Original Article

Studying the status of research grants of Smart University of Medical Sciences with an emphasis on achievements, challenges and solutions

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Abstract
Background: The role of interdisciplinary research in medical sciences in expanding the frontiers of knowledge, innovation, and invention of new technologies, solving health system challenges, improving public health, enhancing social welfare, and sustainable development is hidden from no one, especially health policymakers. This study was conducted to review the status of Smart Medical Sciences University's research grants.
Methods: This study was based on an integrated analysis of quantitative and qualitative data. Quantitative data were collected by reviewing published documents of calls for proposals from 1398 to 1402 and online satisfaction questionnaires, and qualitative data were analyzed thematically.
Results: Based on the analysis of the data for the past 5 years related to the call for research grants of Smart University of Medical Sciences, a total of 31 projects have been approved. In this regard, most submitted projects were in the fields of virtual and augmented reality (12%), mobile learning (11.6%), games and game design (9.2%), instructional design (7.2%), artificial intelligence and machine learning (6%), platforms (5.6%), course evaluation (6%), educational resources (4%), assessment (4%) and other fields (34.4%). In addition, based on qualitative data analysis, 27 outcomes emerged for the education and health system in 11 areas. Finally, based on the combination of findings, strategies were categorized to overcome the challenges of research grant calls.
Conclusion: Despite identifying challenges in research grant calls, the results show that development grant calls at Smart University of Medical Sciences have had positive achievements for the health education system, which can ultimately be used to improve the medical education system.

Introduction

In the era of technology and scientific advances, universities play a significant role as centers of research and innovation in the field of medical sciences. One of the important and effective ways to develop and advance medical research is to provide university grants. Research grants are among the main pillars of the world's innovation and development of science and technology.[1] These grants provide the necessary financial resources to enable basic and applied research in various fields of science. Grants are often provided by institutions such as scientific and research institutions, universities, charities, private companies, and governments, and play an important role in advancing frontiers of knowledge, innovation, and invention of new technologies, improving public health, enhancing social welfare and sustainable development. Grants also lead to job creation, training of specialized human resources, and ultimately economic growth and development.[2]

In this regard, Smart University of Medical Sciences as the first virtual university in the country's health sector was established in 2016 to create a fundamental and

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intelligent transformation in Iran's health system and respond to emerging needs and challenges in the health sector with permission from the Ministry of Health, Treatment and Medical Education.

This university relies on the opportunities arising from new educational technologies and e-learning methods to attract students from all over the country. Using the countless benefits of virtual education and advanced electronic communications, it seeks to play a pivotal and influential role in realizing the goals and policies of the national health system by markedly improving the quality of education, research, and treatment in all areas related to health.

From the very beginning of its establishment by adopting policies such as granting research grants, this university has tried to encourage and motivate researchers to conduct research in key and priority areas for the health system.

Therefore, one of the most important research priorities of this university from the very beginning of its activity has been to produce applied knowledge and new technologies in various fields, especially in the field of new educational technologies. To this end, three calls for research grants have so far been issued to domestic and foreign researchers in the field of development projects for blended learning education. This study examines and analyzes the national grants provided in recent years at the university. It should be noted that this study is the first of its kind in the field of examining national grant calls.

Methods

This study was conducted using an integrated analysis of quantitative and qualitative data, focusing on the fields, topics, goals, challenges, and achievements of grants.

The qualitative data were analyzed thematically. This involved coding responses, identifying patterns, and categorizing them into themes. Multiple researchers independently reviewed the themes to ensure consistency and reliability, enhancing the transparency of the analysis.

Statistical analysis

Quantitative data were analyzed using statistical methods one-sample t test with SPSS 26. These methods were chosen to robustly assess the data, ensuring the findings' reliability and validity.

Description of grants status

The process of evaluating and approving research projects:

Based on the published guidelines of the university regarding the stages of project evaluation, initially, the proposal is registered in the university's research assistant system by the researcher. After the final registration of projects in the university, an initial screening is conducted based on the announced axes by experts, and the results of the first stage are made available to researchers. Subsequently, eligible projects are reviewed and evaluated by at least two specialized referees. In this stage, in addition to the referees' opinions, the university's research affairs extensively interact with researchers by providing various guidelines to finally modify projects and provide different consultations to researchers at various levels to the extent possible.

Based on available documents, this process has been developed and improved by Smart University of Medical Sciences through rethinking in subsequent calls. Feedback from various researchers across the country has also been used to address future challenges. Projects approved by referees officially and legally began their implementation process by being approved by the university council, signing a contract, and receiving an ethics code.

