



A HYBRID EDUCATION QUALITY ASSESSMENT METHOD BASED ON HEURISTIC OPTIMIZATION ALGORITHM

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Abstract. Hybrid education is the most effective process of education, which is the mixture of two education processes that help increase the student’s understanding level. In the study, it has been discussed that the intelligent learning environment influences the education style, which allows the students and the educator to understand the topic correctly. Also, from the study, a good bond between the teacher and the students increases the achievement rate in an education system. Therefore, the professional life of the students is also more developed. The study aims to consider the disadvantages of the modern or hybrid education system, and the communication gap is one of the significant disadvantages of education.

Key words: Hybrid education, digital education, smart learning, heuristic optimization model, educational infrastructure.

1. Introduction. The word hybrid means the combination of two or more than two elements. A hybrid education system or HES is a kind of education that is a combination of the old education style and the new education style. In the present day, the culture of hybrid education has become more and more popular among the people. Hybrid education is the combination of a good quality education style that helps students for better growth and development in order to their educational life. Sometimes the old education systems are suitable for the academic growth of the students and sometimes, the modern digital education systems are better. For this reason, hybrid education is one of the best methods of education [13]. Students feel comfortable in this education system as the education system is flexible to the students. The hybrid education system is better than the monotonous and traditional education system. The hybrid system of education increases the learning opportunities of the students, and it increases their interest in learning. This increases the potentiality of the students on traditional knowledge as well as modern scientific understanding [7]. This process of education helps the students to understand the complicated matter in a short time. The clarification of the subjects is essential for a student to increase knowledge, and it helps to increase the possibility of success too.

Figure 1.1 shows the hybrid education system’s process and steps. It can be said from the above picture that there are 4 factors that control the hybrid education technology: industries, government, communities, and technology. The factors of the education system are smart learning, social media, and MOOC.

Users of this education system used smart technology to take the education out of the class. The learning process of the HES is mainly the challenged-based education system and the case-based learning system [24]. The propeller planning and strategies increase the quality of the education process among the students, and the learning process becomes much easier and more comfortable. The compilation of the traditional education process and the modern education process makes education and learning helpful for educators [23].

The research on the Hybrid Quality Assessment Method (HQAM) has several potential contributions that can advance the field of education and benefit both educators and students. Here’s a summary of the research contributions:

1. By evaluating the role and importance of HQAM in student growth and development, the research contributes to a better understanding of how diverse assessment methods impact learning outcomes. This knowledge can help educators design more effective assessment strategies that align with educational goals and promote deeper comprehension, critical thinking, and skill acquisition among students.

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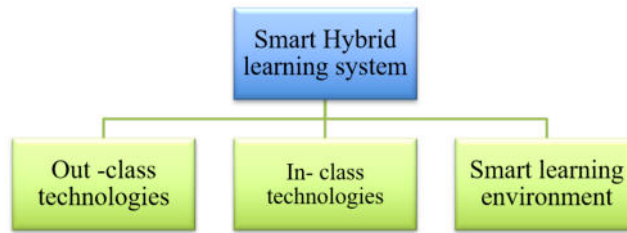


Fig. 1.1: Smart Hybrid learning system

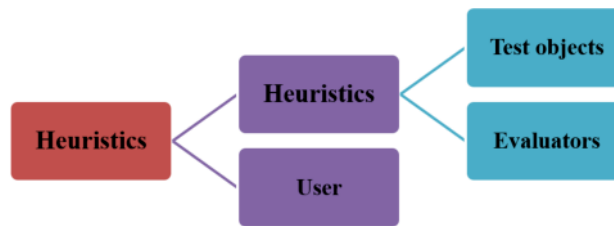


Fig. 1.2: Model of the heuristic optimization

2. Through an examination of the impact of the Hybrid Education Method (HOM) on HQAM, the research identifies how the combination of in-person and online elements affects assessment results. This insight can guide educators in refining the hybrid education model to leverage its strengths, mitigate its weaknesses, and create a balanced and effective learning environment.
3. The assessment of the advantages and disadvantages of HQAM for educational development provides educators with valuable information for decision-making. It empowers them to make informed choices about incorporating hybrid assessment methods in their teaching practices, considering both the benefits and challenges to maximize the effectiveness of the approach.
4. The research's exploration of the current situation of HQAM in the education process provides a snapshot of the state of implementation. This contribution highlights trends, challenges, and potential gaps in using hybrid assessment methods, facilitating discussions on how to address shortcomings and capitalize on successful approaches.

