

Mathematical Modeling Instruction Based on ISM In Middle and High Schools to Encourage Path-Obstruction Detection

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Abstract. The mathematical modeling course is one of the courses in the mathematics curriculum that has the most cross-cutting content with other courses, and achieving cross-curricular outreach is an important part of integrated practice implementation. This study uses the ISM method to find 18 factors from 5 dimensions that prevent the promotion of mathematical modeling courses, explains how the components are interconnected, and arranges the link using hierarchies, concludes that social support has the most significant impact on the promotion of mathematical modeling courses, and that their development cannot be achieved without the collaborative efforts of society, schools, teachers, and students. This study makes recommendations for reforming the system for integrating and developing mathematical modeling courses with basic courses, as well as for increasing awareness of and recognition for these courses with the cooperation of multiple parties.

Keywords: ISM, Core Literacy, Obstacle's identification, Mathematical modeling course promotion.

1. Introduction

The Chinese Ministry of Education released the "Curriculum Guideline for Integrated Practical Activities" in 2017, which stipulates that it be taught as a required subject at all grade levels; the "New Curriculum" will place more emphasis on interdisciplinary thematic learning starting in 2022. Due to its high level of compatibility with the content of interdisciplinary integrated practice, the mathematical modeling curriculum is progressively attracting significant attention in the education sector. However, in basic teaching, the results of mathematical modeling teaching are not satisfactory. It may be possible to accelerate and improve the deployment of interdisciplinary content practices in mathematics classes by researching the obstacles to the expansion of mathematical modeling courses in middle and high schools.

This research draws the conclusion from the prior literature that the students, teachers, curriculum, school, and society are the primary influences on the promotion of mathematical modeling courses.

For student and teacher level factors, according to WANG [1]'s paper "Reflections on Teaching and Learning Mathematical Modeling in Secondary Schools," which he wrote after conducting research and making practical observations about mathematics teaching in Chinese high schools, mathematical modeling courses and mathematical applications are not identical thing, and teaching must maintain logical coherence.

Additionally, in their paper titled "The Knowledge Form of Mathematical Modeling in New High School Mathematics Textbooks from the Perspective of Teaching Transformation Theory", HUANG et al [2] examined the significance of teaching mathematical modeling in Chinese education and proposed that in order to encourage the healthy development of mathematical modeling courses, teachers must be aware of their connotation and instructional components.

The curriculum itself has also been studied by several academics. ZUO [3] examined the issue of "difficult to choose, difficult to do, and difficult to finish" in the mathematical modeling course and teachers must assist students in overcoming the difficulties in the mathematical modeling course.

In addition to this, with regard to factors related to social aspects. ZHANG & LEI [4] analyzed many factors affecting the development of integration of sports and education from three aspects: drivers, policy factors, and support factors, and proposed in the article "Research on the influencing

factors of the development of integration of sports and education based on ISM model" that the development needs the support of reserve talent structure and competition system.

Finally, a number of academics have conducted extensive research on school-related variables. The secondary school mathematical modeling curriculum, according to SU& CHEN [5], requires schools to put up a reasonable curriculum, improve school-enterprise linkage and cooperation in education, and evaluate students' achievements in a variety of ways.

According to the findings of earlier research, the majority of theoretical studies simply examine how specific parameters affect mathematical modeling courses and are unable to explain the fundamental connections between the variables and the methods by which they have an effect. This paper introduces ISM method, uses the ISM model to calculate the importance of the barrier factors, and provides specific policy recommendations based on the results of the ISM calculation for an in-depth analysis of each type of factor. ISM model is used to identify 18 barrier factors for the promotion of mathematical modeling courses in middle and high schools in five dimensions. Additionally, by focusing on their strengths and avoiding their weaknesses during the teaching process, educators can enhance the teaching effectiveness of mathematical modeling courses. This can be done by using the research in this paper to identify the causes of the poor teaching effectiveness of mathematical modeling courses.

2. Identification of promotion-related obstacles

2.1. Level of Curriculum Ontology

Modeling concepts and mathematical modeling are both referred to as one of the core literacies in mathematics in the Chinese Curriculum Standards for Compulsory Education in Mathematics (2022 Edition) and the Curriculum Plan for General High School and Curriculum Standards for Mathematics (2017 Edition). Its distinguishing feature is that the New Curriculum is "literacy-oriented." Due to this, it's essential to uphold a high standard of instruction during the development and execution of the curriculum, with the subject's quality at its core.

