Strides Dev Med Educ. 2021 December; 18(1): e1065 doi 10.22062/sdme.2021.196266.1065

Review

Move to the Fourth-Generation Universities: A Systematic Scoping Review of Educational and Management Strategies

Amir Mohammad Salehi[1], Hossein Ali Mohammadi[1], Mohammad Ahmadian[2], Elham Khanlarzadeh[3*]

[1] Student Research Committee, Hamadan University of Medical Sciences School of Medicine, Hamadan, Iran
[2] Student Research Committee, Hamadan University of Medical Sciences School of Paramedicine, Hamadan, Iran
[3] Department of Community Medicine, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran

Received: 2021 June 13
Revised: 2021 November 02
Accepted: 2021 November 03
Published online: 2021 November 14

***Corresponding author:**
Department of Community Medicine, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran
E-mail: khanlarzadeh800@yahoo.com

Citation:
Salehi AM, Mohammadi HA, Ahmadian M, Khanlarzadeh E. Move to the fourth-generation universities: A systematic Scoping review of educational and management strategies. Strides Dev Med Educ. 2021 December; 18(1): e1065. doi: 10.22062/sdme.2021.196266.1065

Abstract

Background: Higher education is not uniform. There are significant differences between higher education systems among different countries and even among institutions in a similar education or system; therefore, identifying the various types of entrepreneurial activities helps the mission of fourth-generation universities.

Objectives: The purpose of this study was to introduce the most important educational strategies to move towards fourth-generation universities.

Methods: We systematically searched the international databases, including PubMed, Web of Science, Scopus, ISC, SID, and Google Scholar, until 2021 using some relevant keywords. Then, screening and selecting eligible articles according to inclusion criteria were done by two researchers independently.

Results: Soft skills training, sustainable development training, training business law, reviewing the continuous training of professors, promoting ideation and creativity to solve problems, development of interdisciplinary training, decentralization of government accelerators and deployment of private accelerators, privatization of higher education, and internationalization are the most important educational strategies to move towards fourth-generation universities. One of the critical aspects and perspectives of the fourth-generation university is the development of job skills, professions, and competencies and empowerment of students and professors in line with the process of national development and solving society's problems scientifically.

Conclusion: This research's analytical results help the universities design and implement their strategies to reach the fourth-generation universities according to the standard implementation models of the fourth-generation universities.

Keywords: Universities, Education, Policy, Fourth-Generation

Background

The university's evolution can be divided into four generations, medieval or first-generation universities, Humboldt or second-generation universities, and entrepreneur or third-generation universities. Recently, fourth-generation universities have been considered to have extraordinarily active interactions with the social and economic status of the university. Today, universities are changing and moving towards third- and fourth-generation universities (1). First-generation universities were universities with the main aim of not pursuing new knowledge and discoveries. These universities try to protect and maintain past knowledge and teach students complying with church principles and beliefs.

However, in addition to teaching, research was added to the scope of second-generation universities, and the traditional structures of first-generation universities changed by introducing research programs in second-generation universities. Although the second-generation universities were very successful as a major part of creating the modern vision and emerging, they had been under pressure for reasons, such as increasing demand for education, limited governmental funds, the emergence of multidisciplinary research, increasing the area of

university and administrative formalities, and increasing global need for entrepreneurs.

The idea of third-generation universities was presented to remove the pressure, which was noticed in second-generation universities. According to the Cambridge model, unlike second-generation universities to research to increase existing knowledge, a new goal was defined as utilizing knowledge in third-generation universities. Also, in these universities, unlike the second-generation universities, there is a lot of competition with the industrial sector to attract students, professors, and research contracts, and they are less dependent on principles and government laws and funds. Research in third-generation universities is broadly transdisciplinary or interdisciplinary. These universities welcome the idea of consilience [agreement among different academic subjects to achieve a subject or author] and creativity as a propellant. Appendix 1 summarizes the characteristics of the first-, second-, and third-generation universities.

The entrepreneurial university has extraordinarily active interactions with its social and economic status in its conventional sense. However, the objective of these relationships is still the university's internal growth. A more advanced model of a young university can be imagined that attempts to increase the speed of its growth and alter its environment through external activities. The university's interaction with this modified environment significantly affects the university itself. To distinguish this, the idea of a "fourth-generation university" is used, and constructing the institution's environment appears as a task in the mission statement of such a university. Second- and third-generation universities also shape their surroundings, but in this case, the university's primary goal is to influence environmental changes, even its total transformation, to meet the needs of the knowledge-based economy. The fourth-generation university is well-placed in the evolution of higher education. The most striking distinction is that these universities take a far more strategic approach to their environment and proactively influence it.

Several successful examples show that universities play a significant role in improving the competitiveness of some territories, and in many cases, they are actively involved in economic development efforts. Due to rising social and financial commitments, modern economic development requires universities to widen their traditional (education and research) operations. High-quality education is a crucial but insufficient factor in allowing universities to reach their full economic potential. High-quality research is also required to adopt research findings by the local economy. Therefore, the competitiveness of enterprises will be improved leading to the improvement of the region's competitiveness. Universities in developed economic zones are increasingly supplementing their conventional operations (education and research) with third-purpose elements as their influence in society and economy grows. Universities nowadays must meet the needs and demands of a knowledge-based society. Modern, internationally recognized universities are inextricably linked to the local economy; they maintain daily contact with local players (1).