The research on HQAM makes valuable contributions to the fields of education and assessment by enhancing student learning outcomes, optimizing the hybrid education model, informing decision-making, improving assessment practices, identifying current trends and gaps, and envisioning a more effective educational future. These contributions collectively contribute to the ongoing improvement of educational experiences for both educators and students.

Heuristic optimization is the kind of algorithm that helps in the development of the students to the trial and error method. The trial and error method is one of the most effective and valuable methods for the educational growth and development of students [29]. Therefore, the proper application of the HQAM on HOM made the educational process more effective. The traditional education system was not as effective as this hybrid system of education. This helps the teachers to make the students more comfortable with different subjects. This increases the chances of getting better marks and qualifications of the students [28]. This includes the process of modern teaching process such as teaching with the help of videos and projectors to increase the imaging capability of the students. The combination of the online and traditional systems of the education process is essential and should be applicable to the development of the students [16]. This increases the probability of understanding all types of complicated things of study as well as guides the students to enhance their base of knowledge in different subjects.

The above figure shows that the model of the heuristic optimization helps in the development of the student's congenital and mental. The users are the main asset of the model and the whole model is depending on the users. Test objects and the evaluators are two factors connected with the users that help in the consideration of the model. There is a correlation between the HES and the heuristic optimization model or HOM in the case of the education system [11]. Therefore, for developing the educational infrastructure and connectivity of the students, the HES and the HOM are two important steps.

A smart learning environment is a technologically enhanced educational setting that leverages various digital tools, data analytics, and interactive resources to create an optimized learning experience. Such environments have become increasingly important in modern education for several reasons, as they significantly influence both students and educators, ultimately demonstrating the relevance of incorporating technology in the educational process.

1. **Personalized Learning:** Smart learning environments can adapt to the individual needs and preferences of students. Through data analysis and AI-driven algorithms, these environments can identify a student's strengths, weaknesses, and learning styles. This allows educators to tailor content and activities to each student, fostering a more effective and engaging learning experience.
2. **Engagement:** Interactive digital tools, multimedia resources, and gamified elements in smart learning environments capture students' attention and keep them engaged. This active participation helps students understand and retain complex topics more effectively than traditional passive learning methods.
3. **Access to a Wealth of Resources:** The internet and digital platforms provide access to a vast array of educational resources, from interactive simulations to global databases of knowledge. Smart learning environments leverage this wealth of information to enhance students' understanding of subjects, allowing them to explore topics in greater depth.
4. **Real-time Feedback:** Technology allows for instant assessment and feedback. Students can receive immediate input on their performance, helping them identify areas that need improvement and reinforcing their understanding of the material. This immediate feedback loop accelerates the learning process.
5. **Collaborative Learning:** Smart learning environments often facilitate collaboration among students, enabling them to work together on projects, share ideas, and learn from one another. This not only enhances comprehension but also fosters essential teamwork and communication skills.
6. **Preparation for the Digital World:** In today's technology-driven society, it's crucial for students to develop digital literacy skills. By incorporating technology in education, we prepare students for the digital challenges they'll face in their future careers.
7. **Professional Development for Educators:** Smart learning environments empower educators by providing tools for more efficient lesson planning, data-driven insights into student performance, and innovative teaching methods. This professional development enhances educators' ability to deliver high-quality instruction.
8. **Flexibility:** Technology enables various modes of learning, such as online courses, blended learning (combining online and in-person instruction), and flipped classrooms (where traditional homework and lectures are reversed). This flexibility accommodates different learning styles and helps students and educators adapt to changing circumstances.

2. Objectives.

The objectives of the research are:

1. To determine the role and importance of the hybrid quality assessment method or HQAM for the growth and development of the students.
2. To calculate the impact of the HOM on the HQAM
3. To estimate the advantages and the disadvantages of the HQAM for the educational development of the students in the present day.
4. To evaluate the process of the application of the HQAM on HOM for the betterment of the students
5. To find the current situation of the education for the application of the HQAM in the education process
6. To elaborate on the chance of future improvement of the students applying the hybrid education system in the education culture.

