodology**

#### **3.1 Research Design and Participants**

This study adopted a quantitative cross-sectional survey design to investigate factors influencing elementary students' engagement in mathematics extracurricular activities. Data were collected from participants at a single time point to examine relationships among motivational factors, engagement strategies, and perceived challenges.

The study involved 200 elementary students from selected schools in Chaoyang District, Beijing, China. Participants were recruited through purposive sampling, with inclusion criteria requiring current or prior participation in mathematics extracurricular activities. The sample comprised students from Grades 3-6 (ages 8-12 years), with balanced gender distribution (49.5% male, 50.5% female) and even grade-level representation. This demographic composition ensured adequate variability across developmental stages and provided sufficient statistical power for subsequent analyses [20].

#### **3.2 Data Collection Instruments and Reliability Testing**

A structured questionnaire was developed as the primary data collection instrument, incorporating validated scales adapted from existing motivational research literature [25]. The instrument comprised four main sections: demographic characteristics, motivational factors, perceived challenges, and student engagement levels, all utilizing five-point Likert scales ranging from "Strongly Disagree" to "Strongly Agree."

The questionnaire items were systematically developed through literature review of established measurement tools and underwent content validation by educational psychology experts to ensure cultural and linguistic appropriateness for Chinese

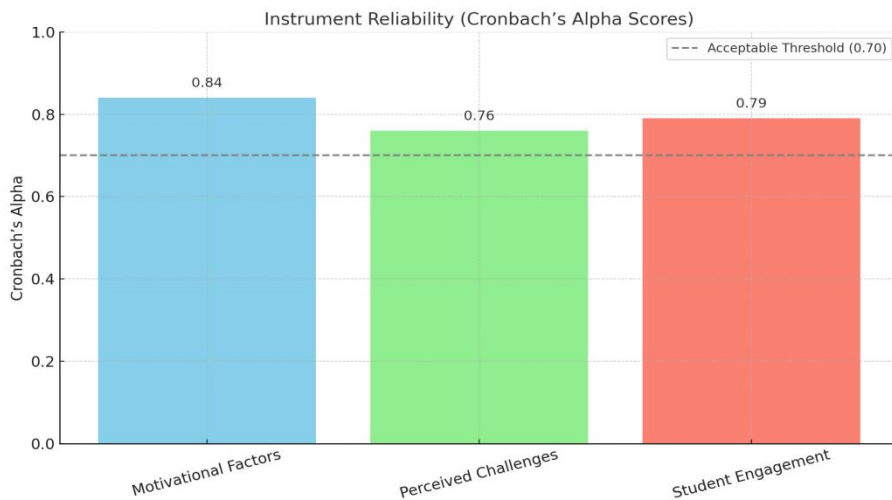
elementary students [26]. Items were simplified to accommodate the cognitive capacity and comprehension levels of the target age group.

A pilot study was conducted with 30 students from schools not included in the main study to assess item clarity and response format effectiveness. This preliminary testing facilitated refinement of item wording and response formats, ensuring the instrument's suitability for the target population before main data collection.

## **4. Research Results**

### **4.1 Instrument Reliability**

Reliability analysis confirmed the internal consistency of all measurement scales employed in this study. Cronbach's alpha coefficients exceeded the commonly accepted threshold of 0.70 for all constructs, with motivational factors demonstrating the highest reliability ( $\alpha = 0.84$ ), followed by student engagement ( $\alpha = 0.79$ ) and perceived challenges ( $\alpha = 0.76$ ) (Figure 3). The reliability coefficients indicated that items within each scale consistently measured their respective underlying constructs, providing confidence in the stability and dependability of the measurement instruments. The motivational factors scale exhibited particularly robust internal consistency, suggesting that the items effectively captured both intrinsic and extrinsic motivational dimensions as conceptualized in the theoretical framework. The acceptable reliability levels across all scales supported the validity of subsequent statistical analyses and strengthened the interpretability of research findings. These reliability results demonstrated that the adapted measurement instruments successfully maintained their psychometric properties when applied to Chinese elementary school students, confirming the appropriateness of the scales for examining motivational dynamics in mathematics extracurricular activities within this specific cultural and educational context.



**Figure 3:** Cronbach Alpha Bar chart

## 4.2 Participant Characteristics Analysis

The gender distribution of participants demonstrated a balanced representation across male and female students. Analysis of demographic data revealed that 50.5% of participants were female students, while 49.5% were male students (Figure 4). This near-equal gender distribution provided an optimal foundation for examining potential gender-related variations in motivational patterns and engagement behaviors within mathematics extracurricular activities. The balanced sample composition minimized the potential for gender bias in subsequent statistical analyses and enhanced the reliability of comparative assessments between male and female participants. Such demographic equilibrium supports the generalizability of findings across gender groups and enables meaningful interpretation of motivational differences that may emerge between male and female elementary students in mathematics learning contexts.