Objectives

Considering the issues mentioned above and the importance of new educational and managerial strategies to achieve sustainable development goals in societies, this study was conducted to review educational-managerial strategies to move towards fourth-generation universities.

Methods

Search strategy: A comprehensive search was first conducted using PubMed, Web of Science, Scopus, ISC, SID, and Google Scholar databases until June 21, 2021, to detect the educational-managerial strategies to move towards fourth-generation universities. To this end, the following keywords, either alone or by conjunctions of ‘’and” or ‘’or’‘, were used to find relevant papers with the concerned keywords in the title, abstract, and keywords sections: "Upgrade","Generation","University","Fourth generation university","University generations", "Approach", "Components", “Educational”"Entrepreneur University","Smart University", and “21st Century University”.

Inclusion criteria were all full texts that explored educational strategies for moving to fourth-generation universities, and based on this index, a wide range of published journals and articles in English and Persian on educational strategies for moving to fourth-generation universities were selected. To select the articles and extract the data, initial screening was based on titles and abstracts. The papers were evaluated independently. The abstracts lacking data were revised for full-text assessment. Then, two researchers individually assessed the full text of the articles and determined their fitness (Figure 1).

Two authors (A.S. and E.K) extracted data from included articles. Using STATA software, the content of the selected studies in the previous stage was carefully examined, and information related to educational and managerial strategies to move toward fourth-generation universities was extracted. The obtained strategies were classified into related groups.

Results

After searching databases until June 21, 2021, 1986 research articles were identified. Of these, 58 duplicates were removed, and 1928 articles were independently examined by two researchers. Initially, 1648 articles were removed after screening their titles and abstracts. Subsequently, the full text of the remaining articles was examined, and 280 articles were excluded. Finally, 58 articles were deemed eligible, of which 14 dealt with soft skills training, 9 with sustainable development training, 8 with reviewing the continuous training of professors,10 with promoting ideation and creativity to solve problems, 6 with development of interdisciplinary training, 10 with decentralization of government accelerators and deployment of private accelerators in university,