Table 4.1: Benefits of the hybrid education process on the students

Factors of the Assesment	Benefit in the Education
Digital technology	The use of electric tools, smart classroom, and PowerPoint's increase the cognitive development of the students.
The individual style of learning	The learning style affects the result related to the learning capacity of the students and also motivates the students.
Teacher students relationship	Encourage the students to better learning. Also helps the students to reduce depression and increase positive behavior.
Flexible education style	Flexible seating arrangements and education in the classroom made a positive effect on the students and also influenced the students in learning [31].

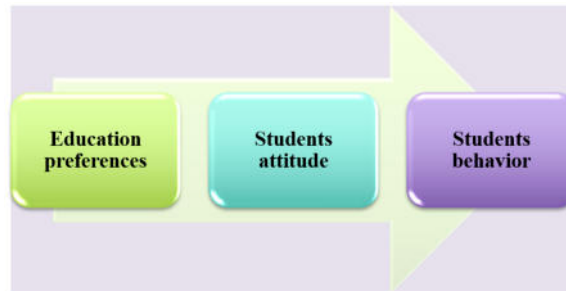


Fig. 4.1: Factors that influence the behavior of the students

3. Proposed Methodology. The assessment of hybrid education which is based on the HOA is one of the most impactful and effective processes that become more popular among students and teachers in the present day. The impact and both positive and negative effects of the education process have been analyzed in the study with the help of the proper methods and techniques. The issues and problems related to education techniques hamper the educational growth of educators [25]. A cognitive developmental test is inextricably linked with the heuristic optimization algorithm. All the conditions and factors the students faced were transformed into sections of statements and points of vision were explored accordingly.

4. Importance of Hybrid Quality Assesment Method. The hybrid assessment method becomes the most valuable and profitable learning method for the better understanding of educators. The hybrid education process increases the understanding level which helps in the personal and the professional life of the students [3]. The PowerPoint presentation and the digital technology provide the students a great learning material that helps them to know more.

The use of the education process increases the quality of the education system and makes the more confident and skilled in the topic. The use of digital technology in the learning process helps the students to make clear the concept of the topic and the doubt clear season is also helpful for the students [27]. Hence, in the modern era, the HQAM made a great impact on the education process.

From the above figure, it can be said that the factors that are the reasons for the behavior of the students are the individual characteristics, needs of the students, skills, and knowledge of the students. The educational preference, the attitude of the students, and the quality of the education are also three factors that affect the behavior of the students.

The effectiveness of hybrid education in more depth:

- 1. Customized Learning Paths:** Hybrid education allows for a more personalized learning experience. Students can access online resources at their own pace, review materials as needed, and explore supple-

mentary content that aligns with their interests. This customization accommodates diverse learning styles, paces, and levels of prior knowledge, enhancing comprehension and retention.

2. **Flexibility:** One of the key advantages of hybrid education is its flexibility. Students can balance their academic pursuits with other commitments, such as work or family responsibilities. This flexibility can lead to increased motivation and reduced stress, as students have more control over when and how they engage with course materials.
3. **Active Learning:** Hybrid models often emphasize active learning strategies. With online components, students are encouraged to take a more active role in their education. This can involve interactive online discussions, collaborative projects, and hands-on activities during in-person sessions. Active learning has been shown to improve understanding and critical thinking skills.
4. **Real-world Preparation:** Hybrid education can better prepare students for the demands of the digital age. By participating in online discussions, navigating digital resources, and mastering time management skills, students develop valuable digital literacy and self-directed learning abilities that are essential in many modern workplaces.
5. **Increased Access:** Hybrid models can expand access to education. Students who may face geographical barriers, such as those in remote areas, or individuals with physical disabilities, can benefit from the online component of hybrid education, gaining access to courses they might not have otherwise been able to attend.
6. **Effective Use of Class Time:** The in-person components of hybrid education can be optimized for interactive discussions, problem-solving activities, and hands-on experiments. This maximizes the value of face-to-face time, allowing educators to focus on activities that benefit from direct interaction while shifting more traditional lectures and content consumption to online formats.
7. **Data-Driven Improvements:** Hybrid education often leverages data analytics to track student progress. Educators can use this data to identify areas where students struggle, adjust their teaching methods, and provide targeted support. This data-driven approach helps improve learning outcomes over time.
8. **Continuous Learning:** Hybrid education encourages a culture of continuous learning. Students and educators alike become more adept at using technology as a tool for ongoing education, research, and professional development.