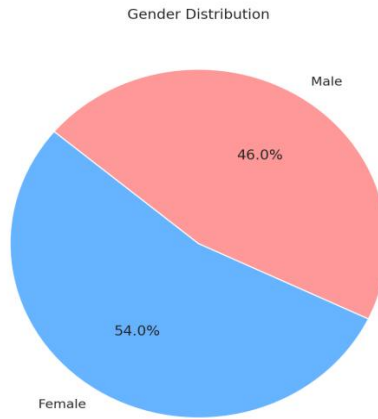
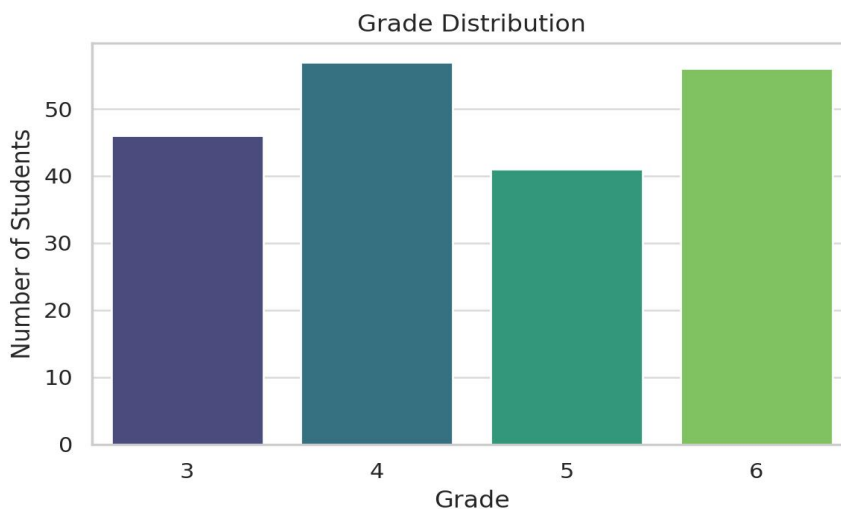


Figure 4. Gender Pie chart

The grade-level distribution across participants exhibited relatively even representation among the four target elementary grades. Grade distribution analysis indicated that Grade 3 students comprised 24% of the sample, while Grade 4 and Grade 6 students each represented 25.5% of participants (Figure 5). Grade 5 students constituted 25% of the total sample, creating a well-balanced representation across all elementary grade levels examined in this study. This even distribution across grades provided adequate statistical power for developmental comparisons and enabled the detection of grade-related differences in motivational factors and engagement patterns. The balanced grade composition facilitated meaningful analysis of how student engagement in mathematics extracurricular activities may vary across different stages of elementary school development, supporting robust cross-grade comparisons while maintaining sufficient sample sizes within each grade category for reliable statistical inference.