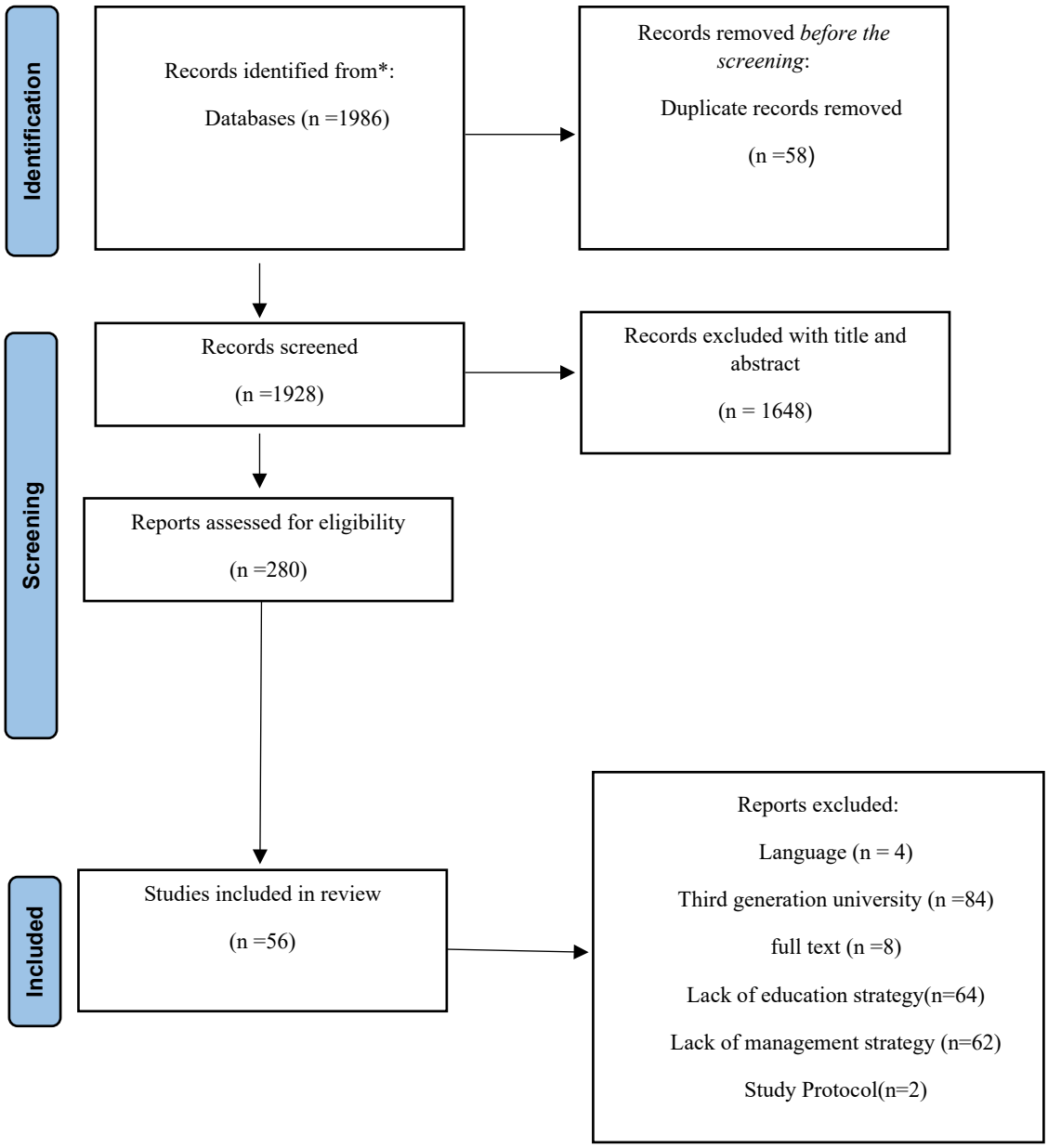

Figure 1. Flowchart of the selection process of the included studies

13 with the privatization of higher education, 7 with internationalization, and 15 with training business law in universities (Figure 1 and Table 1).

According to the article by Zuti et al., the fourth-generation university includes a model consisting of two pillars called "education-research and third mission"(1). The first pillar refers to the traditional activities of universities in the field of education and research, and the second pillar, called the "third mission of the university," deals with the economic development, entrepreneurship, and internationalization of the university. Combining the second pillar with the traditional activities in the first pillar increases the role of universities in improving the economy and society.

The fourth-generation university fits appropriately in the progress of university development. The most noticeable difference between them and other generations of universities is that they are highly strategic and planned because they can actively shape their environment. According to Table 1, each of the educational strategies extracted from the studied articles is a subset of one of the pillars of the proposed model by Zuti et al. for the fourth-generation universities, which each strategy is explained in detail below.

1- Soft skills training

By searching the workplace, we find that hardware skills are more important than soft skills, including problem-solving, creativity, efficiency, utilizing resources, teamwork, listening, and management. In most

Table 1. Evidence from educational-managerial strategies to move towards fourth-generation universities

Pillar	Education-Management Strategy	First Author (Reference)
Education-research	Soft skills training	L. Callagher et al (20), Y.-C. Chang et al (21), P. D' este and M. Perkmann (22), G. Dalmarco et al (23), M. Amaral et al (24), M. O. Arikewuyo and G. Ilusanya (25), L., D. Bienkowska et al (26), D. Di Berardino and C. Corsi (27), A. Adeniran et al (28), E. Amrina and F. Imansuri (29), L. P. Amaral et al (30), P. Sylvestre et al (31), R. K. Mavi (32)
	Sustainable development training	V. Bikse et al (33), N. Budyldina (34), N. Errasti et al (35), D. Farrington and D. Ismaili (36), M. Guerrero and D. Urbano (37), R. K. Mavi (32)
	Reviewing the continuous training of professors	G. Secundo et al (38), M. VAMPA (39), A. Disterheft et al (40)
	Promoting ideation and creativity to solve problems	V. Bikse et al (33), A. G. Bodunkova and I. P. Chernaya (41), J. Bronstein and M. Reihlen (42), N. Errasti et al (35), H. Etzkowitz (43-45), D. A. Kirby et al (46), R. Lombardi et al (47)
	Development of interdisciplinary training	H. Etzkowitz (44, 45), P. Savetpanuvong and P. Pankasem (48), D. Urbano and M. Guerrero (49),
Third mission	Decentralization of government accelerators and deployment of private accelerators in university	V. L. Albulescu et al (50), E. Berggren (51), M. O. Arikewuyo and G. Ilusanya (25), J. Bronstein and M. Reihlen (42), N. Budyldina (34), D. Di Berardino and C. Corsi (27), M. Guerrero et al (52), V. Bikse et al (33), D. Williams and A. Kluev (53), L. Markuerkiaga et al (54)
	Privatization of higher education	V. L. Albulescu et al (50), G. Dalmarco et al (23), E. Berggren (55), M. O. Arikewuyo and G. Ilusanya (25), T. Baaken et al (56), D. Bienkowska et al (26), V. Bikse et al (33), A. G. Bodunkova and I. P. Chernaya (41), N. Budyldina (34), N. Errasti et al (35), H. Etzkowitz and R. Viale (57)
	Internationalization	L. Markuerkiaga et al (54), T. Minola et al (58), V. Ratten (59), M. S. Reshetnikova (60), C. N. Reyes (61)
	Training business law in universities	V. L. Albulescuet al (50), E. Berggren et al (55), D. Bienkowska et al (26), N. Errasti et al (35), V. Bikse et al (33), G. Dalmarco et al (23), H. Etzkowitz (43, 44, 62), M. Guerrero et al (63-65)

universities, hard skills (laboratory, clinical, etc.) are taught well, but little attention is paid to these skills.