Results
Quantitative findings
Description of registered projects

Over the past 5 years, Smart University of Medical Sciences has published 3 national grant calls to support research projects. The first call was in 2019, the second call in 2020, and the third call in 2022. In the first call, a total of 73 projects were submitted from all over the country, 80 projects in the second call, and 97 projects in the third call. In total, 31 projects were approved in the 3 calls.

Table 1 shows the statistical frequency of projects registered in the three calls.

Description of supported research areas in these grants

Based on an analytical review of the registered project titles, it appears that the research topics supported in these three calls have mainly focused on e-learning and innovative educational technologies. These include artificial intelligence and machine learning, virtual and augmented reality, mobile learning, games and gamification, instructional design, platforms, course assessment, learning resources, student evaluation, and other related subjects (Table 2).

In general, out of a total of 250 submitted projects, the highest number of proposals were related to the following areas, respectively:

- Virtual and augmented reality with 30 projects (12%)
- Mobile learning with 29 projects (11.6%)
- Games and gamification with 23 projects (9.2%)
- Instructional design with 18 projects (7.2%)
- Artificial intelligence and machine learning with 15 projects (6%)
- Platforms with 14 projects (5.6%)

Table 1. Number of registered and approved plans

Call	Number of registered proposals	Number of approved plans
First	73	3
Second	80	12
Third	97	16
Total	250	31

- Course assessment with 15 projects (6%)
- Learning Resources with 10 projects (4%)
- Assessment with 10 projects (4%)

In addition, a questionnaire was used in this study to assess the level of satisfaction among participants with the third call for grants from the Intelligent Medical Sciences University. Based on this questionnaire, the satisfaction level of participants was calculated by multiplying the score of each option by its frequency, summing them up, and dividing by the total number of respondents. Scores ranging from 1 to 2.33 were considered dissatisfied, scores from 2.34 to 3.66 were considered moderately satisfied, and scores from 3.67 to 5 were considered fully satisfied. Based on the collected data, the status of the items related to participant satisfaction with the third call for grants from the Intelligent University of Medical Sciences, categorized as dissatisfied, moderately satisfied, and fully satisfied, is presented below (Table 3).

As shown in Table 3, based on the results, participants in the third call for grants from the Intelligent Medical Sciences University, except for items 7, 9, 10, and 11, have expressed moderate satisfaction, while they have declared full satisfaction with the remaining items.

To examine the statistical significance of participant satisfaction with the third call for grants from the Intelligent Medical Sciences University, a one-sample t-test was used, and the results are presented in Table 4.

According to Table 4, the results of the one-sample t-test indicate that the sample mean (98.55) is higher than the population mean (45), and this observed difference, with a t-value of 40.9, is statistically significant at a 99.0% level of confidence ($P < 0.01$).

Qualitative Findings
Achievements of supported projects
Based on available documentation, the supported projects in the form of research grants have achieved various outcomes in diverse areas. For example, in the field of educational technology, several projects have provided innovative solutions based on emerging technologies such as artificial intelligence, augmented reality, and gamification, paving the way for improving the teaching-learning process.

In the area of designing artificial intelligence algorithms, several successful projects have developed algorithms

Table 2. Aggregation of the budget allocated to calls separately

Call number	Amounts in Rials
First	158 000 000
Second	2 846 000 000
Third	4 676 000 000

Table 3. Response percentage of the participants of the third call of the Smart University of Medical Sciences grant