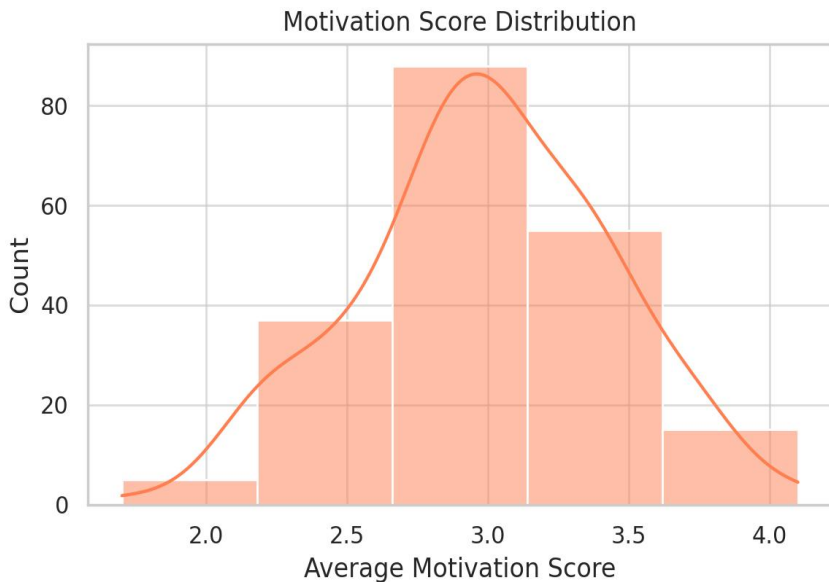


**Figure 5:** Grade distribution

### 4.3 Motivational Factors Analysis

The distribution of motivation scores among participants revealed varied patterns of motivational orientation toward mathematics extracurricular activities. Analysis of motivational factor scores demonstrated considerable variability in students' intrinsic and extrinsic motivational profiles, with scores spanning the full range of possible values on the measurement scale (Figure 6). The motivation score distribution exhibited characteristics consistent with normal distribution patterns, indicating that the sample captured students with diverse motivational orientations ranging from low to high levels of engagement motivation. This variability in motivational scores provided optimal conditions for examining relationships between different motivational profiles and subsequent engagement behaviors. The distribution pattern suggested that students approached mathematics extracurricular activities with heterogeneous motivational frameworks, reflecting individual differences in personal interest, perceived competence, and responsiveness to external incentives. Such motivational diversity within the

sample enhanced the analytical power for detecting meaningful associations between motivational factors and student engagement outcomes in subsequent correlation and regression analyses.



**Figure 6:** Motivation Score Distribution

#### 4.4 Variable Relationship Analysis

Statistical analysis revealed significant associations between all measured variables and student engagement in mathematics extracurricular activities. Correlation analysis demonstrated that motivational factors exhibited the strongest positive relationship with engagement ( $r = 0.62$ ,  $p < 0.001$ ), indicating that students with higher motivational orientations displayed correspondingly greater levels of participation and involvement (Table 2). Engagement strategies also showed substantial positive correlation with student engagement ( $r = 0.57$ ,  $p < 0.001$ ), suggesting that effective pedagogical approaches significantly influenced

students' willingness to participate actively in mathematics extracurricular programs. Conversely, perceived challenges demonstrated a moderate negative correlation with engagement ( $r = -0.39$ ,  $p < 0.001$ ), confirming that students who encountered greater barriers experienced reduced levels of participation. Regression analysis further substantiated these relationships, with motivational factors serving as the strongest predictor of engagement ( $\beta = 0.49$ ), followed by engagement strategies ( $\beta = 0.42$ ) and perceived challenges ( $\beta = -0.31$ ). Analysis of variance revealed significant differences in engagement levels across grade levels ( $p = 0.003$ ), indicating that developmental factors also contributed meaningfully to student participation patterns in mathematics extracurricular activities.

**Table 2:** Variable Summary Table of Results

Variable	Correlation with Engagement	p-value	Regression $\beta$	Significance
Motivation	0.62	<0.001	0.49	Significant
Engagement Strategies	0.57	<0.001	0.42	Significant
Perceived Challenges	-0.39	<0.001	-0.31	Significant
Grade Level (ANOVA)	-	0.003	-	Significant

## 5. Discussion

These findings reveal many significant insights into the complex motivational dynamics shaping whether pupils can participate in mathematics extracurricular activities. Taken from a humanistic education approach, the strong positive correlation between motivational factors and involvement ( $r = 0.62$ ) is consistent with Self-Determination Theory's fundamental proposition: that sustaining lifelong learning behavior relies on intrinsic motivation[27]. This relationship

extends beyond traditional measurement of success to include psychological, emotional, social, and cognitive dimensions of mathematical learning, as Attard [17] claims. Meaningful engagement with mathematics occurs when students feel it has relevance to themselves personally and find joy in what they are doing.

The double dosage of intrinsic and extrinsic motivational factors, unlike traditional Western individualism education context, blurs such clear-cut categories. In contrast to Western methods that usually place all emphasis on individual achievements, China's collectivist educational environment is a complex interwoven system of influences. There, parents encourage and peers give recognition are as essential to starting off as the scaffolding around those very first steps [28]. Our findings support Johnson et al.'s [9] bi-directional view while highlighting a need for pedagogical approaches that respect individuals and give systemically nurturing background support to their unique personalities as well. This generative approach will continue to be fruitful.

The strong position of engagement artifacts on student participation ( $r = 0.57$ ) suggests that innovative methods must be adopted in mathematics extracurricular activities. Gamification, personalized feedback systems, and interactive ways of teaching were particularly effective at motivating participation by students involved in these activities[29]. These findings suggest that humanistic education principles can be implemented through various teaching strategies that place students in charge of their own learning and make problem-solving meaningful reality.

The moderate negative correlation between perceived challenge and engagement ( $r = -0.39$ ) screams with calls for justice in education. Technology, time management, scheduling conflicts—these are all access barriers that determine patterns of engagement and may favor students from families with higher incomes or more spare time [30]. From a humanistic perspective, these are barriers to the intellectual development of students, barriers that mean students' right to explore and conquer mathematics does not have recourse. What is needed is an

institutionalized system which combines support throughout the institutions and designs rules which can ensure this.

