BUSITEMA UNIVERSITY
Pursuing Excellence

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The Literate Engineer

Policy Guidelines for Teaching Information Literacy to Engineering Students at Busitema University

Engineering Library Committee
Faculty of Engineering Lecturers
Engineering Information Foundation, New York, USA

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ABSTRACT

The Policy Guidelines on Teaching Information Literacy to Engineering Students at Busitema University called "**The Literate Engineer**" have been compiled by the Library Staff at the Engineering Library in liaison with the teaching staff of the Faculty of Engineering and Technology at Busitema University. This was made possible with funding support from the Engineering Information Foundation (EiF) of New York, United States. The goal is to incorporate information seeking in the teaching of engineering courses as essential component in delivering engineering education at Busitema. This novel approach to teaching and learning gives shared responsibility to lecturers and librarians to teach engineering courses. Lecturers will be facilitators who empower students to become more autonomous; librarians will be the coaches who develop within students a capacity to evaluate and choose information; and in turn, engineering students will experience a more engaging, interesting, and rewarding education experience. Engineering librarians will have as one of their main goals to facilitate engineering students to acquire information competencies. Information skills are vital to the success of lifelong learning, employment, and daily interpersonal communication of engineers, such as when managing complex engineering projects. We are certain that learning for engineering students will receive higher approvals.

The policy guideline details the processes for infusing information literacy into the courses. The policy guides the curriculum developer on what to include in the courses; what engineering students should know and be able to do and the kind of support that the lecturers need to deliver the course. Accordingly, the policy guideline is an exemplary curriculum review guide - a tool that will assist in planning and implementing a rich-high-quality information skilling instructional programme. The policy guides on the mandate of the lecturers and librarians in course development, defines information literacy concepts, assesses learning theories to information literacy, discusses lifelong learning paradigm, the adaptation of information literacy international standards to educating a literate engineering, the management of learning and facilitation of instruction throughout the study programme, and stakeholder capacity development to enhance their facilitation skills.

ACKNOWLEDGMENTS

The guidelines give a clearer reflection of the information literacy needs of the desired Literate Engineer who has gone through the gates of Busitema University. The guidelines represent not only our information literacy work at the Engineering Library at Busitema University; it is a compilation from different international documents related to information literacy - principles, procedures, recommendations, and concepts. Through a series of five workshops and eight follow up meetings at the implementation stage of the "Literate Engineer" curriculum, a draft of the policy guideline was produced by the Project PI/ University Librarian and distributed to the Curriculum Review Committee for comments during the period December 2021 to October, 2022. The draft policy guideline received comments, suggestions, and completely new paragraphs from the academic fraternity of the Faculty of Engineering and Technology. The draft received further scrutiny and review from the Office of the Deputy Vice-Chancellor – Academic Affairs and Innovations, the Academic Registrar, and Deputy Director Quality Assurance.

We are so grateful to:

a) Engineering Information Foundation's (EiF) generous grant support towards the project activities. With the EiF's financial support, we brought together lecturers and librarians in a series of five workshops to develop the policy guidelines, the action plan, course materials and assignments; held eight follow up meetings during the implementation process, conducted midterm reviews, carried out a survey and end of semester course evaluation.

b) Dr. Fredrick Kiwuwa Lugya, the University Librarian and EiF Library Project PI facilitated all the project activities and developed all project materials, including drafting the policy guidelines, action plan and course materials and assignments.

c) Prof. Samuel-Baker Kucel - the Deputy Vice Chancellor - Academic Affairs and Innovation, Dr. Gimuguni Lillian Nabasa - the Academic Registrar, and Dr. Safina Biira - the Deputy Director Quality Assurance, participated in all project activities and provided intellectual input into the initial drafting of the policy guidelines and the action plan.

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i) Mr. Matovu Davis, Head of Department - Department of Computer Engineering & Electronics Engineering.

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DEFINITIONS OF BASIC CONCEPTS

The concepts included in this list are defined from an operational point of view. They, in general, have more than one semantic connotation that varies depending on the process and context – the Literate Engineer. Several concepts are based on definitions created by other authors – especially IFLA's guidelines on information literacy for lifelong learning by Jesús Lau; when this is the case, the source is quoted. The objective of the vocabulary is to provide a conceptual framework to the implementation of information literacy for teaching engineering programmes at Busitema University.