No.	Satisfaction survey items of the 4th grant call of Smart University of Medical Sciences	Answers to items in percentage					Average	Level of satisfaction
		Strongly Disagree	Disagree	Somewhat Disagree	Agree	Strongly Agree		
1	The process of sending the grant call was clear and organized.	0.0	0.0	25.7	56.8	17.6	3.91	Full satisfaction
2	The terms of participation in the grant were clearly defined and easy to understand.	0.0	5.4	33.8	33.7	23.0	3.78	Full satisfaction
3	The guides and instructions provided by the university to participate in the call were helpful...	2.7	4.1	25.7	43.2	24.3	3.82	Full satisfaction
4	The timing of Grant's invitation was reasonable and allowed enough time to prepare plans.	5.4	4.1	27.0	40.5	23.0	3.71	Full satisfaction
5	Communication-related to the grant invitation (announcements, updates, etc.) was timely and clear.	1.4	6.8	20.3	37.8	33.8	3.95	Full satisfaction
6	The judging process was transparent and fair.	4.1	9.5	21.6	37.8	27.0	3.74	Full satisfaction
7	Feedback provided on rejected designs was constructive and helpful.	13.5	17.6	21.6	28.4	18.9	3.21	Relatively satisfied
8	The university's support during the submission process was acceptable.	4.1	12.2	21.6	35.1	27.0	3.68	Full satisfaction
9	The amount of the grant offered was appropriate and compatible with the needs of the research project.	5.4	18.9	21.6	40.5	13.5	3.37	Relatively satisfied
10	The terms and conditions associated with the grant were reasonable and well-defined.	1.4	23.0	24.3	28.4	23.0	3.48	Relatively satisfied
11	The grant management process (reporting, budget management, etc.) was efficient and supportive.	5.4	12.2	29.7	21.6	31.1	3.60	Relatively satisfied
12	In general, I am satisfied with the call for research grants from the Smart University of Medical Sciences	4.1	9.5	24.3	31.1	31.1	3.75	Full satisfaction
13	The terms of participation in the grant were clearly defined and easy to understand.	4.1	8.1	20.3	25.7	41.9	3.93	Full satisfaction
14	The guides and instructions provided by the university to participate in the call were helpful.	0.0	1.4	20.3	41.9	36.5	4.13	Full satisfaction

for personalizing education and enhancing pattern recognition accuracy. Additionally, several projects have focused on producing engaging educational content based on virtual reality and simulation, offering their products in the market.

In summary, some of the key achievements of the national calls from the Intelligent Medical Sciences University can be categorized into several sections. The categorization is presented in Table 5.

Challenges in the implementation process of grants
Based on feedback obtained from documents and records, some of the key challenges in the three grant calls can be summarized as follows:
1. Delay in project initiation due to untimely allocation of grant funding.
2. The lack of advanced laboratory facilities and equipment for conducting applied research poses a significant challenge for researchers.
3. Lengthy administrative and financial processes in universities and research centers to meet project requirements.
4. Constraints in interdisciplinary interactions and group collaboration management in research

projects.
5. Non-alignment of some research findings with the needs and requirements of applied fields such as industry and the market.
6. Time constraints for some projects hinder achieving all intended objectives and expected outcomes.

Future solutions
1. Precise financial planning and clear scheduling to ensure timely allocation of grant funding by sponsors before the start of research projects.
2. Increased investment from the government and private sector in equipping research centers with laboratories and necessary advanced equipment for conducting fundamental and applied research.
3. Review and improvement of administrative and financial processes in universities to reduce administrative bureaucracy and expedite the fulfillment of research project needs.
4. Establishment of interdisciplinary collaboration centers and offices in universities to facilitate the formation of interdisciplinary research teams.
5. Organizing specialized conferences and symposiums involving researchers and industry professionals to

Table 4. One-sample T-test of participants' satisfaction with the 3rd grant call of Smart University of Medical Sciences

Variables	Statistical indicators						
	Number	Mean	Standard deviations	*P* value	df	T value	Difference of means
The participants' satisfaction with the third call for the Smart University of Medical Sciences grant	74	55.98	10.04	.000	73	9.40	10.98

P Value Significant at the one percent level.

Table 5. Some of the achievements of grant presentation according to the specialized field

Specialized field	Consequences
Educational technologies	Development of algorithms and intelligent systems for adaptive learning and personalization of education. Producing rich and interactive educational content using new technologies such as augmented reality. Improving practical and experimental skills of learners through educational simulations.
Educational game making	Producing several attractive educational games for medical students. Helping to learn lesson concepts through games. Increasing the motivation and involvement of learners in the learning process.
Mobile learning	Development of mobile-based educational programs and applications. The possibility of easy and ubiquitous access to educational content through smartphones. Facilitating learning at any time and place for learners.
e-learning	Development of electronic learning management systems. Production of rich and interactive electronic content. Increasing equitable access to education through e-learning.
Course evaluation	Development of new tools and methods for evaluating educational courses. Increasing the credibility and validity of learning assessment processes. Facilitating continuous evaluation and feedback to learners.
Education platforms	Development of new educational platforms to provide courses and educational content. Facilitating widespread access to quality education through online platforms. Ability to manage and monitor the learning process by teachers.
Educational Resources	Production of multimedia educational resources and content. Enriching educational resources based on new technologies. Improving the quality and attractiveness of educational resources
Assessment	Development of technology-based measurement tools. Improving the process of validity and reliability of diagnostic tests. Expediting and facilitating educational assessment and evaluation processes

identify precise needs and challenges in the industrial sector.