The implementation of a curriculum for mathematical modeling should be based on the description of core literacies in the new curriculum, the structural integration of teaching materials and related materials, a reasonable and effective teaching design, a focus on hierarchy and diversity, an appropriate reflection of interdisciplinary theme learning, and the execution of some mathematical modeling courses for students.

In conclusion, the curriculum ontology level limiting factors identified in this study are a low percentage of mandatory information in textbooks (R_1), high learning threshold (R_2), challenges in teaching practice (R_3), and absence of teaching assessment techniques (R_4).

2.2. Level of Social Orientation

The demand for skills in today's society goes beyond only requiring students to be experts in a broad variety of professional knowledge; it also includes the requirement that students be able to apply their knowledge and work through issues. In light of this, the development and promotion of courses in mathematical modeling is ultimately a related process of societal literacy development and training. As a result, two key elements in the promotion of the curriculum are the mainstream society's acknowledgment of this fundamental literacy and the demand for abilities associated with it.

The social level can effectively promote the promotion and development of the pertinent courses if it can successfully integrate the pertinent synergistic social resources and standardize and popularize the pertinent competitive system.

In conclusion, this paper's collection of social-level limiting factors includes a deficient educational environment (C_1), a flawed competition system (C_2), a lack of social support (C_3), and insufficient talent development (C_4).

2.3. Level of School Management

It is impossible to separate the specific development activities and design plans for the pertinent core literacy courses from the school education managers' knowledge and comprehension of the new curriculum reform as well as their research into and application of the new standards. Schools should modify the curriculum plans for essential literacy-focused education reform and offer acceptable and suitable class schedules for the pertinent courses.

Schools should also coordinate and support the teaching and research efforts of faculty members, vigorously support the implementation of the national curriculum in classrooms, encourage the growth of pertinent practical activities, create contexts for instruction that emphasize the subject's core literacy, and start original campus cultural events. It is also necessary to judiciously introduce hardware and software in terms of objective conditions in order to increase the chance of student-teacher interaction and cooperative learning.

In conclusion, the stumbling blocks identified in this work at the school level are a lack of focus on curriculum development (M_1), isolated practice activities (M_2), out-of-date hardware settings (M_3), and infrequent teaching and research activities (M_4).

2.4. Level of Teacher Quality

The teachers' own technical and pedagogical level has a direct impact on the practical application of the course in mathematical modeling, but the course's fundamental concepts still rely on the teachers' fundamental literacy. But each board needs to be strengthened and enhanced based on its three components—knowledge literacy, competence literacy, and practical literacy—by combining the elements of mathematical modeling courses, which require teachers to continuously learn, update their initial knowledge structure, improve their knowledge system, raise the bar of their instruction, and have high and thorough competence.

Since they actively participate in front-line teaching activities, teachers in mathematical modeling courses are ultimately dependent on their teaching for the transfer of knowledge and the use of resources. It is obvious how the numerous literacy components of mathematical modeling courses affect how well they are promoted.

In conclusion, this paper's collection of limiting variables at the school level includes a lack of practical literacy (T_1), inadequate competence literacy (T_2), and insufficient knowledge literacy (T_3).

2.5. Levels of Student Literacy

Every interaction between teachers and students takes place in the classroom, and this interaction is crucial to both teachers' teaching and students' learning. Therefore, improving core literacy and successful teaching is only possible when students are actively engaged in and incorporated into the learning process in the classroom.

The success of the course is greatly influenced by the level of student participation and engagement, which has a bearing on the learning threshold and prerequisites for the mathematical modeling course. As a result, for the practice and promotion of the course, the students' understanding of mathematical modeling, mathematical modeling cognition, basic skills, and literacy are all significant variables.

In conclusion, the limiting factors identified in this paper at the student level are inadequate basic skills and literacy (S_1); low awareness of mathematical modeling (S_2); and weak recognition of mathematical modeling (S_3).

Based on the explanation above, Table 1 displays a system of indications of barriers to diffusion.