Academic. An academic staff is a member of the teaching staff that is called teaching assistant, lecturer, senior lecturer professor, or in the western academic a faculty or teaching staff etc. at universities; or "teacher" at pre-university education. The word has the general connotation of teaching-oriented education. An academic staff, in the traditional sense, is in charge of the role of providing knowledge in the learning space, centering on his/her own information capability instead on what students can independently do. *Synonyms: professor, educator, lecturer, instructor, academic, teacher.*

Cognitive theory. A group of theories and scientific research primarily derived from Jean Piaget´s theory, which is based on "...the mental processing of information: it's acquisition, organization, codification, review, storage and retrieval from the memory, as well as oblivion (Schunk, 1997)." *Synonyms: cognitive psychology, cognitive science.*

Constructivism. A learning process centered on the student; it uses strategies so that the subject builds his or her own knowledge, using research strategies, case studies, teamwork (or collaborative work), and meaningful learning, among other pedagogical approaches. *Related term: Congnitive science, meaningful learning.*

Development of information skills (DHI): A process facilitated at learning institutions that focuses on the students or teaching staff, so that they develop their capability to identify, locate, access, retrieve, and use information. *Synonyms: user education, bibliographic instruction, information literacy, user formation.*

Facilitator. A term used in management to denote an individual that democratically supports a group, so that they themselves reach the desired learning objectives. In education, it means the academic staff who works as a manager of the learning process of a group of people or learners, so that they can build their own knowledge. *Synonyms: Learning manager, learning director (similar to a sports team), learning administrator, learning guide*.

Information. It is a perception of a datum or data through the stimulation of one of the human senses. In other words, "an individual acquires information when he is aware of certain data that belongs to an event" (Debons, 1988). This group of relevant data can be acquired by a person when they, obtain,

process, organize, transfer, promote and use it to transform themselves in their environment. *Synonyms: data, knowledge*.

Information Competencies. The term "competence" implies a group of skills to identify an information need, as well as retrieving, evaluating, using and reconstructing the knowledge contents of the retrieved information resources. *Synonyms: information skills, information capabilities, information literacy.*

Information Literacy. This term is commonly used in the English-speaking world to denominate information competencies that imply the capacity to identify when information is needed, and the competence and skill to locate, evaluate and use information effectively. Literacy is a term used by the Ministry of Education to call the basic teaching of reading and writing, but not necessarily of learning to learn. The preferred term, therefore, is development of information competencies, at least from library and information science point of view. *Synonyms: information skills, bibliographic instruction, user education, information competencies.*

Information Skills. The semantics of this phrase differ from "information competencies" in the sense that "competencies" imply a set of skills, but they could be regarded as synonyms. Competence is the skill or aptitude to do something; while ability is regarded as the capacity and willingness to do something. In other words, information skills could be defined as the capacity to identify an information need and the aptitude to satisfy it. *Synonyms: information competencies, information capacity*.

Learner. This is a term that is becoming popular to name an active student role in the learning process. It can be defined as an individual who participates at a learning-oriented education process, where he or she has the responsibility of constructing knowledge in a flexible environment with or without a facilitator. *Synonyms: learner-actor, student*.

Learning. "The effect of the learning process that is defined as a durable change produced in the behavior or capabilities of an individual, [through] ractice or other forms of experience" (Shuell, 1986). *Synonyms: education, teaching*.

Learning process. Phases required by a learner to build knowledge; it can be done in different educational spaces, such as a classroom, a laboratory, a library or using the internet. *Synonyms: education, instruction, teaching.*

Professor. A synonym of teacher. The word implies a teaching-oriented education role – in higher education institutions, it means the highest rank that a faculty member can achieve, in other words, to have full academic professional development, especially in research, besides teaching. In Uganda, this

term is used to mean university high-ranking academic staff grounded in research, teaching and innovation. *Synonyms: academic, teacher, facilitator.*

Skill. A developed dexterity to perform an information task. *Synonyms: capacity, competence, aptitude.*

Student. A person involved in the educational process. The meaning implies someone who participates at the teaching oriented educational process, in other words, a passive role. *Synonyms: student, learner, actor learner*.

Student. A common term used in education to call someone who studies at a teaching institution. Current theories emphasize on a superior concept that goes beyond studying, in which the proposed word to call a student is "learner". *Synonyms: student, learner, scholar*.

To learn. "This is the process of acquisition and modification of knowledge skills, strategies, beliefs, attitudes and behavior" (Schunk, 1997). *Synonyms: to study, learning, to think*.

A. INTRODUCTION

Information competencies are a key factor in lifelong learning. They are the first step in achieving educational goals. The development of such competencies should take place throughout an engineering student's life, especially during their educational years, where librarians, as a part of the learning community and, as experts in information management, have or should assume the key role of facilitating information literacy. Through the creation - collaboratively between librarians and the engineering lecturers, of information literacy curriculum-integrated programmes, librarians should actively contribute to the students' learning processes in their search to enhance or develop the skills, knowledge and values needed to become lifelong learners.

A.1 Funding - write about EiF funding proposal USD 25,000 - add the logo as well

Chartered in the State of New York, United States in 1994 as an independent private foundation, the Engineering Information Foundation (EiF), through grant funding is helping to enhance communication and the use of information in Engineering education.