The basic need of a university graduate to achieve a job and accept specialized responsibilities of society is a skill; it means individuals in addition to having mental and physical abilities and educational level, need

behavioral characteristics, such as personality, type of attitude, motivation, and personal values that should be achieved by technical, human, and perceptional skills during the education period. Today, in all organizations and institutions, the model of individual and professional competence is used to identify these skills, and accordingly, required knowledge, skills, attitudes, and personality characteristics are determined to achieve every job (2); however, companies and businesses most of the time suffer from the lack of such skills in their workforce.

The existence of graduates who do not use their properties and are just waiting for investment injection to start their work is a serious danger to each country's economy.

The base of this wrong culture goes back to universities, where students do not use government resources properly, and there is much dissipation in these resources, and no one denounces the issue. As a result, that consumerism culture replaces the productive culture, and a graduate student of such a university will never be able to create wealth, and if he/she can, will suffer for a long time because he/she does not know how to manage the resources.

In recent years, these skills have become the pivot of many valid universities around the world. Therefore, it is necessary to plan the actions in this field and combine "being a student" with "skill training." Soft skills can be taught to students through volunteering and holding workshops (3). Volunteering is one of the best ways to teach soft skills because when students accept some of the job responsibilities, such as holding a conference, they gain experiences, such as crisis management, responsibility, public relations, funding, and attracting sponsorship before entering into the workplace (3).

2- Sustainable development training

The global document of countries' sustainable development consists of three parts, macroeconomics, society, and the environment, and pursues seventeen aims. Sustainable development training is one of the most important prerequisites for sustainable development in society. Domestic entrepreneurship will not be achieved unless having a major and hopeful vision for the country's future. Undoubtedly, students need to percept the whole puzzle to understand their place in the development puzzle. Training macroeconomics, sociology, and the environment help students understand the development concept and increase their entrepreneurial motivation for the country's development.

3- Training business law in universities

Entrepreneurship has grown significantly in the last decade, and new ways have been shown for newfound economics. With this development, entrepreneurship training has become essential. Since the focus of the fourth-generation university's activities is on the axes of innovation, technology, and entrepreneurship development, utilizing university growth centers' capacities is the main and unique solution of this approach. To achieve the issue, universities can design courses to teach entrepreneurship and wealth creation in the form of an academic course so that students do not face legal problems or even bankruptcy in their future jobs (4).

4- Reviewing the continuous training of professors

Adding technological training to the retraining of professors will update them. In addition to this training, it is necessary to remove and diminish the one-dimensional, article-based, and second-generation professors; the professors' promotion bylaw and its promotion ways should also be reformed and increased. If innovation and technology are accredited in the bylaw, professors and students will be propelled in this direction.

5- Promoting ideation and creativity to solve problems

Numerous techniques, named creative thinking tools, have been developed to generate innovative ideas. These strategies have originated from developing goods and supporting competition. Meanwhile, there are cases, such as brainstorm, holding ideation contests, and awarding special grants to creative students and professors that make students innovative (5, 6). Therefore, the university is responsible for informing students and creating new knowledge that can be useful for human beings' current challenges. Teaching these techniques to solve students' problems and use their solutions to solve the issues of university, industry, and the health system is considered a reasonable step in moving towards fourth-generation universities (5, 7).

6- Development of interdisciplinary training

Interdisciplinary refers to new knowledge areas that study more than one sheer field of knowledge. Interdisciplinary is not a specialty, and no one can consider himself as an expert in this field; rather, it is a method of producing knowledge to manage the complexities and explore fundamental facts. In other words, interdisciplinary is a process of answering, answering to a complex question, which cannot be addressed through a particular discipline or a profession. Over the past hundred years, higher education based on academic disciplines promoted the pivotal discipline model of specialization. But today, another approach must be added to this field, which is the interdisciplinary approach.

Interdisciplinary is beneficial in terms of being interdisciplinary and rescues scientists trapped in solitary cabins and exhibits the values of technological convergence for society's benefit (8). One of the top strategies for promoting interdisciplinary studies is paying attention to health-oriented disciplines and updating the curriculum of such fields in accordance with the interdisciplinary perspective because the main problem of current curriculums is that they are written with a focus on today's technologies and use the physician-patient relationship model at the moment; However, considering the acceleration of changes in the current curriculums, they cannot prepare students to change (9). In this regard, bioinformatics and social

medicine units can be added to the curriculum of bachelor and general doctorate courses (10).

7 - Decentralization of government accelerators and deployment of private accelerators in university

Entrepreneurship and accelerators have an effective role in this regard; because universities need educational and financial support to create leading entrepreneurship. On the other hand, the government cannot meet all the needs, and the acceleration in private knowledge-based companies is better than the governmental part. The reason is that the remote part always maintains a high level of service to survive the competition (11). Accelerators of private startups have been established to educate and facilitate startups and help universities' economic development. Therefore, the entrance of private accelerators in the field of entrepreneurship education causes the student to connect directly with the startup ecosystem, leading to the improvement of his/her abilities (12).

