Toward Accountable Education in the Medical Sciences Universities by Connecting Innovation and Intellectual Capital

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Abstract

This article addresses this important issue that medical sciences universities are an organization that is rich in intellectual capital in various fields and specialties and also have multiple customers and segmented markets. Therefore, it is necessary to establish a connection between these assets and innovation by properly managing the intelligent capital and identifying the society's needs. It should also avoid continuing to educate academic fields that are no longer needed by society and try to replace them with ones that are appropriate to the needs of society to save its tangible capital. This means that education is accountable for the needs of society. This will not happen unless establishing a continuous and strong connection between the university and industry.

Keywords: Intellectual capital; Innovation; University; Accountable education; Society

Value innovations define as identification, measurement, and then maximize the features that create value and minimize or eliminate the features that do not have this effect (1). For any university, achievement at the highest level of quality is a significant value attribute. It means providing the right education in the right way for the right people, according to society's demands (2).

The assets of each organization are divided into tangible and intangible assets. Tangible assets are the same as physical resources such as buildings, equipment, and others. Usually, three terms, intangible assets, knowledge assets, and intelligence capitals, are used interchangeably, while these terms are often used in accounting, economics, management, and literature, respectively.

Recently, the focus of innovative and most progressive organizations is on their Intellectual capital (IC)(3). Universities of medical sciences, like other organizations, need to manage and evaluate their intangible assets because of their serious and important mission. Therefore, it needs to adopt methods that can create a syntropy between these assets (4). This study's logical structure is that inherent differences in IC's key features lead to reinforcing effects or changing the knowledge to create innovation.

These effects are not always separate and independent, but they are often entangled in the organization. Besides, the interaction between them plays a vital role in forming these effects. Therefore, IC's influence on innovation and value creation capabilities and their impact on moving towards accountability education in medical universities has been discussed in this study.

Conceptual framework and hypothesis creation

- Intellectual capital

The concept of IC was first coined in 1969 by an economist named Galbraith. The term capital refers to its economic roots, the role of intelligence in producing value for the organization (5-7) to help the organization achieve its goals (8) and create a competitive advantage for the organization (9). Based on some studies on IC, it can be divided into the following three categories:

- ***Human capital*** **(HC)**: It includes attributes such as knowledge, skills (5), education, values, experience(7), innovation, creativity, problem-solving ability (10, 11), loyalty, flexibility, expertise, competence, motivation, commitment, attitude and agility that people have in the organization and if they leave the organization, they will take it with them (12-15).

- ***Organizational capital*** **(OC):** It is also called structural capital and includes hardware, software, databases, organizational structure and processes, inventions, brands, and anything else related to the capabilities of the organization that supports employees' productivity (11). The OC falls into four categories: process capital (including workflows, operational processes, specific methods, business development plans, and collaborative culture), innovation capital (including intra-organizational intelligence assets such as inventions, copyrights, and trademarks)(8), technological capital (16) and systems capital (knowledge encoded and stored in databases, networks and information systems)(17). OC remains in the organization even when employees leave (18).

- ***Social capital (SI)****:* It means the existing knowledge, accessible and exploitable through interactions between people and communication networks. It includes the organization's relationships with employees, customers, and the environment, also called customer capital (18-21).

-Types of innovation

The most common classification for innovation is incremental and radical. Incremental innovation (II) is the capability to refine and reinforce existing services and goods. Radical innovation (RI) is the capability to transform existing services and goods significantly. The incremental method includes better improvement and utilization of the existing technical trajectory, but the radical method disrupts the existing technical trajectory. Therefore, II focuses on reinforcing and promoting the existing knowledge and RI on transforming the existing and prevailing knowledge, obsolescence of technologies, and evolution of old knowledge into something new (20, 22).

Also, RI is more customer-centric and problem-solving and often depends on employees' ability and motivation at the operational level to design solutions for customers. It is a form of new materials, methods, and technologies, but II focused on the organization's internal development activities and individuals and depended on its ability and motivation in promoting its effectiveness and efficiency (22, 23).

- Intelligence capital as a framework for developing strategies for innovation

An organization's ability to innovate depends on its IC and its ability to utilize its knowledge

resources. Achieving new products requires organizational knowledge, and IC is the sum of the organization's knowledge that can create a competitive advantage for the organization (3). Based on this, it can be concluded that innovation is a process of knowledge management, and the hallmark of innovative organizations is their ability to create knowledge (20). It should be noted that the concept of IC is about creating knowledge and emphasizes the destruction of knowledge.

Destroying knowledge means that the organization must remove obsolete knowledge or knowledge that is not required, prevent duplicate knowledge from entering the organization, and plan to supply the knowledge necessary for innovation. As a result, IC can provide a framework for strategy development in the innovation process as (24) as follows:

- ***Innovation and human capital*:** In an organization, HC is the most relevant intangible asset for innovation. Implicit knowledge of individuals is unique and the source of innovation for the organization because new ideas are usually the results of people's knowledge, skills, and experience in solving the problems (25).