Table 1. System of indicators for diffusion barriers

Secondary indicators	Tertiary indicators	Description of the Indicator	Serial number	Ref
Curriculum Ontology	The low percentage of compulsory content in the textbook	At the moment, textbooks are the most widely utilized instructional resources, and they play a significant role in popularizing mathematical modeling	R_1	[6]
	Higher learning threshold	High levels of foundational knowledge and proficiency are needed for mathematical modeling courses, as well as broad competencies like knowledge transfer and transdisciplinary literacy	R_2	[6]
	Difficulties in teaching practice	Since a mathematical modeling course is developed differently from a standard course, there are procedural challenges at every level of teaching practice	R_3	[6]
	Lack of teaching evaluation methods	The revised criteria still do not give explicit indicators for observation or take into account students' fundamental literacy	R_4	[6]
Social Orientation	Underdeveloped educational environment	Although there has been a fairly well-developed training system for mathematical modeling in higher education, the community's acceptance and support for the creation of mathematical modeling courses are insufficient	C_1	[4]
	Imperfect competition system	Competitions in pertinent mathematics modeling have also been steadily promoted in China in recent years, but regional differences and participation rates need to be taken into account more	C_2	[4]
	Lack of social support	China has also started to steadily push competitions in relevant mathematics modeling in high schools in recent years, but more consideration has to be given to regional variations and participation rates	C_3	[4]
	Incomplete talent development	Not only do students need to acquire significant professional knowledge to succeed in the new era, but they also need to be able to use that information to solve problems in the real world	C_4	[4]
School Management	Lack of attention to lesson plans	The frequency and significance of the conduct of the mathematical modeling course as a fundamental literacy development program has a direct bearing	M_1	[7]
	The single practice activity	The new standard places a strong emphasis on developing settings, figuring out how to include mathematical modeling courses in practical campus activities, and engaging in open campus cultural events, all of which are beneficial for promoting mathematical modeling courses	M_2	[7]
	Outdated hardware facilities	A certain amount of physical infrastructure is required for the construction of mathematical modeling courses, which are integrated with contemporary information technology	M_3	[7]

	Low frequency of teaching and research activities	Support the development of teaching and research activities, and create a curriculum tailored to the needs of the school based on the national unified textbook, which will help the mathematical modeling curriculum	M_4	[8]
Teacher Quality	Inadequate knowledge literacy	Teachers of mathematical modeling courses must possess a deeper understanding of the subject's ontology and interdisciplinary applicability	T_1	[9]
	Weak competency literacy	Teachers must be able to strengthen the use of information technology to improve teaching management abilities and consolidate teaching design skills as part of the mathematical modeling course	T_2	[9]
	Lack of practical literacy	The open-ended nature of mathematical modeling courses forces teachers to be more creative in their lesson planning, and after the course is over, it also calls for teachers to actively reflect on their work	T_3	[9]
Student Literacy	Weak awareness of mathematical modeling	Students who lack knowledge of mathematical modeling find it difficult to create new mathematical issues and use appropriate mathematical modeling and methods to solve them based on particular circumstances, which makes it impossible to construct mathematical modeling courses	S_1	[10]
	Low awareness of mathematical modeling	The capacity to create real-world problems, utilize mathematical models to examine and solve them, and create analytical reports at various stages are all examples of mathematical modeling awareness	S_2	[10]
	Inadequate basic competence and literacy	Ontological and interdisciplinary understanding of mathematical fields, model interpretation skills, model calculation skills, and model evaluation skills are among the model-building competencies	S_3	[10]

3. ISM Method

3.1. Introduction to the ISM model

The Interpretative Structural Modeling Method (ISM), first put forth by Professor Warfield in 1973, is a strategy for analyzing the connections between intricate components in economic and social systems using graph theory. With a clear analytical lineage and a high level of integration of subjective and objective, qualitative and quantitative, mathematical models and thinking logic, the ISM method is a tried-and-true technique for determining the internal structure of complex systems. The model allows for the systematic representation of relationships that would otherwise be complex, dispersed, and scattered in a visual, recursive, and comprehensive structural model.

Takahiro Sato demonstrated in 1978 that the ISM method is suitable for goal analysis and materials development in the field of education and has a well-developed theoretical system for engineering risk analysis. [11] The ISM method can assist in establishing systematic practical pathways and in clarifying the internal logical orientation and hierarchy in the curriculum promotion process. It can also offer scientific and logical thinking on how to successfully scale up mathematical modeling courses.