Several limitations need to be addressed when interpreting these findings. First, the cross-sectional design precludes establishment of causal relationships; moreover, relying on self-reported data might have introduced response bias. Second, given the Chaoyang District context's purposive sampling strategy along with its cultural specificity, these results cannot be generalized to other populations or educational systems too readily either. Third, we recommend that future studies set up a longitudinal tracking system, conduct cross-cultural comparative analyses, and employ mixed methodologies so as to enhance understanding on the part of students in informal math-learning fields while at the same time providing theoretical insights for making all students' educational experiences more inclusive.

## **6. Educational Implications**

Specific suggestions really aren't teaching students to develop a variety of motivations; humanistic mathematics programs and extracurricular programs do. To appeal to the intrinsic motivation of different children and teenagers working in a comprehensive manner, mathematics teachers must first find a way out where there's no way in. Differentiated motivational strategies, for example, set up clubs or groups, Maths-based Interest organizations (astronomy in mathematics, sports statistics, and number theory cookery HQs; bird-watching and wildlife photography all include math clubs) should be introduced to attract students who come from various backgrounds.

In the meantime, structured recognition systems, such as progress portfolios built individualistically while parallel to classroom work, can provide long-term psychological preparation for success. Peer appreciation circles that promote non-competitive equals among friends and family presentations in the auditorium are designed both as an incentive mechanism and as a modern form of

parent-teacher conferences to discuss how an individual student is doing or generally about our school. Educational software exactly designed for school-aged students ought to be made. In this light, we are very confident that we can get not only encouragement for our work from the market but also positive feedback!

Professional development programs should concentrate on three main tasks: elaboration interviews to discover student interests and concerns, politically reinforced pedagogy practices into the mathematical curriculum (inspiring learners who link symbolic thinking with their life experience), and technology integration skills. For instance, primary school-age children not only with computer games that are age-appropriate expressions of math activity but also in how they can work together as a team at different stages of solving problems, continually changing each other's pieces around. The design of Curriculum Content and learning style must be such that students can go their own way: join in as soon as they get interested and leave when they lose focus. It had to be so designed that students could enter and leave whenever they wanted.

Schools should apply systematic barrier reduction tactics. For example, they could provide transportation vouchers to those who come from far away or an alternate language facility system where the school communicates in many languages. They should also set up "peer buddy" systems in which experienced participants are matched with beginners. In addition, protocols for teacher-parent collaboration should be established. These protocols could include monthly communication templates between home and school, handouts that give parents ideas about what extension activities they might do in the home to tie into what children are learning at school, and even family math engagement workshops to create a stronger ecosystem of support around children who are taking part in maths clubs.

Educational policy should require that extracurricular mathematics programs are all-inclusive. These programs need to bring about the fairness issue parity check: how many children from various demographic groups are being served with this program and who is not included at what level of extent? In addition, educational

policymakers should make sure that there is a school funding formula that takes into account those needs above 1 norm as they allocate resources to schools serving high-poverty populations. Finally, programs should be forward-looking because the whole point of policy frameworks is continuity—so an obvious thing should be established as annual evaluation protocols for these programs using both quantitative participation data and qualitative student voice surveys by which continuous improvement towards equity in outcomes can be maintained.

## **7. Conclusion and Future Directions**

From the perspective of humanistic education, this study provides profound theoretical and practical support for understanding pupils' participation in maths extracurricular activities. Prior research contends that motivational factors, instructional strategies, and perceived difficulties are interwoven in complex ways that determine how students participate. In other words, student educational models are not simple complexes but intertwined into an entire fabric of instructional psychology and conditions.

With a model based on a synthesis of three theoretical contexts — Self-Determination Theory, Expectancy-Value Theory, and Social Cognitive Theory — we have a more holistic and profound understanding of which psychological needs, teaching methods, and environmental contexts intersect to create meaningful experiences of mathematics learning. The results become part of a rapidly developing literature that is now beginning to recognize that extracurricular activities are not merely added features but should function as a part of all-around education. The means to sustain student autonomy, promote social tie-ups, and cultivate intellectual interest will be developed within mathematics learning contexts.

There are several limitations to this study. The cross-sectional design cannot establish the causal relationships between any of these variables, nor can it capture how student motivation changes over time. The use of self-reported data may lead

to response bias, especially among younger participants. We therefore need to take a mixed approach that includes both observational materials and objective engagement indicators. Future research should extend sample variation throughout different regions and school systems with the aim of improving generalizability and moving findings closer to actual educational practice. Additionally, investigation of the long-term impact of early mathematics extracurricular participation on students' STEM career trajectories and mathematical identity development would provide valuable evidence for educational policy and program design decisions.

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