- ***Innovation and organizational capital*:** The knowledge of individuals and groups stored and coded in the organization provides structures and processes that lead to innovative ideas and products. Encoded knowledge facilitates knowledge sharing throughout the organization and its network and is a reliable source for the distribution of innovative ideas in all branches of the organization, enabling the conversion of this knowledge into innovative results (26).

- ***Innovation and social capital*:** Organizational groups and networks make different knowledge domains accessible to inform the people about new solutions to solve existing problems, and they also facilitate the acceptance of new ideas throughout the organization (27).

- The relational model between innovation and intellectual capital

Organizational knowledge resources affect organizational innovation power. In the organization, the various aspects of IC are not separate from each other. For instance, individual knowledge (human capital) is often coded and organized for the organization (organizational capital) and transferred, influenced, and promoted in groups and networks (social capital)(28).

Various studies show that innovation is the process of knowledge management or visualization of organizational knowledge. Innovation has also been described as the exchange and reuse of previous and existing knowledge in a new context that can lead to new products. Hence, networking in the organization is essential to facilitate the acceptance and implementation of new ideas. Creating a close relationship between suppliers and distributors can enhance the new technology acceptance process. (29-31).

According to the relational model between innovation and IC obtained from this research (Figure 1), SC is highly influenced by HC because increasing the capabilities and motivation of the organization's employees leads to higher productivity and more creativity in the organization, which is a crucial factor in strengthening II. This innovation, seeking to enhance knowledge, experience, and professional skills, increases SC. It means that a better relationship between the organization and customers is formed, and knowledge sharing is facilitated (22, 32).

HC affects OC because employees' ability and satisfaction impress the organizational culture, effectiveness, and efficiency of processes and innovation process in the organization by structuring the organization's knowledge and

separating old, new, and repetitive knowledge. It is a step towards achieving innovation in both incremental and radical trajectories (20, 33, 34).

OC also has a significant impact on SC because its organizational culture, processes, and innovation capability lead to attracting and retaining more customers, distributing new ideas, and fostering acceptance of these ideas (28).

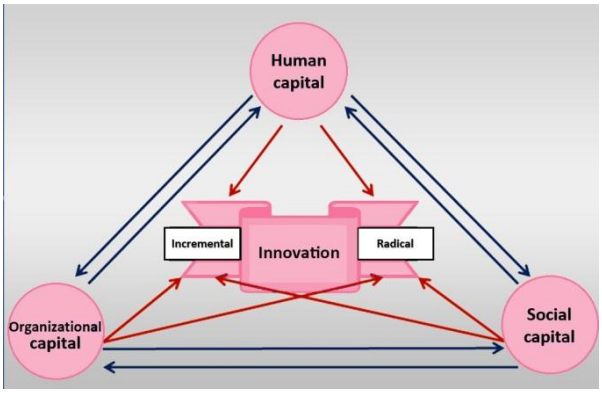

Figure 1: The relational model among intellectual capital and types of innovation

Discussion

- Moving to accountable education by managing intellectual capital

One of the most critical measuring frameworks has been developed by the Danish Trade and Industry Agency. This framework provides IC in the form of resources, activities, and results. By which the paradox that may have arisen is:

-Why high ranked universities do not produce high-quality knowledge?

-Why is not the potential (resources) in many universities proportional to their results?

HC in universities is a set of explicit and implicit knowledge of academic staff (professors, researchers, and assistants) obtained through formal and informal educational processes in line with their specialized activities (35).

OC in universities includes explicit knowledge related to the internal process of publication, communication, and management of scientific and technical knowledge in the organization. This type of capital comes from the operating environment and technology resources available at the university. The operating environment is the interactions among research organizational processes, practices, procedures, culture and values, and scope of an information system, and also technology resources include bibliographic and citation resources, archives, technical advances, inventions, licenses, software, and databases(32).

Measuring these assets helps to know how the university can use them to generate value and improve organizational capital by encouraging innovation among employees, creating a positive culture and advanced information technologies. However, HC is related to the individual competence of researchers. In the global economy and the growing demand for qualified research staff, the HC of universities is highly volatile (36). There is a great danger called brain drain in universities that do not invest in their HC. On the other hand, there are two critical questions:

- How can the university maintain these valuable assets for itself?

- Does the university have enough customers for its products?

For this purpose, it is necessary to take steps to meet the needs of society and industry. Attention must be paid to how it can link with industry and society, meaning how it can increase its SC and protect them. It is where the importance of SC in universities comes into play. SC is also a wide range of economic, political, and institutional relationships between the university and its non-academic partners, i.e., companies, nonprofit organizations, local government, and society in general, as well as people's perception of the university and the

degree of attractiveness and reliability of the university for individuals (22, 28, 32, 36, 37).

Education has been considered as one of the influential producers of SC. In universities, scientific spirit, reinvention ability, and the ability to combine ideas within students should be formed while strengthening foresight, participation, and identity consolidation in interaction with others within the same environment. As members of society, the educational system learners need to know what society is like, and how can they play their social roles efficiently? The university can be a suitable platform for many activities that potentially increase SC (28, 38).