3.2. ISM model analysis procedures

STEP1: Constructing the adjacency matrix

When determining if two neighboring factors are correlated, the adjacency matrix is utilized. The adjacency matrix of influencing factors is formed, each influencing factor is represented by, and the elements in the adjacency matrix are determined in accordance with equation 1 as a result, the interdependence of the suggested influencing factors is evaluated.[12]

$$A = S_{ij} = \begin{cases} 1, & \text{when } S_i \text{ has an effect on } S_j \\ 0, & \text{when } S_i \text{ has no effect on } S_j \end{cases} \quad (1)$$

STEP2: Finding the reachable matrix

The existence of a connection between any two elements and a path constitutes the reachability matrix. Equation 2 can be used to construct the reachability matrix based on the known adjacency matrix.

$$R = (M + I)^{n+1} = (M + I)^n \neq (M + I)^{n-1} \neq \dots (M + I)^2 \neq (M + I) \quad (2)$$

STEP3: Solving hierarchical relationships

Due to their hierarchical nature, hierarchical-directed graphs can visually depict the composition relationships between each knowledge unit in the structure. [13]

The reachable matrix is used to calculate both the prior set and the reachable set. All matrix elements, up to and including 1, in the corresponding rows of the reachable matrix must be included in the reachable set, and the corresponding columns of the reachable matrix must be included in the prior set.

The level of each knowledge element, or the hierarchical distribution of each element, is determined by first obtaining the factors contained in the highest level using equation 3, then removing the corresponding rows and columns from the reachable matrix to obtain a new matrix, which is then further obtained using equation 2.

$$L = \{S_i \mid P(S_i) \cap Q(S_i) = P(S_i)\} \quad (3)$$

STEP4: Building structural models

A multi-level recursive structure schematic diagram can be drawn according to the order of the elements, connecting adjacent levels and factors of the same level using directed edges. However, it is important to note that factors at the same level are not connected: each level of factors only points to other factors; upper-level factors do not point to lower-level factors, and the relationship between factors is formed in one way. It is possible to obtain the whole model of the related factors' recursive structure.

4. ISM Calculation

4.1. Constructing the adjacency matrix

Based on the expert panel's assessment of the interrelationships among 18 elements impacting the promotion of mathematical modeling courses, this study creates an adjacency matrix of those factors. The results are shown in Table 2.

Table 2. Adjacency Matrix

	R ₁	R ₂	R ₃	R ₄	C ₁	C ₂	C ₃	C ₄	M ₁	M ₂	M ₃	M ₄	T ₁	T ₂	T ₃	S ₁	S ₂	S ₃
R ₁	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
R ₂	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
R ₃	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
R ₄	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
C ₁	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
C ₂	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
C ₃	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
C ₄	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M ₁	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
M ₂	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
M ₃	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
M ₄	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
T ₁	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1
T ₂	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
T ₃	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
S ₁	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
S ₂	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
S ₃	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4.2. Finding the reachable matrix

The reachable matrix, which is displayed in Table 3, was obtained by solving the data in Table 2 for n = 5 using Matlab software following the formula in Table 3.

Table 3. Reachable Matrix

	R ₁	R ₂	R ₃	R ₄	C ₁	C ₂	C ₃	C ₄	M ₁	M ₂	M ₃	M ₄	T ₁	T ₂	T ₃	S ₁	S ₂	S ₃
R ₁	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0
R ₂	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
R ₃	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
R ₄	0	0	1	1	0	0	0	1	0	1	1	0	0	0	0	1	1	0
C ₁	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C ₂	0	0	1	0	0	1	0	1	0	1	1	0	0	0	0	1	1	0
C ₃	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
C ₄	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
M ₁	0	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
M ₂	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
M ₃	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0
M ₄	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1
T ₁	0	1	1	0	0	0	0	1	0	1	0	0	1	1	1	0	0	1
T ₂	0	1	1	0	0	0	0	1	0	1	0	0	1	1	1	0	0	1
T ₃	0	1	1	0	0	0	0	1	0	1	0	0	1	1	1	0	0	1
S ₁	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0
S ₂	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0
S ₃	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1

4.3. Hierarchy division

The ISM hierarchy table and the ISM construction hierarchy diagram are created using the information in Table 3, as shown in Figure 1. [14]