A.2 Compilation

The principles, procedures, recommendations, and concepts listed in this policy document are a compilation from different international documents related to information literacy. Most of the content is based on published experiences generated by the International Federation of Library Associations and Institutions (IFLA) and national library associations, as follows:

- Guidelines on information literacy for lifelong learning by Jesús Lau Chair, Information Literacy Section / IFLA, 2006;
- The extensive work of the Association of College and Research Libraries (ACRL), for example Information Literacy Standards for Science and Engineering/Technology by the ALA/ ACRL/ STS Task Force on Information Literacy for Science and Technology;
- The seminal and early contributions of the American Association of School Libraries (AASL);
- The work done by the Big Blue project;
- The information skills problem-solving models of the Big Six expounded by Eisenberg and Berkowitz (1997) - all from the United States;
- The contribution of the Society of College, National, and University Libraries (SCONUL) from the United Kingdom;
- The Australian and New Zealand Institute for Information Literacy; and
- The contributions of the Mexican Information Literacy Forum.

A.3 Use of the Policy Document

The policy provides a conceptual template to guide the development and implementation of the information literacy programme at Busitema University's Faculty of Engineering and Technology. The document provides information to frame the IL efforts of the lecturers, librarians and students at the Faculty of Engineering. The policy:

- establishes a clear philosophy and set of overarching goals that will guide the entire curriculum review and implementation and the decisions that affect each aspect of the curriculum;
- establishes sequences both within and between student academic levels and assures a coherent and articulated progression in grades;
- outlines a basic framework for what to do, how to do it, when to do it and how to know if it has been achieved;
- allows for flexibility and encourages experimentation and innovation;
- promotes interdisciplinary approaches appropriately;
- suggests methods of assessing the achievement of the curriculum's goals and objectives;
- provides a means for its own ongoing revision and improvement; and
- provides direction for human resources management, material and fiscal resources to implement the curriculum.

The policy serves as a checklist during the planning and implementation of an IL programme, or to reinforce previous information literacy work.

A.4 Arrangement of Policy Document

The policy document is divided into ten sections (A to J), with each having subsections that comprise of the organizational spectrum of information literacy work for teaching engineering courses. Key to this policy document is the narrative to each topic on how to implement the programme in a science public university - Busitema University; a list of key information literacy terms with their definitions, and a bibliography for further reading. In each case every topic is briefly introduced, followed by paragraphs with lists of bulleted points.

- A. Introduction (**A.1 to A.10**)
- B. Information Literacy Concepts (**B.1 to B.10**)
- C. Theoretical Constructs to Information Literacy – Learning Theories (**C.1 to C.6**)
- D. Information Literacy and Lifelong Learning (**D.1 to D.4**)
- E. International Standards (**E.1 to E.4**)
- F. Learning/ Instruction Management (**F.1 to F.2**)

- G. Information Literacy Learning Menu (**G.1 to G.6**)
- H. Personnel Development (**H.1 to H.4**)
- I. Learning Assessment (**I.1 to I.3**)
- J. References

A.5 University Mandate

The mandate of the University is to provide higher education through quality teaching, research and outreach.

A.6 Vision

A Center of Excellence for producing information literate Engineers

A.7 Mission [Let's choose one of these two statements]

To promote excellence in engineering education and training at Busitema University through a clearly defined path of Information Literacy e-curriculum that meets the needs of our students and reflects current trends in the engineering profession - path to an information literate engineer

OR

To promote excellence in engineering education and training at Busitema University through a clearly defined path to an information literate engineer

A.8 Philosophy

We believe in helping our students recognize and articulate the need for relevant information, locate and access it, ethically use it to critique resources, facts and opinions, to generate new knowledge and solve societal problems.

We commit to:

a) Help our students engage with information to solve engineering problems, thus create new understanding through active investigation and thought, instead of memorizing facts presented in-class lectures.

b) Help our students acquire integrated skills to effectively participate in the generation and application of information for lifelong learning.

c) Help our students to become pedagogically sophisticated through triangulated approaches, and enable them to become interdisciplinary researchers.

d) Use multiple appropriate approaches to realize the intended learning outcomes, and enable students to do the assessment, and recognize as many learning styles and approaches as is realistically possible within the engineering discipline.

e) Impart in students a set of integrated abilities encompassing the reflective discovery of information, the understanding of how engineering information is produced and valued, and the use of engineering information in creating new knowledge and participating ethically in communities of learning.

f) Impart in students a set of applied skills for negotiating the huge amount of engineering information in the modern world and instilling in engineering students the practice of objectively examining competing versions of the truth and rejecting claims for which there is no evidence.