Therefore, when defining the purpose, content, and method of education for studying at the university, it is vital to focus on the business model. The business model has nine basic components that can be used to determine whether the field of study and its educational curriculum meet society's needs. Based on this, it is possible to add or subtract a field of study or change its curriculum according to society's needs. Table 1 shows how academic fields adapt to society's needs based on the business model. By answering the questions, the necessity of having some new academic fields can be determined according to society's needs (39).

Finally, it can be concluded that the measurement of IC is a significant stimulus to increase the productivity of knowledge-based work. Therefore, a measurement tool must be defined. It should be a tool that can demonstrate targeted processes for the renewal and growth of strategic resources. It should also consider the different qualities of the output, e.g., the university's output (e.g., publishing scientific works, holding a training course) and the customer/user/society (e.g., problem-solving).

Table 1: Adaptation of academic disciplines to the needs of society based on the business model

Model components	Definition	Its adaptation to the fields of academic
Customer sections	Each organization serves one or more customer sections.	Which part of society benefits from the services of each academic field?
Suggested values	The organization seeks to solve the customers' problems and meet their needs through suggested values.	Which of the customers' needs is met by each of the academic fields?
Communication channels	Suggested values are provided to customers through distribution and sales communication channels.	How can each academics field meet the needs of its customers through industries?
Relationship with customer	Relationships are established with each customer section, and these relationships are maintained.	How can each academics field communicate continuously with its customers and related industries?
Revenue streams	Suggested values successfully presented to customers lead to revenue streams.	How can each academic field commercialize its products and services?
Key resources	These are the assets required to provide the components described earlier.	What resources are needed by each academic field to achieve their goals, products, and services?
Key activities	These are the activities required to provide the components described earlier.	What key specialization does each academic field offer apart from other similar disciplines?
Key contributions	Some activities are outsourced, and some resources are obtained from outside of the organization.	With which centers, organizations, and disciplines can it share resources to implement its training classes, laboratories, and workshops?
Cost structure	Elements of the business model lead to the cost structure.	How much does it cost for each academic field to provide its resources?

These tools should also help universities determine which of these outputs and indicators are practical and which are not and accordingly take steps to eliminate or improve the shortcomings (19, 35).

- Moving to accountable education by planning for innovation

In this regard, the first step is to determine metrics intelligently because it makes resource allocation well guided, people are accountable for their actions and responsibilities, and the impact of innovation activities can be evaluated. As mentioned earlier, the primary role of innovation metrics is to ensure that you use enough appropriate activities to achieve your goals (22, 38).

They are usually divided into two different categories of input and output criteria. In other words, it is the answer to the question of "What leads to the innovation process of the university and what arises from it." Input metrics such as "Are you doing enough appropriate activities to achieve your goals?", and "Are you allocating your resources properly?" will be measured. In contrast, output metrics measure whether these activities and resources had a positive impact on your innovation process or not (40).

To achieve innovation and entrepreneurship, universities need to move towards developing relationships with industry To meet this end, it is necessary to create an interaction between the courses taken in various fields of study and the active companies and jobs. Such an innovative connection has been created by the HSEE site (https://bamahse.com/). HSEE stands for health, safety, energy, and the environment. This website's content is written for Persian language speakers, and it introduces all fields of medical sciences and jobs and companies related to these fields (Fig2). HSEE also presents a new idea called Creative Student Electronic Portfolio. (Table 2).

Figure 2: A view of the HSEE site

This idea aims to provide students with Table 2 from the beginning of each semester until the end of it to complete their specialized courses in consultation with professors. At the end of their courses, students are familiar with many companies and institutions related to their field. They would also know which companies are successful, which are producers, or knowledge-based, what are patents related to the field, and especially based on the last column of the table, the students are asked to provide ideas for each specialized course tailored to meet the needs of industry and society (41).

Table 2: The proposed structure of the creative student electronic portfolio

Title of specialized courses passed	Practical application of the learned material	Companies and institutions active related to the learned content	Supplementary capabilities and skills required	The idea of patents related to the lesson	Students' innovative ideas to meet the needs of industry and society
....	....	....	....	....	....

Recently, universities are coordinating their capitals and activities to meet the desired innovation needs by asking about their strategic plans based on the answers to the following questions:

-What is the status quo of the university in terms of innovation?

-How can the university compete in the changing world?

-What are society's needs?

-What are its existing resources?

-How can the university gather its resources?

-How can the university train and empower students to be an innovator?

-Where can the university look for new ideas and ways to achieve its goals?

Conclusion

It can be concluded that universities can achieve a variety of incremental and radical innovations by creating a common goal and strengthening the synergy between their IC. By achieving innovation, they will strengthen their intellectual capital. Value innovation results from continuing positive interactions among IC to achieve these innovations in universities. This achievement means producing science and training a skilled workforce accordingly to meet society's needs.

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