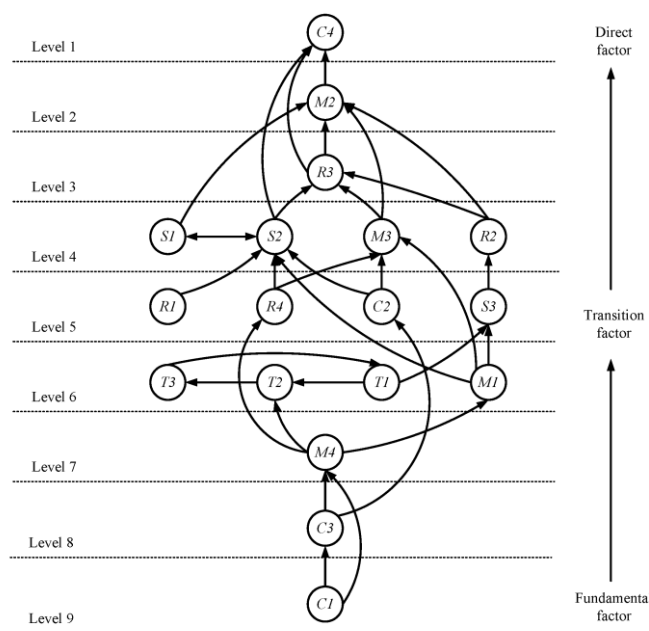


Figure 1. A structural model to explain the factors of influence for the promotion of mathematical modeling courses

In this study, the reachable matrix M is used to partition the collection of affecting elements at each level. Then, using the matching criteria, a directed graph of the factor recurrence structure that prevents the promotion of mathematical modeling courses in middle and high schools is created. The elements impacting the promotion of mathematical modeling courses in junior and senior high schools are finally built into an explanatory structural model.

4.4. Results of ISM factor recursive structure directed graph analysis

Figure 1 makes it evident that there is a 9-level hierarchical structure to the elements impacting the promotion of mathematical modeling courses in middle and high schools. The model demonstrates the intricate logical connections between the 18 internal influencing elements that prevent middle and high schools from promoting mathematical modeling courses. The nine levels are broken down into three categories in this paper: basic, transitional, and direct impacts.[15]

a. The three impacts C_4 , M_2 , and R_3 are among the direct influences and are situated at levels 1-3 of the model.

b. The model's fourth through seventh levels contain the transition impacts, which include S_1 , S_2 , S_3 , M_1 , M_3 , M_4 , R_1 , R_2 , R_4 , C_2 , T_1 , T_2 , T_3 , and thirteen other influences. Students, who are the primary beneficiaries of mathematical modeling course learning, have poor knowledge of mathematical modeling, little knowledge of mathematical modeling, insufficient foundational skills and literacy, and poor understanding of the course's ontology. The combination of these factors, along with the unsatisfactory system of mathematical modeling competitions and the disregard for the curriculum plan, significantly hinders the promotion of mathematical modeling courses in junior and senior high school. The mandatory content of the textbook accounts for a low percentage, the learning threshold is high, and the lack of teaching and evaluation methods. These components work together in key ways. As teachers, creators, and builders of mathematical modeling courses, instructors also have deeper reasons for not teaching mathematical modeling, including a lack of information, a lack of competence, a lack of practical skills, and obsolete hardware and facilities in schools. These 13 elements, which are indirect factors that increase the likelihood of accidents, connect the relationship between the underlying and direct influencing factors.[16]

c. The fundamental influencing components, which include C_1 , and C_3 , are found in the eighth and ninth layers of the model. They are large-scale manifestations of the influencing factors and can

affect the transitional influencing elements to affect the direct influencing factors. They significantly affect how well the middle and high schools implement the mathematical modeling curriculum.

5. Analysis and Recommendations of the ISM

5.1. Analysis of Models

There are several variables that can interact with one another at the same level as well as at multiple levels through conduction to affect how mathematical modeling courses evolve in middle and high schools. In order to create a network that ultimately has a lasting impact on the promotion and adoption of mathematical modeling courses in junior and senior high schools, the lower-level factors can both directly affect the upper-level factors to which they are connected and indirectly affect the higher-level factors through the intermediate-level factors.

A. Superficial elements

The first three levels of the model are the direct influence factors (C_4 talent development is not comprehensive, M_2 practical activities are single, R_3 teaching practice is difficult). These three elements have a direct impact on how well middle and high schools promote and develop mathematical modeling curricula. The current requirement for talents is not only extensive professional knowledge but also the ability to apply the knowledge to successfully solve practical problems, which coincides with the ability fostered by mathematical modeling. However, the current related talent training system is not yet developed comprehensively, so it becomes the first level of factors that hinder it.