A.9 Justification

The engineering discipline poses unique challenges in identifying, evaluating, acquiring and using information. For instance, peer-reviewed articles are generally published in more costly journals and, therefore, not always available; gray literature requires knowledge of the agency/ organization publishing the information; much of engineering is now interdisciplinary and, therefore, requires knowledge of information resources in more than one discipline; and information can be in various formats (e.g., multimedia, database, website, data set, patent, Geographic Information System, 3-D technology, open file report, audio/visual, book, graph, map) and, therefore, may often require manipulation, working knowledge of specialized software, or/ and special information searching and use skills.

The need for engineering students to be information literate as a requirement for their success both academically and in their future professional pursuits is interminable. This need has only increased due to the changing engineering paradigm, COVID-19 induced challenges, and the increased demand to provide online instruction and courses for highly practical disciplines like engineering. To address these challenges, the library in collaboration with the Faculty of Engineering and Technology is developing the first-ever disciplinary-based information literacy (IL) e-curriculum for teaching engineering courses at Busitema University. This will be known as the Engineering Information Literacy E-curriculum. This e-curriculum will assist engineering lecturers and librarians to ensure that the engineering subject matter is taught in line with the University Vision, Mission, and Values, the Busitema University Library Mission, the needs of engineering students and lecturers, and the developments seen in current research on IL skills development.

The e-curriculum will increase the variety and frequency of IL sessions to be delivered and the quality of that delivery. To inform our new IL policy and action plan, the library looks outward to the variety of library online resources subscribed to through the Consortium of Uganda University Libraries and development partners, increasing book budget, collections development policy, and library research support services.

A.10 Goals/ Objectives

1. **Online Integration** - To enhance engineering teaching and learning through the development of a series of online learning modules which will aid in the achievement of key IL competencies.
2. **Educational Role** - With a focus on embedded librarianship, to increase collaboration between the librarians and the lecturers to incorporate resources and information literacy outcomes into an effective educational experience for students.
3. **Assessment** - To develop a set of assessment tools that can be applied to select IL-related services, enabling to us evaluate the impact of IL programming.

Putting this policy in place, the library is affirming its strategic role in ensuring engineering students are able to develop the IL skills they require for success during their education at Busitema and future employment.

Developing the Engineering Information Literacy e-curriculum policy, Busitema University Library is demonstrating its commitment to excellence in its IL programming. There is always room to develop, change and achieve a higher level of success. In this policy and action plan, we build on what has been done over the past years and look towards our future progress.

B. INFORMATION LITERACY CONCEPTS

There are different concepts that are related to information literacy that will clearly provide direction to Busitema's Faculty of Engineering information literacy programme. This section contains a brief definition of the relevant terms followed by the key concepts of information literacy.

B.1 What is information?

Information is a resource that has varied definitions according to the format, and media used to package or transfer it, as well as the discipline that defines it. Case (2002) provides a broader definition. Here the term is synonymous with:

- Encapsulated knowledge
- Packaged human experience
- A source that can provide a myriad of data
- A resource that takes different formats, packaging, transfer media, and varied methods of delivery
- People: family, friends, tutors, fellow students
- Institutions, i.e., national health service professionals or help facilities

B.2 The need for effective use of information.

Information has become a vital source for world economies and is certainly the basic component of education. Information is a vital element to technological and scientific change. It poses several challenges to individuals of all walks of life: students, workers, and citizens of all types. The current information overload requires people to validate and assess information to verify its reliability. Information by itself does not make people information literate. Information is certainly a:

- A vital element for creativity and innovation
- A basic resource for learning and human thought
- A key resource in creating more knowledgeable citizens
- A factor that enables citizens to achieve better results in their academic lives, with regard to health, and at work
- An important resource for national socio-economic development

B.3 What is literacy?

The basic definition of literacy is "*the condition of being literate*" according to the Chambers English Dictionary (2003). This reference work, on the other hand, defines literate as "…learned; able to read and write; having a competence in or with" (p. 1856). In education parlance, "Basic Literacy" means the classic or traditional literacies of learning how to read, to write, and to perform numeric calculations and

operations; basic literacies in almost all societies are learned in formal education settings, but sometimes basic literacies are learned at home or in community centers.

B.4 Other "Literacy" concepts related to information literacy.

Information literacy is linked with other types of related literacies, but it should be differentiated from them, especially from information technology, media literacy, network literacy, digital literacy, network or Internet literacy, "Computer Literacy" and "Media Literacy" (Bawden, 2001). These last two literacies are clearly defined by Horton (F. Horton, Jr., personal communication, December, 2004) in the following terms:

- Computer Literacy. The knowledge and skills necessary to understand information and communication technologies (ICTs), including the hardware, the software, systems, networks (both local area networks and the Internet), and all of the other components of computer and telecommunications systems.
- Media Literacy. The knowledge and skills necessary to understand all of the mediums and formats in which data, information and knowledge are created, stored, communicated, and presented, i.e., print newspapers and journals, magazines, radio, television broadcasts, cable, CD-ROM, DVD, mobile telephones, PDF text formats, and JPEG format for photos and graphics.