8- Privatization of higher education

Some researchers believe that the participation of other parts of society in financing higher education services has better results than the time the government is financing these services. While many investigations have emphasized the private part's involvement in higher education, the government is unable to afford the high costs of it. Insufficient government capacity to provide higher education services leads to education privatization (13, 14). It can also refer to the emergence of a knowledge-based economy and the change in university applicants' population composition, which has accelerated the move towards privatization in education (15).

Privatization is the process, by which the government transfers its duties and properties to the private part, which is one of the four principles of "structural reform" in economics. Privatization in medical education means that an organization presents education out of the governmental departments. Private educational institutions are funded in different ways and are under different levels of government control. It means that they can be totally independent or relatively independent or be profitable or non-profit and community-oriented (16).

Regarding the benefits of privatization in higher education, including improving the quality of education, independence of organization, supporting the laws and regulations governing these centers, the absence of high demands and ideals (political and ideological), the possibility of increasing the power of choice and managers' decision-making, better and more practical choice, and increasing competition can indicate the need to move towards fourth-generation universities.

However, apart from the benefits of higher education privatization in medical sciences, privatization in education causes deepening of class gaps and social inequality and changes the educational function, science production, publication, and implementation of academic research according to society's need for applications with the aim of profitability and material investment (17). Accordingly, to move towards fourth-generation universities, it is necessary to pay attention to the advantages and disadvantages of privatization and to carry out privatization properly in higher education.

9- Internationalization

Fourth-generation universities are institutions for strengthening scientific and educational exchanges between different nations and cultures (32). This role is due to two similar but distinct phenomena; globalization means unification, and internationalization means cooperation and partnership (33). Education in the international dimension is a relatively new phenomenon that has led to serious changes in education. In second-generation universities, internationalization was considered an individual activity, and the entire educational system was neglected. However, in fourth-generation internationalization does not focus only on the international transfer of students and professors (34), but all components and elements, including educational systems, areas of scientific transfer, curriculum and learning outcomes, borderless education, transnationalism, internationalization of research, and development of cooperation and capacity building are considered (35). A fourth-generation institution must accommodate student mobility as a result of internationalization (2).

Discussion

Today, fourth-generation universities, in addition to fulfilling the missions and duties of past generations, are responsible for meeting the needs and desires based on the knowledge society. However, the question always arises as to what conditions must be in place for universities to move towards local and global competition. The most important difference between fourth-generation universities is having a strategic approach that can actively shape their environment. Modern economics require new teachings and applications, as well as the participation of society and economics in theory and practice (18).

In this study, the educational-management strategies presented in the related articles were classified into none categories: soft skills training, sustainable development training, training business law in universities, reviewing the continuous training of professors, promoting ideation and creativity to solve problems, development of interdisciplinary training, decentralization of government accelerators and deployment of private accelerators in university, privatization of higher education, and internationalization.

According to the model proposed for the fourth-generation university components by Zuti_et al. (1), five strategies (55%) are related to the first pillar (education-research and third mission), and four strategies (45%) are related to the second pillar (third mission of the university).

Unlike the strategies related to the first pillar, the efficiency of the second pillar is related mainly to the factors within the university and can be easily achieved

with planning and proper and sufficient attention of the stakeholders. The fourth-generation universities are to some extent dependent on the level of the economy of the country and the region, in which the university is located, and these results are consistent with the model proposed by Zuti et al. for the fourth-generation university because the necessary infrastructure to implement the components of each one of the pillars is the level of the local economy (1).

According to the vision document (National Development Document) and the higher education sector in the country's fourth economic, cultural, social, and political development plan, Iran has envisioned the future primarily in economic, scientific, and technological level in Southwest Asia. The general policies and twelve themes of the Fourth Development Plan include issues, such as "laying the groundwork for rapid economic growth," "environmental protection," "spatial development," and "knowledge-based development," which are the strategies derived from this is review can be effective in achieving most of the provisions of the National Development Document (19). Also, regarding fourth-generation universities, such as Harvard and Cambridge universities, in the first step having a sustainable education system at all levels (students, faculty, and staff) and then using financial support from various companies, conducting research work in line with the needs, internationalization and internationalization and attraction of local and international students who have the necessary mobility, the creation of new business enterprises through the inventions of universities, and the transfer of knowledge to institutions and companies are very famous (18). The strategies extracted from the articles are suitable strategies for moving other universities towards fourth-generation universities.

According to the educational-managerial strategies expressed in this study, the following issues are suggested:
- Officials and policymakers in the field of higher education are recommended to facilitate the decision-making conditions of universities and give universities more authority to connect with the private sector and industry through the reform of the method governance.
- Specialists and planners in the field of higher education are recommended to include economic courses in each field in the design and development of the university curriculum.
- Universities are encouraged to develop interdisciplinary culture and values through student associations by increasing interdisciplinary activities.
- It is suggested that universities use student and university projects to solve problems and cultural, social, economic, and environmental issues.