The second layer of influencing variables is how to incorporate the mathematical modeling curriculum into practical activities on campus. The single teaching practice activity inadvertently limits the promotion of the mathematical modeling curriculum in junior and senior high schools.

The design of mathematical modeling courses differs from that of ordinary courses, and the different elements of the teaching practice level—selecting, carrying out, and closing—all provide process challenges. This raises the barrier to the spread of mathematical modeling courses in middle and high schools to a third level.

B. Transitional elements

The sub-influencing factors (S_1 students' poor awareness of mathematical modeling, S_2 students' low awareness of mathematical modeling, outdated M_3 hardware facilities, and high R_2 learning threshold) constitute the fourth level of the four levels of transition influencing factors. Students are the primary audience for mathematical modeling courses, and their factors will have a direct impact on talent development and teaching practice, while objectively outdated hardware infrastructure and a high learning curve for mathematical modeling itself also have an impact on practice activities individually.

The fifth level of influencing variables is the intermediate level (R_1 low proportion of mandatory material in textbooks, R_4 lack of teacher assessment techniques, C_2 flawed competition system). S_3 : Students' literacy and fundamental skills are lacking the middle level, which is the fifth level, contains the motivation and support for the promotion of mathematical modeling curriculum in junior and senior high schools. It also emphasizes that this promotion must be ensured through the coordinated efforts of numerous parties and comprehensive improvement to ensure the success of physical education. The students' attention to mathematical modeling is directly impacted by the low percentage of mathematical modeling in the teaching materials and the single teaching style, whereas the full competition system has no such impact.

Deeply affecting variables are at the sixth and seventh levels (T_1 teachers' poor knowledge literacy, T_2 teachers' weak competence literacy, and T_3 teachers' dearth of practical literacy). M_4 Low Frequency of Teaching and Research Activities M_1 Lack of Attention to Curriculum Planning). At this level, there are many determining variables, and among them, the general caliber of professors has a direct bearing on how effectively students apply mathematical theory to actual situations through courses in mathematical modeling. The choice of learning focus made by the students during

the learning process is also strongly influenced by lesson plans. The lack of frequent teaching and research activities has an impact on them all.

C. Fundamental elements

The final two levels of the model are contained in the basic influencing factor (C_1 educational environment underdevelopment and C_3 lack of social support). While social support, which serves as the backbone of mathematics teaching and learning, is hampered by a number of problems, the educational environment is a significant force behind the growth of mathematical modeling courses in middle and high schools. It is clear that the main source of the issue is the general educational environment, which eventually has an impact on how deeply physical education and education are integrated. In the end, they will both be crucial to the development of math modeling courses in middle and high schools.

5.2. Recommendations for development

A. It takes time to gradually introduce mathematical modeling courses into middle and high schools. The current emphasis is on localities developing development strategies appropriate for the implementation of mathematical modeling courses in middle and high schools in accordance with the current state of the local educational system, and then providing feedback to the national level for coordination, adjusting mathematics teaching objectives, reforming the system of integrating and developing mathematical modeling courses with basic courses, optimizing the structure of teacher reserve, and other educational reforms. Some of the needs are listed below.

B. In order to achieve the ultimate goal of teaching students to apply mathematical modeling to their lives, schools should, among other things, strengthen the construction of hardware facilities in accordance with the development strategy of mathematics, foster an environment that is conducive to modeling education, and seek out the support of the community.

6. Conclusion

Based on the literature and preliminary expert group opinions on the promotion of mathematical modeling courses in middle and high schools, we study the factors that prevent the promotion of mathematical modeling courses in this paper using the ISM algorithm. We summarize the key factors that prevent the promotion of mathematical modeling courses in middle and high schools, sort them out, analyze them, and then put them into the ISM mode.

a. Lack of social support is a significant barrier to the development of mathematical modeling courses in middle and high schools since the educational environment for mathematical modeling is undeveloped there. Second, textbooks should be updated to reflect current standards and the structure of the teacher reserve and objective competition system.

b. Until the deeper key components are improved, the students' elements and instructional practice challenges like specially supplied surface-level elements will not advance and breakthrough.

To play a significant role in the promotion of mathematical modeling curricula in middle and high schools, the development of mathematical modeling curricula depends on the interaction of many parties, including educational environment integration, social capital support, teacher quality improvement, and curriculum ontology reform.

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