



Taxonomies in Higher Education

Abdullah H. Bin Sawad
Department of Information
Systems, Faculty of Computing
and Information Technology
King Abdul-Aziz University,
Jeddah, Kingdom of Saudi
Arabia

Fahad Masood Reda
Department of Information
Systems, Faculty of Computing
and Information Technology
King Abdul-Aziz University,
Jeddah, Kingdom of Saudi
Arabia

Fayez Nahed Al-Sehani
Department of Information
Systems, Faculty of Computing
and Information Technology
King Abdul-Aziz University,
Jeddah, Kingdom of Saudi
Arabia

ABSTRACT

In higher education, there are many taxonomies or classifications. It needs more time and much resources to cover it. This paper trying to cover some taxonomies in higher education to make standardization. The taxonomy of Structure of the Observed Learning Outcome including first, second, third, third, fourth and fifth SOLO have been discussed. Furthermore, decision making in higher education is an important concern while the processes of decision-making involvement have been defined in six steps. In addition, the value chain, inbound logistics and operations of higher education has been discussed in detail along with integration in higher education. Quality assurance in higher education is examined. Additionally, open educational practices and reform in high education are considered. Besides, environment of learning and Decision Support Systems have also been depicted, along with data used in higher education. Taxonomy of cognitive domain is also analyzed as one of the fundamental taxonomies in higher education. Since important for modern world, instructional technology is described. Knowledge acquisition was also part of this paper.

Keywords

Taxonomy, Higher education

1. INTRODUCTION

There is a basic need for an arrangement of characterizing learning undertakings which will allow preparing efficient to make productive utilization of standards of learning [3, 10, 12]. this paper propose a taxonomy that characterizes and classifies various areas in the learning environment and executing workflows in higher education A **taxonomy** is scientific categorization characterizes the structures for relating substance to each other. It might be centered around or over the association or may reach out to outside accomplices and the web. Generally, the taxonomic model has recently identified with unstructured substance, such as reports and site pages in spite of the fact that there is expanding union between unstructured substance and organized information [14, 16]. There are many benefits of taxonomy in higher education [17] such as

- It is capable to arrange the distributed resources for higher education by gathering dynamic applications.
- It reduce the expense of execution or increase output by maximum use of resources available in the environment.
- Execution multiple structures domains to obtain specific processing capabilities.

- Integration of numerous groups required in overseeing of various parts of the analysis work process in higher education

The rest of the paper is organized as follows. The first section, the taxonomy of Structure of the Observed Learning Outcome. The second section, the taxonomy of level of education. The third section, decision-making in higher education. Fourth section, value chain in higher education. The fifth section, taxonomy lecturer performance. The sixth section, taxonomy “quality of service” in higher education. Seventh section, taxonomy by interaction. The eighth section, elements of the taxonomy of collaborative e-learning. The ninth section is about Integration in higher education, and 10th tells about quality assurance in higher education. Section 11, open educational practices in higher education. In section 12, topic is reform in higher education. Sections 13 and 14, evaluation of General Institutions in higher education and environment of learning in higher education, respectively. Section 15, Decision Support Systems based on leading technology. After it, 16th section, data used in higher education. Section 17 covers the topic of cognitive domain taxonomy. The following, 18th, section describes inquiry-based learning taxonomy. In the next two sections (19 and 20), taxonomy of instructional technology service and major knowledge acquisition techniques and are explained. Finally, the last, 21st section is the conclusion.

2. THE TAXONOMY OF STRUCTURE OF THE OBSERVED LEARNING OUTCOME (SOLO)

As learning processes [1, 2], it turns out to be more complex. SOLO, is a method of classifying learning outcomes regarding to their complexity. The Taxonomy names and recognizes in five different levels as per the intellectual procedures. As shown in Figure1 the five levels based on the study of outcomes of academic teaching are as following:

- **First SOLO “Pre-structural”:** In this level, the learner is not sure about the lesson or subject, so. It is not necessary the learner to use and know more of the basic technique of going about it, so it not need it.
- **Second SOLO “Uni-structural”:** Usually the reaction of learners focus on many relevant aspects, but the learners are sharing and discussing as independently. Thus, the several concept of the learners have about that subject. The evaluation for this level is primarily quantitative.



- **Third SOLO “Multi-structural”:** Because the learners focus on many relevant aspects but they are sharing and discussing as independently. However, the learners are disconnected. Evaluation of this level is primarily quantitative.
- **Fourth SOLO “Relational”:** the viewpoints have become unique and integrated into a coherent whole. This level has learners who are professional because the know how to make all the items connected.
- **Fifth SOLO “Extended abstract”:** In all of previous integrated might be conceptualized in higher level reflection and summed up to new subject or area. Currently the learner ready to make new of ideas. Currently the learner is ready for making new ideas on the mastery of the subject.

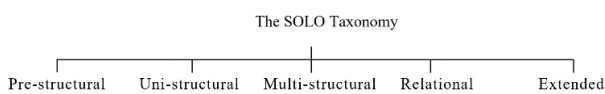


Figure 1: SOLO Taxonomy

Five elements. The first element is inbound logistics, the second primary element is operations. Then, the third element is outbound logistics, the fourth is marketing and sales then the fifth primary element are services [5, 15].