5. Impact of HOM on the HQAM. The impact and the effect of the HOM on the HQAM are undeniable as the trial and error method which is used in the HOM is the most vital for the execution of the latest and modern technology in the educational institute. The modern and hybrid education system is the collection of several kinds of educational processes that help in the growth on development of students [20]. By incorporating various assessment types, the HQAM can cater to different learning styles. Some students excel in traditional written exams, while others might thrive in project-based assessments or oral presentations. This approach acknowledges the diversity of learners and promotes a more inclusive educational experience.

The importance of the heuristic optimization algorithm has been shown in the above figure where the secondary frequency control, HVDC transmission, and primary frequency control are the factors for implementing a new and latest education system. The trial and error method played a vital role. The hybrid system of learning increases the flexibility of the time period and helps the students to obtain knowledge from different sources [16]. The development of this mode of learning helps the students to get the lectures of different teachers at their homes as well and they could utilize those contents according to their own time period or schedule. This helps the students by saving their time on a journey to different situations and increasing their efficiency in knowing details of different topics [7]. In this system of education modern systems are required such as internet facilities, and digital machines such as mobile, computers or laptops.

6. Advantages and the Disadvantages of the HQAM. The implication of hybrid education in the educational institute attracts educators to the modern technique and technology of the education process. This education process involves the students in the hybrid education system [22]. The concept of the students becomes clearer through the service of technology in the education system.

The curriculum and teaching methodology that is used in the method is more beneficial for the students than the traditional and authentic process [4]. With the help of this education process, the relationship between

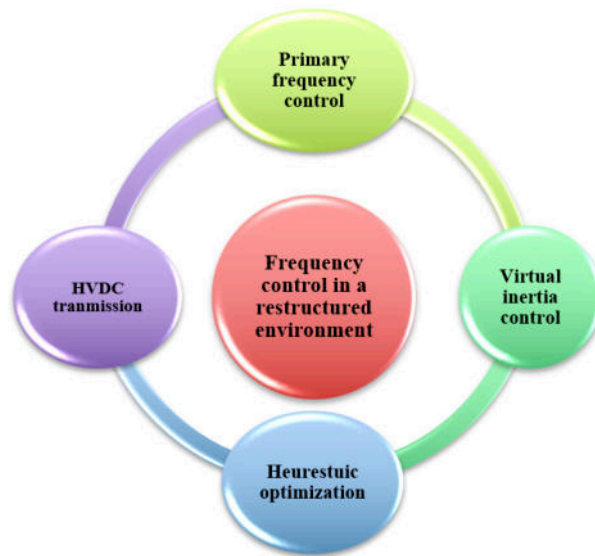


Fig. 5.1: Impact of the heuristic optimization algorithm

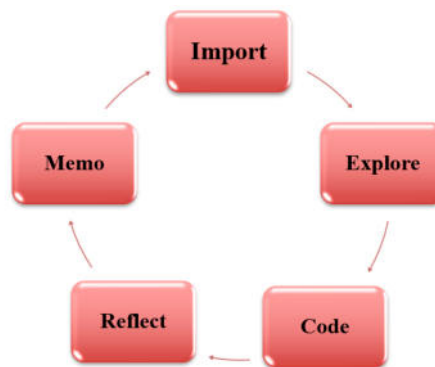


Fig. 6.1: Hybrid education model

the teachers and the students improves, and fear and anxiety decrease.

One of the potential limitations or drawbacks of the Hybrid Quality Assessment Method (HQAM) is the reliance on internet resources, which can pose challenges in certain situations:

Access Disparities: Not all students may have equal access to reliable internet resources. Socioeconomic disparities or geographical limitations could result in some students having limited or inconsistent access to high-quality online materials. This inequality can create an uneven playing field in the assessment process, affecting the fairness and equity of evaluations.