Discussion

This study focuses on the examination and analysis of grant calls for virtual education development projects implemented by the Intelligent Medical University in the past 5 years. Currently, the production and utilization of knowledge hold significant importance for both public and private organizations and institutions. Knowledge is generally defined as information that, through creating changes in individuals or entities, reflects itself differently over time.[3] One prominent characteristic of knowledge is its growth and generation through dissemination and exchange. Considering the costs that organizations incur for knowledge production, optimal exploitation of these outputs is crucial. This exploitation is made possible through the transfer of knowledge from researchers to stakeholders and the community.[4] Knowledge transfer refers to the dissemination of research findings, experiences, concepts, and new skills to individuals and other organizations. Optimal utilization of knowledge generated by researchers and organizations is of great importance. This exploitation can lead to increased efficiency, innovation, competitiveness, and organizational performance improvement.[5]

Furthermore, the transfer of knowledge to external stakeholders can contribute to achieving greater impact and influence from the provided research and knowledge. Therefore, attention to knowledge transfer and optimal exploitation of scientific and research outputs in organizations and institutions is vital. This practice facilitates organizational performance improvement, innovation, development, and sustainable growth.[6]

Based on existing texts, governments allocate considerable resources through tax policies or direct investment to support research and development. For example, in the United States, the National Institutes of Health (NIH) and the National Science Foundation (NSF) invest over $30 billion annually in basic and applied studies across various sciences.[7] However, surprisingly, there is limited quantitative evidence regarding the effectiveness of government expenditures on research and development.[8] However, there are at least two reasons why understanding the impact of government spending is vital.

Firstly, the effectiveness of such expenditures is not evident. Waste or inefficiency may lead to non-productive use of government resources and undermine public support for research and development.[9] Secondly, efficient allocation of government expenditures requires understanding the conditions under which the investment with the highest potential return should be made.[10]

In economic literature, efficiency usually refers to evaluating an institution's input relative to its obtained output. An organization is classified as efficient if it produces the highest possible output from the input dataset (output-oriented).[1] Consequently, determining the efficiency of educational institutions based on grant provision is a challenging process. Therefore, there is an ongoing debate in the relevant literature regarding the efficiency of higher education institutions related to research output indicators. While in the past, the number of articles was used as an indicator, today, many studies rely on the importance of research grants.[11]

In a study by Talbot et al conducted in 2015 in Denmark and Norway, it was demonstrated that grant recipients published a greater number of scientific articles compared to individuals whose grant requests were rejected. Additionally, the group of grant recipients tends to receive higher citations on average. This implies that grants generally have an effective impact on research productivity. The study showed that research grants have diverse effects, including building capacity and doctoral students' research, achieving new research results and perspectives, establishing new and broader research networks, and discovering new research topics.[12]

In this regard, Ghirelli et al by examining the grant requests submitted to the Swiss National Science Foundation, demonstrated that funding competitive projects significantly influences researchers' publication outputs. This funding leads to an increase in the number of published articles and results in more research publications within three years after receiving the funding. Although the impact of research grants on research performance can be diverse and complex, some studies have shown that receiving grants can increase the number of published articles. However, the impact on citations (references) is less observed, which may be due to the complexity of research projects.[13]

Moreover, the results of some studies indicate that the effects of research grants can also influence other aspects of research performance. For instance, grant-winning researchers may have a higher percentage of international collaboration and greater success in securing funding for their research groups.[14]

Overall, the findings of this study demonstrate positive achievements in the field of virtual education and research in the country, despite numerous challenges, in the final analysis of the grant calls for development projects.

Conclusion

Based on the results of this study include researching and exploring pioneering and innovative areas in interdisciplinary research in medical sciences. Identifying areas that have the greatest impact on addressing challenges and technological development can assist universities and researchers in focusing their research programs in the most impactful directions. Additionally, conducting studies that evaluate the impacts and consequences of

interdisciplinary research in medical sciences can aid policymakers and decision-makers in this field. These studies can help prioritize, develop policies, and optimize resource utilization. Ultimately, such studies can assist policymakers, managers, and researchers in universities and relevant organizations in making strategic decisions and advancing interdisciplinary research. The results suggest actionable insights for health policymakers, highlighting the need for strategic allocation of research grants. By addressing identified challenges, policymakers can enhance the impact of grants, supporting advancements in health education and technology.

Authors' Contribution
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Competing Interests
The authors declare no conflict of interest.

Ethical Approval
The Ethics Committee of Smart Medical University verified this study (Ethical approval ID: IR.SMUMS.REC.1403.049).

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