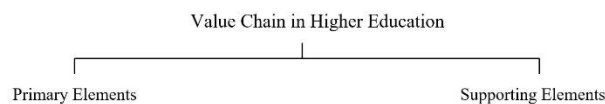


Figure 3: Value Chain in Higher Education

3. DECISION-MAKING INVOLVEMENT IN HIGHER EDUCATION

The processes of decision-making involvement defined in six steps. First, developing the frame of the decision means clarifying the nature of the problem, assessing the situation in business, determining criteria for success and creation of boundaries for the process in decision making. Second, Decision on the people to be involved. It is to ensure the decision may impact the principle representative involvement of all groups and individuals. Third, decision process working out. it involves mobilizing, developing and utilizing available structures for decision making, patterns of working, creating teams for different tasks, timing and decision process working out. Fourth, generating and evaluating alternatives of the decision. Various choices make decisions based on the utilization of established frameworks of choices. Fifth, integration of values. Sixth, focusing on the decision aftermath. Developing systems for implementing and evaluating organizational decisions [6, 7, 8].

4. TAXONOMY OF LEVEL OF EDUCATION

[9] as shown in Figure 2 Levels of education include many of categories which involve Early childhood education (less than primary education) after that come primary, lower and upper secondary, post-secondary, short secondary, short cycle tertiary education then move on higher education bachelor level, master and doctoral education.

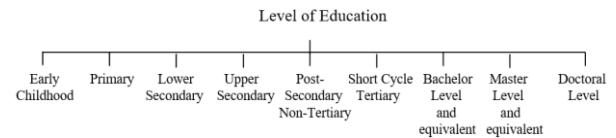


Figure 2: Level of Education

5. VALUE CHAIN IN HIGHER EDUCATION

In [5, 15] there is an orientation to applying the concept of a value chain to clarifying and extend in different areas. Many specialist believe that the administration business particularly the higher education foundations ought to build up or develop their own value chain. it gives a basic guide to future investigates to enhance the value chain concept and make it more fitting for applying in the higher education area. Researchers can utilize different strategies to investigate the value chain segments. The taxonomy characterizes and classifies approaches for value chain in higher education (primary elements and supporting elements) as shown in Figure 3. It consists of five primary elements and four supporting elements of the value chain in higher education.

5.1 Primary Elements

As shown in Figure 4, primary elements which consider main keys for value chain in higher education includes

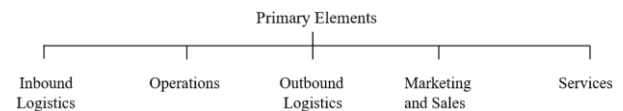


Figure 4: Primary Elements in Higher Education

5.1.1 Inbound Logistics

Inbound logistics, its whole processes that related to receiving and distribution of information. Also, can be represented as students, teachers, and other resources like (financial, technical, industry specialist, plant, and equipment, etc.) as shown in Figure 5.

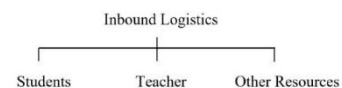


Figure 5: Inbound Logistics

5.1.2 Operations

Figure 6 shows operation can be represented as student learning, teaching specialists, research, and consultancy (Highest level of professional that expert that gives advices within education field).

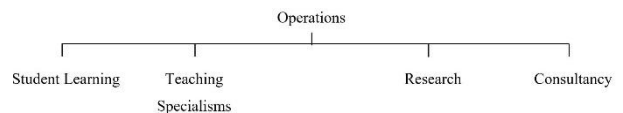


Figure 6: Operation

5.1.2.1 Student Learning

Figure 7 shows student learning online and offline, part time and full time also, onshore and offshore.

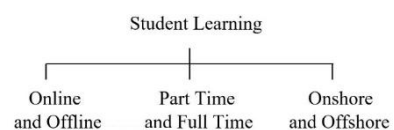


Figure 7: Student Learning

5.1.2.2 Teaching Specialisms

Figure 8 shows classification of teaching specialisms is a methodology and skills, which help in teaching area. It contains curriculum design, innovative teaching, mentoring and facilitation, and professional development.

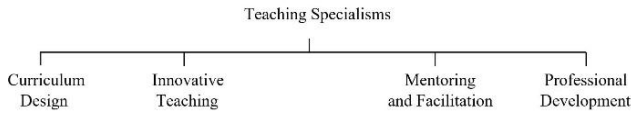


Figure 8: Teaching Specialisms

5.1.2.3 Research

Research can be represented in three classifications. Research – LED teaching, the professional development also, publication and project as shown in Figure 9.



Figure 9: Research

5.1.2.4 Consultancy

Figure 10 shows consultancy in higher education in teaching and learning curriculum design [4].

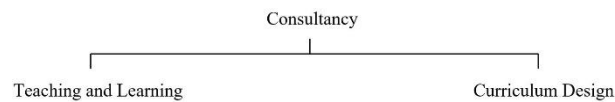


Figure 10: Consultancy

5.1.3 Outbound Logistics

For outbound logistics, include all the activities such as collecting, storing, and distribution of output in higher education Figure 11 classifying in market-ready student, competent teaching, competent researchers, relevant courses, customized courses, satisfied stakeholders.