Technical Issues: Internet connectivity issues, hardware limitations, or compatibility problems with certain devices can disrupt the assessment process. Students may encounter difficulties in accessing online resources or submitting their work, leading to frustration and potential delays in the assessment timeline.

Quality Control: The quality and reliability of online resources can vary significantly. While the internet offers a vast array of information, not all sources are accurate, up-to-date, or credible. Depending solely on Internet resources for assessments might lead to inconsistencies in the quality of information students use, potentially impacting the accuracy of their work.

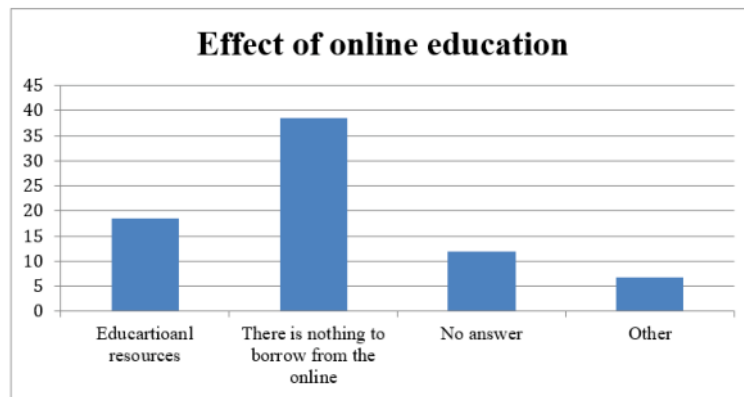


Fig. 6.2: Effect of online education

Plagiarism Concerns: With the abundance of online content, the risk of plagiarism increases. Students might be tempted to copy information directly from online sources without proper citation or attribution. This challenges educators to implement effective plagiarism detection mechanisms and educate students about proper research and citation practices.

Distraction and Misdirection: The internet can be a double-edged sword in terms of distractions. While it offers valuable resources, it also presents countless distractions, such as social media, unrelated websites, or advertisements. Students might struggle to stay focused on the assessment task, impacting the quality of their work.

Digital Literacy Requirements: Relying on internet resources assumes a certain level of digital literacy among students. Some students, particularly those who are less familiar with technology or online research techniques, may face difficulties in navigating online resources effectively. This can hinder their ability to find and use appropriate information.

Assessment Validity: Depending solely on internet resources might limit the range of skills and knowledge that can be effectively assessed. Certain types of assessments, such as practical skills, hands-on experiments, or in-person interactions, may be challenging to evaluate solely through online resources.

To mitigate these limitations, educators using the HQAM should consider:

1. Ensuring that technical issues are promptly addressed and providing clear guidelines for submission.
2. Emphasizing critical evaluation of online sources and teaching proper citation techniques.
3. Encouraging focused work habits and minimizing potential distractions during assessments.
4. Offering support and resources to enhance students' digital literacy skills.

Balancing the benefits of internet resources with these potential limitations is essential to create a fair and effective assessment process within the HQAM.

Figure 6.2 has shown that the highest number of the effective field of online education is that there is no item that can be borrowed from the online which is 38.6 and the value of the educational resources is 18.5. The satisfactory and friendly relationship between the students and the teacher encourages the students to provide education quality to the teacher [8]. This becomes the best mode of education and helps the students and teachers both to increase their learning process from earlier times. On the other hand, this system is not effective for casual students because in this system all the things and learning processes depend on the learning habits of the students only [15]. Students who are not serious about their future are not adequate for this modern hybrid education system. They need to be observed by their parents and teachers and for those students traditional system will be better [12]. A hybrid education system increases the interest of students in study and it enhances the practicality of the learning process.