Conclusion

The post-corona world will be an arena of dramatic change and accelerating dynamics. The changes will be so bizarre and rapid so that the lack of proper planning and the slightest carelessness can lead to strategic surprise costs in political, economic, social, and even cultural areas. The future environment will be full of change and uncertainty; the only approach and policy that is likely to be more successful are new perspectives on business issues, the emergence of fourth-generation universities, and the actual use of knowledge and expertise. Elite and the elimination of the traditional top-down view will be in the structure of government. The analytical results of this research help the universities of the country to design and implement their strategies to reach the fourth-generation universities following the standard implementation models of the fourth-generation universities.

Acknowledgments: The authors are grateful to the Student Research Center at Hamadan University of Medical Sciences.

Conflict of Interests: No potential conflicts of interest were reported by the authors.

Ethical Approvals: IR.UMSHA.REC.1400.774

Funding/Support: This study was financially supported by the Student Research Committee at Hamadan University of Medical Sciences

References

1. Lukovics M, Zuti B. New functions of universities in century XXI towards "Fourth Generation" universities. Journal Transition Studies Review. 2015; 22(2): 33-48.
2. Robles MM. Executive perceptions of the top 10 soft skills needed in today's workplace. Business communication quarterly. 2012;75(4):453-65. doi:10.1177/1080569912460400
3. Lazareva O, Kovtun O. Developing soft skills at ESP classes in technical heis. 2017; 108-15. doi:10.26697/9789669726094.2017.108
4. Akbulaev N, Mammadov I, Shahbazli S. Accounting Education in the Universities and Structuring According to the Expectations of the Business World. Universal Journal of Accounting and Finance. 2021;9(1):130-7. doi:10.13189/ujaf.2021.090114
5. Eragamreddy N. Teaching creative thinking skills. International Journal of english language & translation studies. 2013;1(2):124-45.
6. Ahmadian Chashemi M, Niazazari K, Salehi M. Designing the model of Fourth-generation University to Improve Education and Research Quality in Higher Education. Educational Development of Judishapur. 2021;11(4):901-11. [In Persian]
7. Im H, Hokanson B, Johnson KK. Teaching creative thinking skills: A longitudinal study. Clothing and Textiles Research Journal. 2015;33(2):129-42. doi:10.1177/0887302X15569010
8. Bindler RC, Richardson B, Daratha K, Wordell D. Interdisciplinary health science research collaboration: strengths, challenges, and case example. Applied Nursing Research. 2012;25(2):95-100. doi:10.1016/j.apnr.2010.06.004. [PMID: 20974103]
9. Meskó B. The guide to the future of medicine: technology and the human touch. 1st ed. Budapest, Hungary: Webicina Kft; 2014.
10. Salehi AM, Ahmadian M, Mohammadi HA, Khanlarzadeh E. Modification of educational curriculum based on the interdisciplinary approach: a requirement in the present era. Strides in Development of Medical Education. 2021;18(1). doi:10.22062/sdme.2021.91628
11. Antal N, Kingma B, Moore D, Streeter D. University-wide entrepreneurship education. Bingley, UK: Emerald Publishing Ltd; 2014. doi:10.1108/S1048-473620140000024009.
12. Metcalf LE, Katona TM, York JL. University Startup Accelerators: Startup Launchpads or Vehicles for Entrepreneurial Learning?. Entrepreneurship Education and Pedagogy. 2020;4(4):666-701. doi:10.1177/2515127420931753