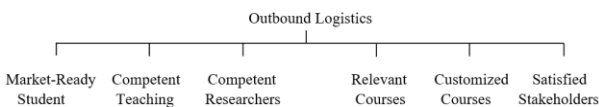


Figure 11: Outbound Logistics

5.1.4 Marketing Sales

In market and sales in Figure 12 area focus on development in brand is a symbol it almost used in business, marketing and advertising, market, channel and network.

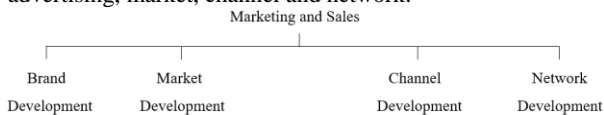


Figure 12: Market and Sales

5.1.5 Services

As service in higher education includes managing alumni relation, recruiter relations is who responsible for recruitment department, consulting services and other relations as shown in Figure 13.

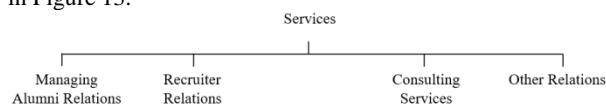


Figure 13: Services

5.2 Supporting Elements

As we mention above the Supporting Elements are technical or physical information system which support an activity for value chain in higher education can be classified in four

elements [5, 15]. The infrastructure, management of human resource, developing the technology and procurement as shown in Figure 14.

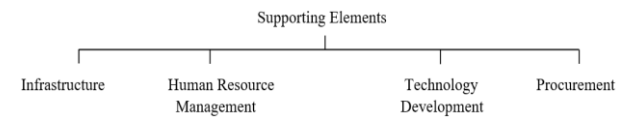


Figure 14: Supporting Element in Higher Education

6. TAXONOMY LECTURER PERFORMANCE

In [11] classifies the decision making of participative in lecture performance in five criteria. Teaching performance, research performance, publication performance, public engagement performance and miscellaneous means in higher education consisting member or elements of different kinds which provides in lecturer performance (Figure 15).

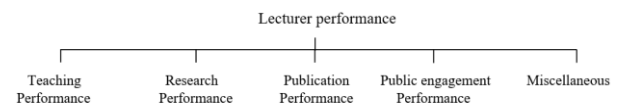


Figure 15: Lecture Performance

7. TAXONOMY “QUALITY OF SERVICE” IN HIGHER EDUCATION

The quality in higher education defined as set of dimensions. According to [13] divided quality in higher education to five dimensions as shown in Figure 16. First, the quality of administrative is all procedures clear and no delay. Second, the quality of physical environment. Third, the quality of core education means courses, academics and so on. Fourth, the quality of support facilities. Fifth, the quality of transformative is measure of quality of higher education especially in Transformative.

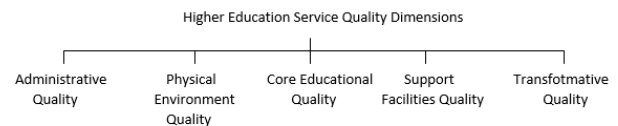


Figure 16: Higher Education Service Quality Dimensions

8. TAXONOMY BY INTERACTION

In this section classifies technologies by the interaction between learners and other parties (educational online technologies). As shown in Figure 17, there are five existing taxonomies. learner to expert, learner to learner, learner to content, learner to context, learner to media [14].

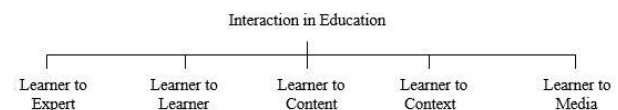


Figure 17: Interaction in Education

Also, there are forms of interaction in distance education include teachers and students, student and student also, form students and content.

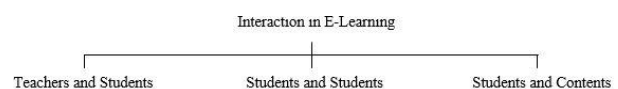


Figure 18: Interaction for E-Learning in Higher Education



9. ELEMENTS OF TAXONOMY OF COLLABORATIVE e-Learning

Figure 19 shows Taxonomy has elements of collaborative E-Learning, which contains three main keys elements. Levels of collaboration, learning activities means what engage students in certain activity and trust continuum is how much the trust is going on during higher education. [9].

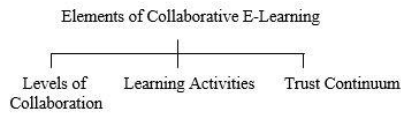


Figure 19: Elements of Collaborative E-Learning

9.1 Taxonomy of collaborative e-learning: levels of collaboration

In [9] as shown Figure 20 describe one of the most important key of elements of collaborative E-Learning, Each level is not better than another. Levels of collaboration include five stages such as Dialogue is the conversational that happen between two or more of people in class peer review is the evaluation of work that had done by one or more people, parallel that means boys and girls are studying in the same school. Sequential, and Synergistic Collaboration.

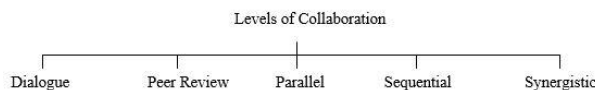


Figure 20: Level of Collaboration

10. INTEGRATION IN HIGHER EDUCATION

At the moment, there are high-speed globalization and integration in many aspects, the global economy, medicine, as well as the media. Therefore, it is very important that there should be integration in higher education in many various types. [18] Figure 21 illustrates that the integration in higher education consist of three concerns they are academic plan, teaching and training tools and teaching language. These three concerns are integrated on individual level and finally they are integrated on the high education level. These three concerns are also known as integration dimensions of higher education.