B.5 The Information Literacy Concept

There are several definitions assumed by associations and authors. The American Association of School Librarians (AASL), a precursor in the IL field, and the Association for Educational Communications and Technologies state that "information literacy is - the ability to find and use information – is the keystone of lifelong learning" (Byerly/Brodie, 1999). Under the component of information literacy, AASL states that: "information literate student accesses information efficiently and effectively, evaluates information critically and competently, and uses information accurately and creatively" (Byerly/Brodie, 1999). Users "should have both information-gathering strategies and the critical thinking skills to select, discard, synthesize, and present information in new ways to solve real-life problems" (Byerly/Brodie, 1999). This information literacy definition extends beyond library skills and beyond the use of discrete skills and strategies to the ability to use complex information from a variety of sources to develop meaning or solve problems (Kuhlthau, as cited in Stripling, 1999).

B.6 A Generally Used Definition

Attempts to define "Information Literacy" have been made for several years, mostly by librarians or professionals related to library science, and there are more similarities than dissimilarities in these definitions (Owusu-Ansah, 2003). The most commonly cited and used IL definition is the one adopted by the American Library Association (ALA), 1998:

"*To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information. The information literate individuals are those who have learned how to learn" (pp. 55-56). They know how to learn because they know how knowledge is organized, know how to find information, and know how to use information in such a way that others can learn from them (Byerly/Brodie, 1999). "Whatever semantics we assume for the IL term, the ALA definition, itself, is broad enough to encompass the entire spectrum of information skills; from Inuit traditional knowledge to high-tech search engines, and will probably be applicable for many decades*" (Campbell, 2004).

B.7 Information competencies.

A competent engineer, whether a student, a professional or a worker is able to recognize her/his information needs, knows how to locate, identify access, retrieve, evaluate, organize, and use information. To be an information literate engineer, one has to know how to benefit from the worlds of knowledge, and incorporate the experience of others into one's background. The information literate engineer is capable, in Mackenzie's words, of:

- "Prospecting: The ability to locate relevant information, to shift it, to sort it, and to select it.
- Interpreting: The ability to translate the data and information into knowledge, insight, and understanding
- Creating new ideas: Developing new insights"

B.8 Library actions that contribute to information literacy.

There are several terms that are part of or contribute to the information literacy (IL) concept. They each have their own semantic content in addition to differences characterized by the type of skills, level, the categories of learning, and instructional facilitating methods. Comprising many different concepts, IL has evolved beyond early library instruction and information skills-focused programs to the current concept of information literacy. While library instruction emphasizes the location of library materials, another IL concept focuses on information strategies, and in yet another concept, IL is used to describe the process of information-seeking and information use competencies. To reiterate, information literacy focuses on information use rather than on bibliographic skills, that is, STEM students must develop information competencies to become effective learners. Some of the IL-related terms are (*See Glossary for additional definitions*):

- Information fluency – Capability or mastering of information competencies
- User education – Global approach to teach information access to users
- Library instruction – Focuses on library skills
- Bibliographic instruction – User training on information search and retrieval
- Information competencies – Compound skills and goals of information literacy
- Information skills – Focuses on information abilities
- Development of information skills – Process of facilitating information skills

C. THEORETICAL CONSTRUCTS TO INFORMATION LITERACY - LEARNING THEORIES

Current learning theories are based on cognitive psychology and constructivist education research. Familiarity with these theories is essential if STEM librarians are to develop effective teaching techniques to guide learning (McGregor, as cited in Stripling, 1999). A librarian not only needs to be familiar with the information literacy components to facilitate, but must also demonstrate competence in facilitating knowledge (pedagogy) and be aware of students' individual learning differences.

There are many different theories on learning and within each one there are variations. There is no right or wrong theory, as not all education practices are based on a specific school of thought (Grassian and Kaplowitz, 2001). STEM Librarians need to choose the theory and its variations that is compatible with their teaching style as well as the subject or topic to be taught. Keep in mind that:

- Learning involves change
- This change is fairly permanent
- Learning may involve a change in consciousness (how we think) or behaviour (what we do) or both
- Learning comes about through interaction with elements in our environment, such as, information, events and experiences (including but not limited to teaching and training) (Squires, 1994).

Here is a summary of the main learning theories, learning models and factors that will influence learning among STEM students', and thinking and learning concepts (McGregor, as cited in Stripling, 1999). It needs to be emphasized that they are only a few of the many that exist.