13. Manna MR, Paul MA, Mete J. Gender Inequality in Education at Present Context: In Indian Scenario. Gender Issues in India: Challenges and Strategies.2017;82.
14. Óskarsson Þ. Who is best placed to provide health care? : a survey among managers of health care institutions. Island: Skemman;2011.
15. Rabiei A, Nazariyan Z. The Barriers to the privatization of higher education in Iran and providing solutions for their removal. Iran Higher Education Journal. 2012;4(2):171-206.
16. Shehnaz SI. Privatisation of medical education: viewpoints with a global perspective. Sultan Qaboos Univ Med J. 2010;10(1):6-11.
17. Ghoraishi Khorasgani MS, Yamani M, Zakersalehi G, Mehran G. A Content Analysis Of Articles In Privatization Of Higher Education In Iran Scientific Journals. Journal Of Science And Technology Policy. 2017;9(3):61-76.
18. Goudarzvand Chegini M. The fourth generation university labor; and action approach (case studies: Cambridge, Stanford, and Harvard universities. Iranian Journal of Engineering Education. 2018;20(78):1-16. doi:10.22047/IJEE.2018.128487.1541
19. Iran Data Portal. 20 Year National Vision. Available From: https://irandataportal.syr.edu/20-year-national-vision.
20. Callagher L, Horst M, Husted K. Exploring societal responses towards managerial prerogative in entrepreneurial universities. International Journal of Learning and Change. 2015;8(1):64-82. doi:10.1504/IJLC.2015.069074
21. Chang Y-C, Yang PY, Martin BR, Chi H-R, Tsai-Lin T-F. Entrepreneurial universities and research ambidexterity: A multilevel analysis. Technovation. 2016;54:7-21. doi:10.1016/j.technovation.2016.02.006
22. D'este P, Perkmann M. Why do academics engage with industry? The entrepreneurial university and individual motivations. Journal of Technology Transfer. 2011;36(3):316-39. doi:10.1007/s10961-010-9153-z
23. Dalmarco G, Hulsink W, Blois GV. Creating entrepreneurial universities in an emerging economy: Evidence from Brazil. Technological Forecasting and Social Change. 2018;135:99-111. doi:10.1016/j.techfore.2018.04.015
24. Amaral M, Ferreira A, Teodoro P. Building an entrepreneurial university in Brazil: the role and potential of university–industry linkages in promoting regional economic development. Industry and Higher Education. 2011;25(5):383-95. doi:10.5367/ihe.2011.0061
25. Arikewuyo MO, Ilusanya G. University Autonomy in a Third-Generation University in Nigeria. Tertiary Education and Management. 2010;16(2):81-98. doi:10.1080/13583881003756468
26. Bienkowska D, Klofsten M, Rasmussen E. PhD students in the entrepreneurial university-perceived support for academic entrepreneurship. European Journal of Education. 2016;51(1):56-72. doi:10.1111/ejed.12160
27. Di Berardino D, Corsi C. A quality evaluation approach to disclosing third mission activities and intellectual capital in Italian universities. Journal of Intellectual Capital. 2018;19(1):178-201. doi:10.1108/JIC-02-2017-0042
28. Adeniran A, Nubi A, Adelopo A. Solid waste generation and characterization in the University of Lagos for a sustainable waste management. Waste management. 2017;67:3-10. doi:10.1016/j.wasman.2017.05.002. [PMID: 28532622]
29. Amrina E, Imansuri F. Key performance indicators for sustainable campus assessment: a case of Andalas University. Industrial Engineering, Management Science and Applications. Berlin, Heidelberg: Springer; 2015: 11-8.
30. Amaral LP, Martins N, Gouveia JB. Quest for a sustainable university: a review. International Journal of Sustainability in Higher Education. 2015;16(2):155-72. doi:10.1108/IJSHE-02-2013-0017
31. Sylvestre P, Wright T, Sherren K. A tale of two (or more) sustainabilities: AQ methodology study of university professors' perspectives on sustainable universities. Sustainability. 2014;6(3):1521-43. doi:10.3390/su6031521
32. Kiani Mavi R. Indicators of entrepreneurial university: Fuzzy AHP and Fuzzy TOPSIS Approach. Journal of the Knowledge Economy. 2014;5(2):370-87. doi:10.1007/s13132-014-0197-4
33. Bikse V, Lusena-Ezera I, Rivza B, Volkova T. The Transformation of Traditional Universities into Entrepreneurial Universities to Ensure Sustainable Higher Education. Journal of Teacher Education for Sustainability. 2016;18(2):75-88. doi:10.1515/jtes-2016-0016
34. Budyldina N. Entrepreneurial universities and regional contribution. International entrepreneurship and management journal. 2018;14(2):265-77. doi:10.1007/s11365-018-0500-0
35. Errasti N, Bezanilla M-J, García-Olalla A, Auzmendi E, Paños J. Factors and maturity level of entrepreneurial universities in Spain. International Journal of Innovation Science. 2018;10(1):71-91. doi:10.1108/IJIS-05-2017-0043
36. Farrington D, Ismaili D. Finding the right person to lead a third generation university: a new approach in the Republic of Macedonia. Procedia-Social and Behavioral Sciences. 2011;15:2083-7. doi:10.1016/j.sbspro.2011.04.058
37. Guerrero M, Urbano D. The development of an entrepreneurial university. The journal of technology transfer. 2012;37(1):43-74. doi:10.1007/s10961-010-9171-x
38. Secundo G, Perez SE, Martinaitis Ž, Leitner KH. An Intellectual Capital framework to measure universities' third mission activities. Technological Forecasting and Social Change. 2017;123:229-39. doi:10.1016/j.techfore.2016.12.013
39. VAMPA M. Albanian Universities mission on "the system" of long-life education. Mediterranean Journal of Social Sciences. 2014;5(19):126-38. doi:10.5901/mjss.2014.v5n19p126
40. Disterheft A, Caeiro S, Azeiteiro UM, Leal Filho W. Sustainability science and education for sustainable development in universities: a way for transition. Berlin: Springer; 2013: 3-27. doi:10.1007/978-3-319-02375-5_1.
41. Bodunkova AG, Chernaya IP. Fractal organization as innovative model for entrepreneurial university development. World Applied Sciences Journal. 2012;18(12):74-82. doi:10.5829/idosi.wasj.2012.18.120012
42. Bronstein J, Reihlen M. Entrepreneurial university archetypes: A meta-synthesis of case study literature. Industry and Higher Education. 2014;28(4):245-62. doi:10.5367/ihe.2014.0210
43. Etzkowitz H. The entrepreneurial university wave: from ivory tower to global economic engine. Industry and Higher education. 2014;28(4):223-32. doi:10.5367/ihe.2014.0211
44. Etzkowitz H. The entrepreneurial university: vision and metrics. Industry and Higher Education. 2016;30(2):83-97. doi:10.1177/0950422218817734
45. Etzkowitz H. Innovation Lodestar: The entrepreneurial university in a stellar knowledge firmament. Technological Forecasting and Social Change. 2017;123:122-9. doi:10.1016/j.techfore.2016.04.026
46. Kirby DA, Guerrero M, Urbano D. Making universities more entrepreneurial: Development of a model. Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration. 2011;28(3):302-16. doi:10.1002/cjas.220
47. Lombardi R, Lardo A, Cuozzo B, Trequattrini R. Emerging trends in entrepreneurial universities within Mediterranean regions: An international comparison. EuroMed Journal of Business. 2017;12(2):130-45. doi:10.1108/EMJB-10-2015-0052
48. Savetpanuvong P, Pankasem P. Entrepreneurial University model: A theoretical perspectives on strategy, entrepreneurship, and innovation. Proceedings of the IEEE International Conference on Management of Innovation and Technology; 2014 Sep 23-25; Singapore. doi:10.1109/ICMIT.2014.6942432.
49. Urbano D, Guerrero M. Entrepreneurial universities: Socioeconomic impacts of academic entrepreneurship in a European region. Economic development quarterly. 2013;27(1):40-55. doi:10.1177/0891242412471973
50. Albulescu VL, Litra M, Neagu C. The "third mission" of universities and some implications. UPB Science Bulletin, Series D. 2014;76(2):301-12.
51. Berggren E. Researchers as enablers of commercialization at an entrepreneurial university. Journal of Management Development. 2017;36(2):217-32. doi:10.1108/JMD-06-2016-0117
52. Guerrero M, Urbano D, Fayolle A. Entrepreneurial activity and regional competitiveness: evidence from European entrepreneurial universities. The Journal of Technology Transfer. 2016;41(1):105-31. doi:10.1007/s10961-014-9377-4
53. Williams D, Kluev A. The entrepreneurial university: evidence of the changing role of universities in modern Russia. Industry and Higher Education. 2014;28(4):271-80. doi:10.5367/ihe.2014.0212
54. Markuerkiaga L, Errasti N, Igartua JI. Success factors for managing an entrepreneurial university: Developing an integrative framework. Industry and Higher Education. 2014;28(4):233-44. doi:10.5367/ihe.2014.0214
55. Berggren E. The entrepreneurial university's influence on commercialisation of academic research–the illustrative case of Chalmers University of Technology. International Journal of Entrepreneurship and Small Business. 2011;12(4):429-44. doi:10.1504/IJESB.2011.039684
56. Baaken T, Davey T, Rossano S. Marketing—Making a Difference for