The use of the modern technology also leads to an increase in the ability of the trial and error method that is used in the HOM. The application of HQAM helps to select the parameters of the HOM. The use and the

Table 6.1: Advantages and disadvantages of the HQAM

Advantages	Disadvantages
One of the main advantages of the hybrid education strategy is that this strategy's implication of digital and modern technology helps to increase the level of understanding of the topic [19].	The limited internet sources and access is the drawback of this education system which makes the education system bounded.
With the help of this process, the students become able to think more divergently about a topic and the imagination level of the educators become increases.	Lack of interaction between the teacher and the students is the other disadvantage of the hybrid education system which makes the education process less effective.
The modern technology and the teaching process in the education system provide the educators more structural presentation of the images which helps the students to remember the topic more effortlessly [17].	The communication problem between the teacher and the students in digital learning is one of the major disadvantages [19]. Communication issues are the reason for the lack of knowledge among the students in an education institute.

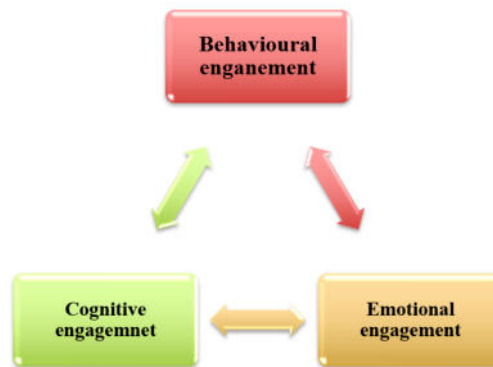


Fig. 6.3: Hybrid learning in the Student-teacher relationship

application of better technology also increase the capability of the machine tools and items that are used in the different kinds of sectors in the educational institute [30]. The capability of the prediction of becoming more accurate and perfect by the use of the HQAM.

The relationship between the students and the teacher becomes stronger through the use of hybrid learning in the education system as this learning process requires digital communication between the students and the teachers [6]. Around 85% of the country all over the world adopted the education system which is digital education for the effective process of the education process. The students who live far from the educational institute are becoming more beneficial for online education.

7. Process of the Application of the HQAM on HOM. The development of the attitude of the students is the most important and vital factor to make the students a great human being. Improving in the behavior also helps to make the development in the personal and professional life in the future [18]. The capacity for the identification of a problem and problem-solving became increased by the process. The education authority applies different types of processes and procedures to apply the HOM on the HQAM. The applica-

Table 7.1: Application of the HQAM on HOM

Process	Benefits
Digital problem-solving process	This process helps the students as well as the teachers to identify the problems and the issues systematically. The identification of the problems and issues helps to solve the problem in a better way.
Smart classroom	The initiative to make a smart classroom helps the teacher to describe a difficult problem in an easy way [1]. The use of the digital board can be able to show the 3d dimension picture to the students.
Reviews and polling process	The polling process and the review process helps to take the reviews from the students. The trial and error method or HOM also increases the accuracy of the process.
Increasing the search capability	The increment in the search capability also increases the boundary of the knowledge of the students.

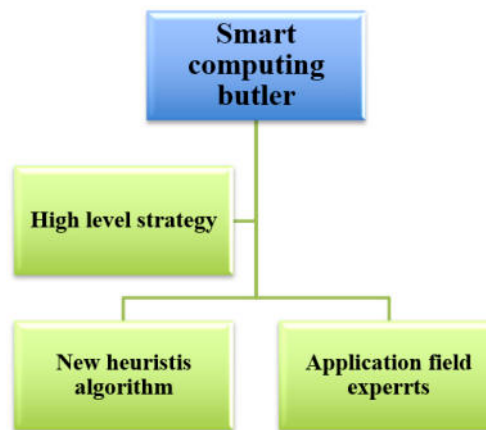


Fig. 7.1: Hybrid element – heuristic algorithm for optimizing the educational courses

tion of the HQAM improves the quality of education which is more effective for the cognitive and emotional development of the students.

Figure 7.2 has shown that the implication of the smart computer in the classroom enhances the quality of the education process in the modern days. The high-level strategies that are used in the HOM are effective for the growth and development of the students in their educational life [5]. The new heuristic algorithm made a great impact on the social and cognitive development of the students.

Figure 7.2 shows that the evolution of the HOM made a big impact on the educational system that increases the level of understanding of the educators. The principle of selection is one of the most essential principles that helps to select the proper issues and the problems [9]. The selection of the issues is the main key factor for reducing the problems and making the topic more clearly to the students.