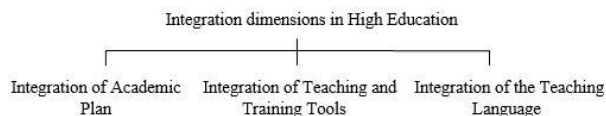


Figure 21: Taxonomy of dimensions of integration in high education [18]

Integration of academic plan, integration is the process of combining the small chunks of information, the resultant information is the resultant of the combination the chunks. An academic plan is the main element for a good and effective University. It incorporates the mission, vision, purpose of the university and produce an effective process of evaluation, rules and regulations.

Integration of teaching and training tools, the integration of teaching and training tools involve the combination of all the elements used in classrooms. The integration of the teaching and training tools in the classrooms not only helps the faculty member to develop a better understanding but it also helps student to develop a broad understanding of the topic.

Integration of the teaching language, the skills integration refers to teaching the many aspects of a skill and treats it as

one of two or more interrelated skills. The teaching language is the medium of understanding for the students therefore integration of teaching language is an important dimension of higher education.

11. QUALITY ASSURANCE IN HIGHER EDUCATION

Quality in higher education is defined as the continuous development and the efficient functioning of institutions of higher education in order to get the trust of the community and its graduates based on universally recognized evaluation mechanism. [19]. The higher education quality is measured by four factors these factors are shown in Figure 22. The discussed factors are academic quality, management quality, financial quality and infrastructure quality

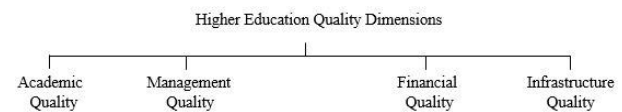


Figure 22: Taxonomy of quality dimensions in higher education [19]

Academic Quality is associated with number of different factors they are, the students should be provided with efficient and effective learning resources that helps in creating a good comprehensive knowledge. The other factor associated is that the teaching staff should provide effective teaching, support, evaluation and should improve it constantly. These services should be monitored constantly to improve academic quality.

Management Quality, The management should be effective enough to respond to each student timely. Moreover, the quality of management can be measured by analyzing the student's engagement and their effective partnership with the management. Management quality is an important concern because of its contribution in student's learning.

Financial Quality, The finance has a great impact on the quality of output i.e. the quality of students produced by an institute. [1] The finance forecasts the cohort size and the student performance is predicted by the class size. The Quality of the teaching faculty is influence by the finance of the institute and it eventually influence the academic performance of the student. Similarly, the finance influence the quality of learning resources and eventually the performance of the student is influenced. The finance influence the quality of staff members, the staff members should not only be given good salary but also some allowances and medical facilities.

Infrastructure Quality, the health of students, faculty members and other staff affect the overall performance of the institute. The concerned authorities should have outdoor games like football, cricket and many more within the campus. Furthermore gym equipment and swimming pool should also there within the university. The university should have a parking lot which can accommodate the student's and other staff's including faculty's vehicles safely. The presence of the above discussed things require complete maintenance, the concerned authorities should have an effective staff to communicate efficiently.

12. OPEN EDUCATIONAL PRACTICES IN HIGHER EDUCATION

With the large number of Internet applications and the high-speed Internet, higher education including a large number of government and private institutions focused on the open



learning resources in order to reduce the cost, effort and the number of working labors. [20]. Figure 23 discussed three challenges in open education resource (OER) they are lack of education, lack of human resource and lack of integration.

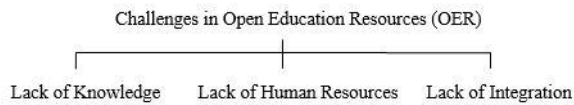


Figure 23: Taxonomy of kind of challenges in open education resource [20]

Lack of Knowledge, to even out the access to knowledge and educational opportunities across the globe, Open Educational Resources Initiative uses information technology. This initiative focuses the students, faculty members and self-learners across the globe. The main aim of using the information technology is to globalize the education and make it accessible for every human being in the earth.

Lack of human resources, human resources are important to initiate and maintain significant repositories of OERs. There is lack in human resources, such as teacher, lecturers and administrative and management systems. The current system is not effective enough because of the elderly faculty members, staff members with lack of knowledge and lack of communication between departments. These factors are caused because of the lack of human resources and the presence of non-effective human resources

13. REFORM IN HIGH EDUCATION

Reform in higher education is an important area for researchers and those who are interested in education, whether the reform of academic, managerial or financial domains. With the large number of universities and Institutes of higher education, there is an urgent need to work on the reform in higher education in all its issues. [21]. The area of reforms in the higher education, as discussed in Figure 24, are systems of tertiary education, privatization, academic work and technology.

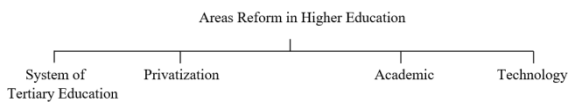


Figure 24: Taxonomy of areas reform in higher education [21]

Systems of Tertiary Education, across the globe the tertiary education systems have expanded in numerous countries. In each country it experience different expansion and different rate of change. This system had great influence on the labor market and demands much highly skilled and educated labors.