C.1 Behaviorist view. Reality is external and absolute. It is measurable, and cause and effect can be determined and standardized; an application example is standardized testing. Some of the main concepts are:

- Conditioning (Pavlov, 2005) – Learning is interpreted according to observable behavior. What people do is what matters rather than what they think.
- Reinforcement (Skinner, 1986) – Stimulus is provided after an act is performed as a way to encourage or discourage repetition of a particular behavior.
- Observation learning (Bandura, 2004) – Learning occurs through watching and then imitating behavior.

C.2 Constructivist approach. Reality is something that is socially constructed by individuals who determine their reality based on their unique prior knowledge and experiences. The theory differs from the behaviorist view in assuming that it is possible to examine what is not observable, attempting to understand what happens in the mind when we learn. Current thinking about learning is strongly influenced by constructivist theory and research. Some of the main constructivist education models are:

- Practical problem-solving activity (Dewey, 1967) – Learning can be achieved by reflective thinking to solve problems through analysis of lifelike problems and potential alternative solutions, i.e., lecturers acting as guides rather than dispensers of information.

- Cognitive developmental stages (Piaget, 2005) – Children's learning development increases through previous understanding, even though the previous ideas might be inaccurate. Piaget describes the four development stages children must move through. They cannot progress from one stage to the next until certain criteria have been met; recognizes what children can do, rather that what they cannot do.

- Building on prior knowledge (Bruner, 1962) – Learners build on their prior knowledge to reach more advanced levels of understanding. Learning is an active process of discovery and categorization.

C.3 Learning models (McGregor, 1999). In constructivist education models, the pedagogy of both learning and cognitive psychology relies on different learning models that are not necessarily exclusive of one another.

- Inquiry learning (Bruner, 1962). lecturers provide problems (with open, closed or active answers) for students to solve and the resources with which to solve them.

- Student-centered learning. Students are seen as individuals who should have a say in what they learn. Learning is active and learners are encouraged to be self-directed, taking responsibility for their own learning.

- Cooperative learning (Slavin, 1995) – Interaction among students promotes achievement of learning goals more successfully than learning alone.

- Brain-based learning. This learning style is based on five assumptions: 1) the brain operates by organizing input and making meaning of it. 2) The brain functions by searching patterns. 3) The brain can do more than one thing a time, and it process wholes and parts simultaneously. 4) Emotions play an important role in learning. 5) Each brain is individual and different from every other brain.

- Meaningful learning. Learners are engaged in meaningful, challenging tasks or in solving real-world problems. They construct their own understanding when they are interested in what they are learning, regulating, and controlling, when they set their own learning goals, are aware of and able to choose their own learning strategies, and are able to work with other students. This model involves many of those previous described.

C.4 Factors in the learning process (McGregor, 1999). Learning is affected by different factors, including, multiple types of learners' intelligence, learning styles, and motivation.

- Multiple intelligences (Gardner, 1983) – Intelligence is a multifaceted concept and learners simultaneously have multiple ones or ways they analyze their worlds. They are: linguistic, logical-mathematical, spatial, bodily kinesthetic, musical, interpersonal, intrapersonal, and naturalist.

- Learning styles (Gardner, 1983) – A learning style is a general preference whereas intelligence is a capacity for dealing with specific content. Some authors emphasize physical and environmental preferences, cognitive styles, and ways of working. There are various categorizations to assess personality types, sensory preferences (visual, auditory, kinesthetic), environmental preferences and thinking styles.
- Motivation (Wittrock, 2004) – The process of initiating, sustaining, and directing activity strongly influences how people learn. Motivational programs are based on behaviorist theory, i.e., providing extrinsic rewards to encourage students to learn. The drawback is that students tend to focus on the reward rather than on the learning activity itself.

C.5 Thinking and learning (McGregor, 1999). The way people think and the kinds of thinking they do is an important element to the process of learning.

- Bloom's Taxonomy (Bloom, 1956) – The taxonomy for classifying learning objectives in the cognitive domain lists thinking skills in a hierarchical order which suggests the skills teachers/faculty should promote. The skills, from the simplest to most complex, are: knowledge, comprehension, application, analysis, synthesis, and evaluation. Knowledge is referred as the simplest meaning unlike the definition in library science.
- Critical thinking (Ennis, 1985) – It is a "reasonable, reflective thinking that is focused on deciding what to believe or do." (pp. 54) Definitions include components of decision making and improvement of thinking.
- Creating thinking (Cave, 1996) – It is the ability to look at things in a different way from the obvious or the traditional. Creative thinking has two components, divergent and convergent thinking. The first is the intellectual ability to think about more than one thing at a time and elaborate ideas, and the second is the ability to evaluate logically, critique and choose the best idea from a selection of ideas.
- Metacognition (Blakey and Spence, 1990) – Thinking about thinking is regarded as metacognition, an important element of both critical and creative thinking. Learners who are aware of what and how they are thinking can improve their thinking. An example of this approach is asking students to reread and analyze thoughts they have recorded in journals.
- Mental models (Glynn, 1997) – Mental models are the framework in constructing new understandings (supports Piaget's and Vygotsky's theories). Learners perceive concepts through mental representations that help them to understand. Mental models stress the importance of prior knowledge, as prior knowledge is held within mental models, and new learning is built on those models.