The probability of the different kinds of hybridization in the education system for the various states has been shown in the above figure. From the figure, it can be said that the value of the hybridization is the highest



Fig. 7.2: Evaluation in the computation of the HOM

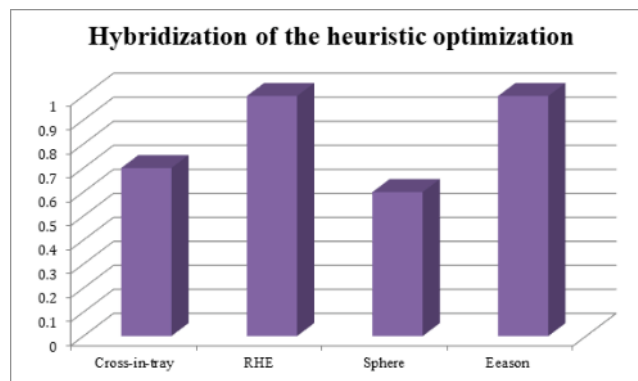


Fig. 7.3: Hybridization of the heuristic optimization in the study

for the RHE, MacCormik, and Eason. The value of the hybridization of the three countries is 1. The lowest rate of hybridization is for the Branin which is 0.3. The heuristic method helps to discover the attitude and behavior of the students to improve their educational careers of the students [14].

8. Current Situation of Applying the HQAM. Presently most of the educational institutes are focused on the application of the digital classroom and the digital education system. The use of the digital process increases the education quality and makes education more beneficial for students [21]. With the help of the HOM method, the students become able to do more practice with the help of the trial and error method [26]. The implication of this system is gradually increasing in the different education centers and schools to support the students in the learning process. The digital system of learning enhances the opportunities for learning and promotes the developmental processes of students and the whole education system [7]. The adaptation requirements of the modern education system are computerized and digitalized classrooms with internet facilities; enabling the students to use digital sources of information and helping them practice different study materials.

The stages of higher-order thinking are shown in Figure 8.2 where the 1st stage is the stage for remembering. Understanding the topic and the proper application of the process are two vital steps according to the model. Analyzing and evaluating the strategy helps the students to make a clear view of the topic. Bloom’s taxonomy is a helpful strategy to increase the cognitive development of students [10]. Therefore, it can be said that the effect and the impact of the HQAM cannot be denied on the HOM for the growth and development of the students.

The last and the final stage of the method is the creation.

Technology, organization, and environment are the three factors of e-learning which can be concluded



Fig. 8.1: Higher-order thinking skills

Table 8.1: Issues of HQAM

Issues of HQAM	Solution process
Lack of responsibilities	Among the teacher in the online education system is the reason for the lack of attraction of the student to the topic.
Scarcity of Confidence	Lack of experience and confidence among the leaders decrease the level of encouragement of the students.
Communication issues	The communication issues are the most effective for the system.

from Figure 8.2. The e-learning facilities are mainly dependent on the educational organization, technological development and environment of the education center [12]. These need to be cooperatively developed for the development of a modernized education system.

9. Problem Statement. The secondary process of data collection has been used in the study to collect data about the impact of the HQAM on HOM. The numeric value of the data could be increased by the use of the primary method [2]. The numbers of resources that are used in the study are less and the use of the high number of resource can be able to make the study more effective and reliable.

10. Results. The application of the hybrid education quality assessment helps to increase the chance of the success of the educational industries that are based on the heuristic assessment. By the help of The hybrid quality education system or HQAM helps to increase the quality of digital learning which includes social media, smart technological learning and MOOC. The anthology of the established education process and the current education process makes instruction and learning helpful for educators. There are different ways of the importance and the essentialities of the digital and the hybrid education system which includes the enhancement in the quality of individual learning and also the relationship or the connection between the teacher and the students [4].