Privatization is a term used in higher education which generally refers to a process of the existing private and public educational institutes including colleges and universities of developing and following particular operational norms by associating them with private enterprises. However, privatization in educational institutes perceives student as a consumer whereas the concern college or university is managed as a product. In addition, the process of privatization involves the concern of adopting the management practices that are associated with private business.

Academic work includes both the eager for knowledge and its practical application and distribution through some work but it does put any constraints on the research which needs to be changed.

Technology, for nearly 30 years, pundits have predicted that education technology would disrupt higher education. Online courses will reduce costs and create unprecedented access to higher education, so the argument goes. Likewise, adaptive learning will improve - or replace - the art of teaching as the right digital content is delivered at the right time to each individual learner.

14. EVALUATION OF GENERAL INSTITUTIONS IN HIGHER EDUCATION

There is a strong correlation between evaluation and any other educational process in higher education such as research, development, creation, modification etc. Evaluation gives an indicator of any institution performance that have been evaluated, and an appropriate action will be taken based on that. [22]. Evaluation is not a type of process which is applicable to a whole system rather it is applied to the subsystems for example the Evaluation of the higher education institutes contains the evaluation of faculty members, academic plan, administrative processes, educational outcomes as discussed in Figure 25.

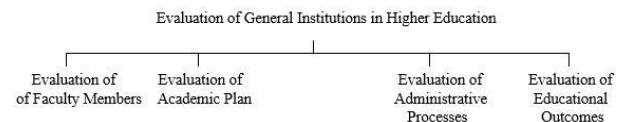


Figure 25: Taxonomy of evaluation of general institutions in higher education [22]

Evaluation of Faculty Members, the purpose of the annual evaluation procedure is to:

- Evaluate the faculty member with respect to the defined evaluation scheme.
- Provide a precise way of evaluate a faculty member's professional behavior, and professional growth
- Provide the complete academic achievement and goal of the faculty member in the form of proper document to the institute.

Evaluation of Academic Plan, the development and the enforcement of the academic plan is the responsibility of the concerned authorities of the university. The Academic plan needs to be evaluated and maintained after some time. University should organize programs beneficial, effective and helpful to the students and faculty members. University should allocate proper resources for these organized programs.

Evaluation of administrative processes, although the evaluation of the administrative processes is not a big concern of the university because of the assumption that the university is being monitored with strong personnel systems. There are number of issues that university faced regarding the administration, they are, maintaining the staff, evaluating them, satisfy each staff member, training and development programs.

Evaluation of educational outcomes, to evaluate the educational outcomes are up to the mark, the outcomes are evaluated through the defined procedure. This evaluation is done to make improvements in the existing system.

15. ENVIRONMENT OF LEARNING IN HIGHER EDUCATION

Educational environment is considered as the main base in any educational institution. The characteristics of this educational environment that is based on correct principles is considered as an effective factor in the progress of students and universities in higher education. [23]. the learning environment has three modes as shown in Figure 26:

- Distance Learning Environment
- Regular Education Environment
- E-Learning Environment

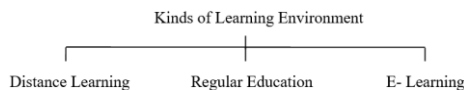


Figure 26: Taxonomy of kinds of learning environment [23]

Distance Learning or online learning allows the students to attend the lectures online that is it is not necessary to come to campus and everything is provided online. Distance does not matter in this type of learning environment, as it provide access to all the related material to all the enrolled students all the time.

Regular Education Environment, puts constraints on students to come to campus on the given time slots and attend the lectures in class rooms. It involves face to face communication between the teacher and students.

E-Learning Education involves the usage of new technology that have surely helps student to get a broad understanding to the topic. This type of learning environment have helped in finding new strategies to the faculty members to develop a better understanding to the students. E-Learning is now a part of many educational institutes because of its great impact on the overall result of the institute.

16. DSS ARE BASED ON THE LEADING TECHNOLOGY

Decision Support System DSS is defined as a system that allows the educational institution or any other institution to choose the right decision in favor of the institution in order to protect it from the potential risks, and enhances the its strengths.[24]The Decision Support System is classified into four types as illustrated in Figure 27.

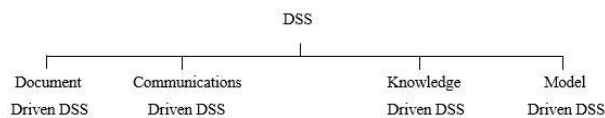


Figure 27: Taxonomy of classifications of DSS are based on the leading technology [24]

Document-driven DSS (Decision support systems) are information systems appointed to any particular task with all the related knowledge and intent to change or suggest any recommendation to the decisions of the people using the given knowledge.

Communications-driven DSS are the support systems which uses network communication technologies to provide collaboration and communication.

Knowledge-driven DSS are the support systems which uses interactive approach, having knowledge related to the problem and generating solutions with the help of given knowledge.