C.6 Tools to promote learning (McGregor, 1999). There are several techniques to encourage learning, including:

- **Coaching**. The guidance (supportive, facilitative) of a student or students through a task or train of thought is a useful technique for teachers/faculty. This is the opposite of directing.
- **Questioning**. A useful tool to access prior knowledge or extend thinking. It is meant to encourage divergent, higher order and critical thinking.

D. INFORMATION LITERACY AND LIFELONG LEARNING

Information literacy and lifelong learning have a strategic, mutually reinforcing relationship with each other that is critical to the success of every individual, organization, institution, and nation-state in the global information society. These two modern paradigms should ideally be harnessed to work symbiotically and synergistically with one another if people and institutions are to successfully survive and compete in the 21st century and beyond.

D.1 Inter-relations of the two concepts. Both of these concepts:

- Are largely self-motivated and self-directed. They do not require the mediation of an outside individual, an organization, or a system beyond the individual himself or herself, although advice and assistance from a respected friend such as a mentor or coach can be helpful.
- Are self-empowering. They are aimed at helping individuals of all age groups to help themselves, regardless of their social or economic status, role or place in society, gender, race, religion or ethnic background.
- Are self-actuating. The more information literate an individual becomes, and the longer the individual sustains good information literacy learning and practices those habits, the greater the self-enlightenment that will occur, especially if practiced over an entire lifetime.

Theoretically one could pursue the goal of becoming more information literate but not continuously over one's lifetime. Conversely, one could pursue the goal of lifelong learning but without having first become information literate. Taken alone, neither path maximizes the potential of the individual to "learn to learn."

D.2 Information literacy and lifelong learning. Harnessed together, information literacy and lifelong learning substantially improve the:

- Set of personal choices and options opened up for, and offered to, an individual in the context of personal, family and societal matters.
- Quality and utility of education and training in both formal school settings preceding entry into the workforce, and later in informal vocational or on-the-job training settings.
- Prospects of finding and keeping a satisfying job and moving up the career ladder rapidly and with appropriate rewards, and making cost-effective and wise economic and business decisions.
- Participation of the individual effectively in social, cultural and political contexts, both at the local community level and at higher levels, and in identifying and fulfilling professional goals and aspirations.

Information literacy is a "set of skills" that can be learned. That set of skills includes a certain attitude toward learning itself, the use of tools, such as online tutorials, the use of techniques, such as working with groups, and the use of methods, such as a reliance on mentors, coaches and ombudspersons.

In contrast, lifelong learning is a good habit that must be acquired and accompanied by the adoption of a positive frame of mind. The willingness to change and a curiosity or thirst for knowledge are very helpful pre-conditions to lifelong learning.

D.3 Libraries and librarians as partners in an information literacy/lifelong learning team. Putting an information literacy/lifelong learning programme at the faculty of engineering cannot be done exclusively by librarians in libraries. This enormous task is the responsibility of all the learning community at the faculty: lecturers, students and the entire Busitema community. A team of engineering lecturers must be formed, and partners identified who can work with the engineering librarians.

D.4 Libraries and librarians as information literacy change agents. Information literacy is important beyond the domain of libraries and librarianship. The Engineering Librarians will serve as change agents - to help the lecturers at the faculty of engineering develop and fuse information literacy policies, programmes and projects into the courses. In this context the librarians will serve as expert consultants and should not be bashful about offering their services in this exercise.

The Engineering Library will play an important role as part of Busitema's institutional information literacy programme and the precursor of the IL change. The librarians and the library are promoters of the information literacy programme and activities because the library is a/an:

- Repository of knowledge
- Information reservoir in multiple formats
- Center with librarians who are information experts
- Department with learning spaces
- Place for interaction with learning peers and teams
- Space for knowledge socialization
- Place with information advisers / reference specialists and consultants
- Center with computer access, processing and communication of knowledge
- Gateway to the Internet, a world of information

E. INTERNATIONAL STANDARDS

Information literacy standards are the core component of the policy. As stated in the introduction, at some instances, the standards have been adopted as they are, but effort has been made to adapt them to teaching of engineering courses at Busitema University's Faculty of Engineering.