Entrepreneurial Universities. Making a Difference Through Marketing: Springer; 2016. 247-65. doi:10.1007/978-981-10-0464-3_18
57. Etzkowitz H, Viale R. Polyvalent knowledge and the entrepreneurial university: A third academic revolution?. Critical Sociology. 2010;36(4):595-609. doi:10.1177/0896920510365921
58. Minola T, Donina D, Meoli M. Students climbing the entrepreneurial ladder: Does university internationalization pay off?. Small Business Economics. 2016;47(3):565-87. doi:10.1007/s11187-016-9758-1
59. Ratten V. Entrepreneurial universities: the role of communities, people and places. Journal of Enterprising Communities: People and Places in the Global Economy. 2017;11(3):310-5. doi:10.1108/JEC-03-2017-0021
60. Reshetnikova MS. Analysis of the Russian experience in formation of entrepreneurial universities within the context of the triple helix model as a factor of economy endogenous growth. Espacios. 2017;38(33):36.
61. Reyes CN. Framing the entrepreneurial university: the case of the National University of Singapore. Journal of Entrepreneurship in Emerging Economies. 2016;8(2):134-61. doi:10.1108/JEEE-09-2015-0046
62. Etzkowitz H. Entrepreneurial Universities for the UK: a 'Stanford University'at Bamburgh Castle?. Industry and Higher Education. 2010;24(4):251-6. doi:10.5367/000000010792609781
63. Guerrero M, Toledano N, Urbano D. Entrepreneurial universities and support mechanisms: a Spanish case study. International Journal of Entrepreneurship and Innovation Management. 2011;13(2):144-60. doi:10.1504/IJEIM.2011.038856
64. Guerrero M, Urbano D, Cunningham J, Organ D. Entrepreneurial universities in two European regions: A case study comparison. The journal of technology Transfer. 2014;39(3):415-34. doi:10.1007/s10961-012-9287-2
65. Guerrero M, Urbano D, Fayolle A, Klofsten M, Mian S. Entrepreneurial universities: emerging models in the new social and economic landscape. Small business economics. 2016;47(3):551-63. doi:10.1007/s11187-016-9755-4

Appendix 1. Some characteristics of first-, second-, and third-generation universities

Aspect	First-generation Universities	Second generation universities	Third generation Universities
Goal	Education	Education and research	Education, research, and utilization of knowledge
Role	Protection of truth	The cognition of nature	Creation of added value
Output	Professionals	Professionals and scientists	Professionals, scientists, and entrepreneurs
Language	Latin	National	English
Management	Chancellor	Part-time scientists	Professional management