Model-driven DSS, are the support system which emphasize on the handling of a model for example statistical, financial, optimization or simulation. These systems requires data and associated parameters but they are not data intensive

17. DATA THAT BE USED IN HIGHER EDUCATION

Input data is the basis for any software program. In higher education, the data used is considered as the base of the performance indicator, evaluation, quality achievement, statistics, in addition to many similar processes [25]. Figure 28 mentions the four type of data used by the higher education. Firstly, the student data to record all the personal information of students. Secondly, the Research data that is all the data related to any particular research carried out by the institute. Thirdly, the teaching data that is all the stuff related to the topics that are taught to the students. Lastly, the administrative data which includes the personal information of all the staff members like faculty member, staff member.

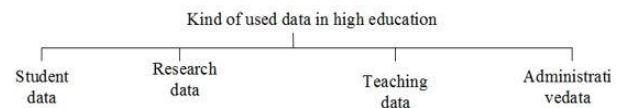


Figure 28: Taxonomy of the kinds of used data in higher education [25]

Student Data, Many institutions currently incorporate a broad statement about the use of student data in their student contracts, or in the policies and forms that students sign at enrolment. At Sheffield Hallam, for example, students are made aware at enrolment that the university will use the data they collect to support their learning and success.[39] When implementing their student dashboard, NTU found that the existing policies they had in place were sufficient to cover the analytics they planned, as the analytics systems were simply using new tools to use data that had already been collected and consented to.

Research Data, In Research Data the purpose of the analysis is known and data is collected either primary or secondary and then it is observed and then conclusions are made by applying all the related theories.

Teaching Dataset: The Teaching dataset support the understanding of the qualitative and quantitative methods that are used in the social disciplines. They are derived from larger datasets and are made simpler for teaching, self-study, doing researches

Administrative Data, The data maintained by any administration, it contains all the personal information of the employees or students. Only legitimate members are allowed to access the private data. It is the responsibility of the administration to protect the data from any theft

18. COGNITIVE OBJECTIVES

There are three main domains of learning and all educators must realize and use them to construct their lessons. These domains are a unit cognitive (thinking), affectional (emotion/feeling), and psychomotor (physical/kinesthetic). Between the years of 1956-1972 the domains of learning were initially developed and represented. The cognitive domain was introduced by Benjamin Bloom in his famous Bloom's Taxonomy [26]. Experienced and new teachers should create a holistic lecture by applying all the three domains (Cognitive-Affective-Psychomotor) in any task that involved learning, this diverse method will for sure help to create a



more well-structured experience of learning. The Cognitive taxonomy contains the following levels according to Blooms taxonomy: knowledge - understanding - implementation - analyzing - composite - valuation. It was modified by Anderson and Krathwohl in 2001, by changing the nouns to verbs, and the cognitive taxonomy after Anderson's modification is shown in Figure 29 [27].

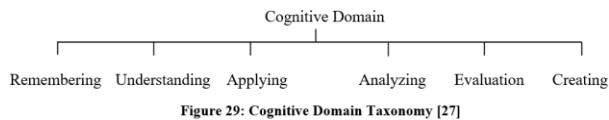


Figure 29: Cognitive Domain Taxonomy [27]

19. INQUIRY-BASED LEARNING

A method of teaching and learning Math and Science by making the students proceed in a way the mathematicians and scientists actually work is called Inquiry Based Learning. This taxonomy, introduced by Bruce and Levin [40], is based on four-part sections of media which are: investigation, intercommunication, conception and explanation. The IBL taxonomy was first proposed by John Dewey (1943), while Tuapawa, Sher and Gu proposed a new fifth media in their Pentextonomy, which is defined as multi-dimensional taxonomy of educational online technologies [28]. The IBL Taxonomy how these authors proposed it is presented in Figure 30.

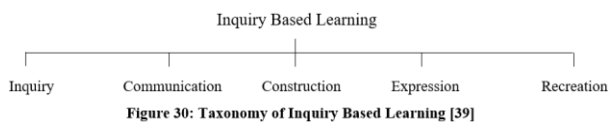


Figure 30: Taxonomy of Inquiry Based Learning [39]

Inquiry media refers to where we utilize technology as media for building the theory or thinking, where have access to the data, by data here we mean text and video, gathering data and analyzing it, an example of a technology which are categorized by the theory building section includes virtual reality software and software that are used for simulation. Example of technology which are categorized by data access are digital libraries and hypermedia environments. Example of a technology categorized in collecting data are services that enable you to create surveys like Google form and video recording tool like Camtasia software. Example of a technology categorized in analyzing data are Spreadsheet software like Google spreadsheet and Microsoft Excel and image processing software like Adobe Photoshop. On the other hand, Communications media refers to where we utilizes technology as media for preparing the document, and communicating with other colleagues, teaching and collaborative media. Examples of a technology which is categorized as a document preparation are Microsoft Word or any word processing software and Microsoft PowerPoint or Prezi or any software that animate the graphics which can be used as presentation. Example of a technology categorized as in the communication are E-mails and E-conferences. Example of a technology categorized as a collaborative media are GDSS (Group decision support systems) and shared document application like Google drive. Example of a technology categorized as a teaching media are systems that a tutoring can be conducted and instructional simulations.