The above figure shows the number of students engaged online and the digital platforms in the present day. It can be said from the picture that the number of SVM is the highest in order to the number of the prediction of the third semester. The lowest number of the students is the decision tree which is around 0.25. The impact of the HOM on the HQAM is also determined by the help of the study. The methods that include trial and error help to execute the innovative and divergent thinking of the students. The HVDC transmission that is used in the HQAM process in the mode of the frequency control of the education system which implements the latest and the modern education system. The use of modern and innovative technology is the most effective and helpful process for the educational growth and the development of the academic career of the students [13]. From the research, it can be said that the use of the HQAM enhances the knowledge and understanding of the

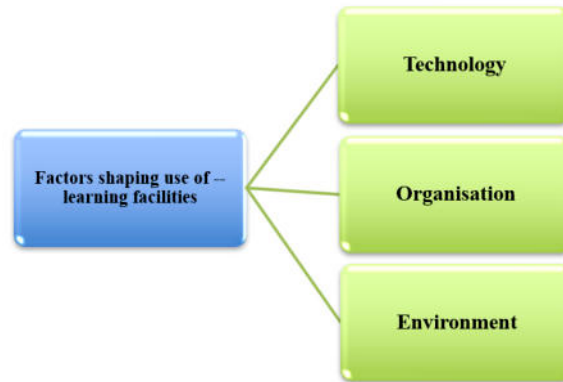


Fig. 8.2: Factors of the e-learning

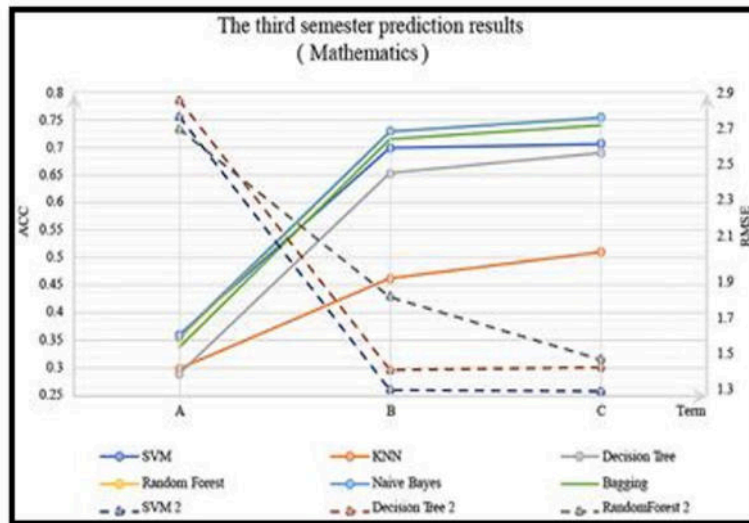


Fig. 10.1: Student engagement in the digital platform

educators.

From the figure 10.2, it can be said that the rate of the improvement of the education quality by using digital learning is the highest for the application of the K-Medoids. The value of K-Medoids is .10. The main drawback of the use of HQAM in the HOM is that the scarcity of the connection and communication between the students and the teacher through online system. Also, sometimes the rate of the understanding of the topic become impenetrable for the educators which is becomes issues for the other students. In the online class, the question answer process is also very problematic and the lack of the proper network connection lags the process of the education.

11. Conclusion. In conclusion, it can be said that the application of the HQAM on HOM helps to decrease the issues of problem-solving in the classroom. The limitation in the internet resources is one of the drawbacks of the process. Different stages that are used in the HQAM process help to increase the cognitive of the students. Also, from the above study, it can be concluded that the flexible study style helps to make the students more comfortable and energetic towards the education system.

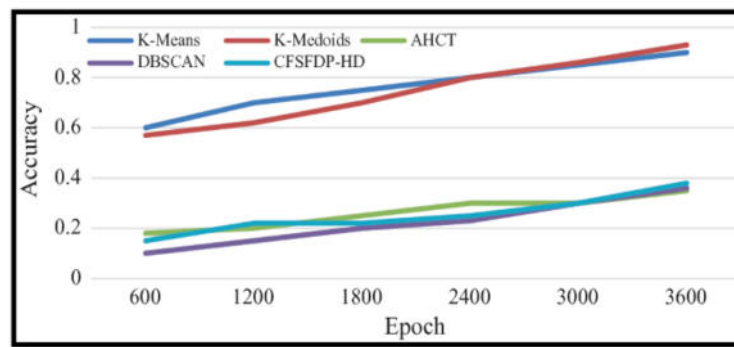


Fig. 10.2: Improving of the quality of the education system

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