Construction media refers to which utilizes the technology for system control, like Robotics, controlling of equipment, within this section are extended to enable creating digital information or as it known by "personal publishing". These products can be created by the user and shared on the internet with low cost, with low-cost environment of production and

low requirements of technical skills and low-cost capital needs allowing regular people to reach large audiences. A perfect example can be Educational videos on YouTube and Khan Academy videos.

Expression is a type of media that merge the construction and communication and refers to which utilizes technology as media for expression, which includes software like Adobe Illustrator or any program used for drawing and painting, and software like Adobe Audition or Ableton live or any software for making music and software like Adobe premiere or any software that can do composition and editing. Hypermedia, software for creating animation, these type of online tools allow the users to "collaborate broader content" and play a vital role in producing and delivering the creative content [42].

Recreating is a type of media point to which utilizes technology as a media for creating engaging activities where an oversized domain of individual tasks occur. Digital form of this media will be interactive games and social media websites and interactive forums. If there is an educative character in this media it can be employed for the right purpose.

20. INSTRUCTIONAL TECHNOLOGY SERVICE POSITIONS

Instructional technology, also known as Educational Technology, focuses on finding the best way to improve effective and efficient learning regardless of the teaching mater. Its main goal is to include hardware and software technologies into day to day education i.e. practical problems in teaching and learning. The principles from various social sciences or machine technologies should be applied to solve current instructional problems [46]. Although the popularity of PC computers significantly led to so-called "computer revolution" in classrooms as well, the full potential of technology is not achieved. It is partly because the technology is changing at a quicker pace than higher education can catch up [46]. Also, if technology is not completely or at all used in classes due to lack of educators skills, it is a financial waste, so it is necessary to have experts who could help in process of integration of technology with instructional goals. Instructional Technology Service positions taxonomy as conceived by Sury and Robinson is shown in Figure 31 [29].

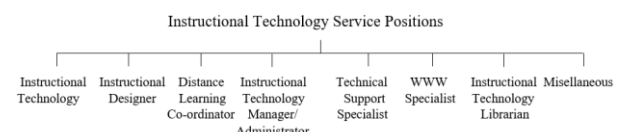


Figure 31: Taxonomy of Instructional Technology Service Positions [29]

Instructional Technologist is a Processing of Re-write Suggestions Done (Unique Article). The process distinctive of the instructional technologist is that the liability to operate with school on various technological problems. The Instructional technologist assists the school to find out about technology, must be skillful with technology, and should try to consolidate technology to become a part of their teaching. In more than one way, the instructional technologist will be seen as an IT specialist/advisor to the college. The declared eligibility for the job of Instructional technologist were sought-after somebody with a Post-graduate in instructional technology or other close domain. The following are some major tasks done by an instructional technologist:



1. Evaluate user requirements (e.g., learning, performance, structure)
2. Detecting and solving issues/opportunities within the geographical point)
3. Arranging educational and performance agenda to meet the goals of organization
4. Help in designing creative solutions.
5. Organize and evaluate educational programs.
6. Helps in creating interactive user experiences.
7. Plays a major role in improving the learning outcomes.
8. Helps in improving the workplace productivity and efficiency.

Instructional Designer is the acquainting features of this group is part in pursuing the advancement of particular instructional output. Dissimilar the Instructional Technologist group, which acquire a wide domain, the Instructional Designer group is highly precisely concentrated on the advancement of the product. Instructional Designer declaration, for example, discusses somebody to help the institute in modifying the tutorials for Web-setup delivery. The following are some major skills are required for any instructional designer [31, 32]:

1. Possess interdisciplinary knowledge, cross-cultural competency, also as commitment and keenness for learning and technology.
2. Have a background in education, a important perspective, and clear learning objectives.
3. Conduct thorough research; boast smart analytical skills and the ability to synthesize information from varied sources.
4. Should be able to effectively participate both visually and verbally, be an effective listener and develop goals that can be measured, according to the customer's demands.
5. Develop content with information that can be used and applied in the real world, specifically, according to the customer's professional domain.

Distance learning coordinators, additionally called educational coordinators, are academic administrators that are experts in the distance learning curricula of educational establishments [30]. Distance learning educators coordinate the web-based curricula and on-line content of faculty websites, as an example, though' on-line distance education may be a comparatively new type of distance learning. Previously, distance-learning coordinators used to supervise the curricula of mail-in courses and different various learning ways like videotaped or televised lectures.

Instructional Technology Administrator provides directive, tutoring, and materials in procedure to simplify the utilization of technology inside the lecture hall, which leads to increment student use and knowledge about technology. May coordinate and direct the tasks of Technology Assistants.

Technical Support Specialist is anyone whose main tasks are the servicing, fixing, or managing the physical components of

the computer or the computer programs [34]. The following are some tasks of technical support specialist:

1. Monitor system potential by checking the compatibility of new software with previously installed software.
2. Develop installed software by checking goals and requirements; assessing the modification that was proposed by the management; advising modification; and then applying the modification.
3. Develop professional and technical knowledge by participating in educational seminars.
4. Cooperate to team effort by achieving similar outcomes as needed.

Web specialists are accountable for planning and maintaining websites for businesses, organizations and people. Specialists can develop and support a web site by putting in updates, fixing bugs and making certain maximum time [35, 36]. Not only do web specialists endlessly maintain and operate websites, however they will additionally work as a part of a consulting team, giving support and recommendation to customers. Web experts should have powerful PC, internet connection and some up to date programming skills and be able to comprehend various software and scripts. Web experts should be able to visualize and communicate creative thoughts with his colleagues. Working in this field requires patience, persistence and the ability to work under pressure. Some business skills can be useful for experts looking to take their career to the next level. The following are some major tasks required by any web specialist [29,35]:

1. To design and maintain website of the educational institution.
2. To educate staff in using Internet for educational purposes.
3. Possess the knowledge of web-based applications such as HTML and Java.
4. Update the faculty when a new useful web-based technology emerges

Instructional Technology Librarian: this recently emerging area has in common few of the conventional parts of academic librarians such as referencing, directive, and gathering advancement. Nonetheless, it sometime combines the further part of both the instructional designer and instructional technologist. A new term has been coined: 'blended librarian', which is defined as a combination of traditional and modern, technologically prepared librarian [37]. He should be able to integrate the information technology with the teaching-learning process in higher education, and is expected to evolve from the current librarians into both librarians and instructional or educational designers. A blended librarian will be able to put together the skills of classical librarians with the IT skills, and can put technology in adequate, beneficial position in education process like an instructional or educational designer would. The main principles outlined by Bell and Shank are:

1. Being the innovative leaders of change in library services at their higher education institutions.



2. Leading initiatives to provide development of information literacy which would improve the integration of IT into teaching-learning process.
3. Gaining required skills ("trade") and knowledge ("profession") by creating programs and classes for improving information literacy among students.
4. Fulfilling the instructional mission of libraries in higher education through working together with instructional technologists and designers.
5. Collaboration with all other positions (instructional technology/design librarians, instructional designers, instructional technologist) in order to bring further progress of creative and avant-garde change in academic library instruction.
6. Modification of how faculty perceives library: providing assistance in combining technology with standard resources for curriculum to make 'blended courses'.

Miscellaneous are the positions not belonging to any of the previously mentioned classes. Usually it is because of specific skills unrelated to IT, such as skills in various crafts, musical education or science [29]. It varies depending on the faculty in question and practical aspects needed.

21. KNOWLEDGE ACQUISITION

Knowledge acquisition or knowledge elicitation is the process of adopting and constantly revising theories about the world around us [47]. It can also be defined as extracting knowledge from a source and making it organized and represented in an understandable way [43]. Knowledge acquisition techniques (or strategies) are investigating different ways to obtain knowledge. The acquisition is better if there is more knowledge gathered at minimal effort and time [42]. To get knowledge an expert in the field is needed (usually that person is the educator). Secondly a knowledge acquisition technique appropriate for the situation must be selected. For example, knowledge acquisition technique that is best suited for lecture is observational i.e. listening and writing notes. The major knowledge acquisition techniques are shown in taxonomy in Figure 32 as given in [42].

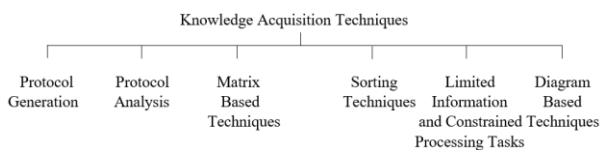


Figure 32. Taxonomy of Major Knowledge Acquisition Techniques [42].

Protocol-generation techniques consist of techniques which all have for purpose creation of media record of behavior i.e. protocol [42]. Included are different interview types - unstructured, semi-structured and structured, reporting techniques i.e. commentary techniques ("think aloud problem-solving"), teach back and observational techniques (observing and making notes). Self-report and teach back are shown to be especially important in higher education [43]. The first gives opportunity for better explanation of thought process, and the latter the receiver of knowledge has a chance to be corrected by professor in case of any misunderstanding of the course material.

Protocol analysis techniques are an extension to protocol-generation techniques. The protocol can be audio, video or other electronic media, or a transcript based on one of these

media recordings [43]. Protocol analysis techniques are used to connect the knowledge present in protocol and knowledge modeling techniques by identifying goals, attributes and relations between objects. Hierarchy-generation techniques should observe knowledge to build taxonomies or similar structures. Not much is explored about these techniques. In matrix-based techniques a grid or table is made (i.e. matrix is filled). The frames in it can be used to represent important attributes of concepts, and a so-called repertory grid technique is applied to those properties to analyze them. Sorting techniques are used for discovering the way people measure and order concepts. This provides knowledge about groups and priorities. An example in [43] mentions how an expert in astronomy would put planets in groups depending on size. Such learning techniques could be especially useful for comprehending more abstract concepts [46]. Limited-information and constrained-processing tasks are, as the name says, techniques in which not all the answers can be obtained because of some limitations and constraints. Usually the time or information are limited. It gives a good overview because the one who is asking questions has to make priorities. An educational quiz with limited time to respond could be an example of such technique. Last group of techniques are diagram-based techniques. Creating and using tools like concept maps, event diagrams and process maps are useful to help people grasp the material better than when it is given in words and predicate logic [43].

22. CONCLUSION

This paper describes taxonomies for different areas in higher education. Also, as a practical tool for those who plan, facilitate and assess to improve structure and content of higher education. Moreover, there are different skills required for improving the effectiveness of lecture in higher education. In the future work will try to make comprehensive taxonomies and work will be in teamwork to get more accurate paper.

23. ACKNOWLEDGMENTS

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