E.1 Structure of the standards. The information literacy standards for becoming effective learners include three basic components: access, evaluation and use of information. These core goals are found in most of the standards created by library associations, such as the relevant contributions of AASL, ACRL, SCONUL and the Australian and New Zealand Institute for Information Literacy, followed by the work of other countries, like Mexico, and individual educators (Byerly/Brodie, 1999; Kuhlthau, as cited in Stripling, 1999). The IFLA information literacy standards are based on these international experiences and contributions, and are fully described in the bibliography at the end of the document. The standards are grouped under the three basic IL components as described by IFLA: Access, Evaluation, & Use.

a) ACCESS. The user accesses information effectively and efficiently

1. Definition and articulation of the information need

- Defines or recognizes the need for information
- Decides to do something to find the information
- Express and defines the information need
- Initiates the search process

2. Location of information

- Identifies and evaluates potential sources of information
- Develops search strategies
- Accesses the selected information sources
- Selects and retrieves the located information

b) EVALUATION. The user evaluates information critically and competently

1. Assessment of information

- Analyzes, examines, and extracts information
- Generalizes and interprets information
- Selects and synthesizes information
- Evaluates accuracy and relevance of the retrieved information

2. Organization of information

- Arranges and categorizes information
- Groups and organizes the retrieved information
- Determines which is the best and most useful information

c) USE. The user applies/uses information accurately and creatively

1. Use of information
    - Finds new ways to communicate, present and use information
    - Applies the retrieved information
    - Learns or internalizes information as personal knowledge
    - Presents the information product
2. Communication and ethical use of information
    - Understands ethical use of information
    - Respects the legal use of information
    - Communicates the learning product with acknowledgement of intellectual property
    - Uses the relevant acknowledgement style standards

E.2 Information literacy. In summary, information literacy is assumed to be the knowledge and skills necessary to correctly identify information needed to perform a specific task or solve a problem, cost-efficiently search for information, organize or reorganize it, interpret and analyze it once it is found and retrieved (e.g. downloaded), evaluate the accuracy and reliability of the information, including ethically acknowledging the sources from whence it was obtained, communicate and present the results of analyzing and interpreting it to others if necessary, and then utilize it for achieving actions and results.

Information literacy is also sometimes referred to as "critical thinking," or "learning to learn," and has been traditionally taught to engineering students at Busitema increasingly in standalone instruction sessions and at different education training contexts and settings.

E.3 Avoid taking skills and choices for granted. It must be stressed that having an information need does not necessarily translate into the motivation to want to find the information (Case, 2002; Ford, 2004; Wilson, 1999; and Hepworth, 2004). In Walton's terms (personal communication, November, 2004), it is frequently assumed that individuals who locate information are rational human beings who will make the best choice – research indicates that this is not true. Furthermore, with particular reference to students, we should recognize the power that the reading list has over their choices. In addition, the other routes students use to locate information, such as between students themselves, sharing what they have found or already know, should also be emphasized. In fact, 'constructivist' approaches (particularly in the form of group work) whether face-to-face or virtual, encourage these types of exchanges and has been recognized in developing this policy.

E.4 Change strategies. Resistance to change is basic to human nature. Engineering librarians are cognizant to the obstacles to implementing IL programmes and thus should always plan to overcome them. According to Walton (personal communication, November, 2004), the major problem faced is that Engineering librarians are resource-based rather than curriculum-based with a strong emphasis on student-centered learning. In addition, Engineering librarians need to sufficiently understand what information literacy related activities are already taking place between lecturers and students so as to build on them when developing IL programmes. Peterson (1978) has the following recommendations for Engineering librarians:

- Changes in methods of instruction are more difficult than changes in curriculum or administration
- When a change requires lecturers to abandon an existing instructional practice, it is not likely to succeed
- If retraining is required, success is threatened unless strong incentives are provided
- Efforts to change curriculum by integrating or correlating the content are resisted and are especially at risk
- The cost of change is a significant factor in determining the permanence of the change
- When a change puts a strain on school personnel or requires a substantial investment in learning new facts and procedures, it is not likely to succeed
- Minimal new behavior has more possibility of being accepted
- Librarians need to take a larger share of the work to make things happen until faculty/teachers see the benefits of collaboration
- Collaboration efforts should not be seen as difficult to achieve
- Library collaboration should be viewed by teachers/faculty as essential to their success
- The gains from change should be seen clearly by participants
- Information professionals should be strong advocates for their programs

F. LEARNING/ INSTRUCTION MANAGEMENT

The participation of engineering librarians in information literacy takes many different forms. The ideal one is to have a programme that is part of the curricula because information literacy requires sustained development throughout all levels of the programme training. Achieving information literacy requires engineering students to have had a cumulative experience in most, if not all, subjects in addition to learning experiences. Information literacy should be woven into the content, structure and sequence of the curricula. Information literacy cannot be the product of a single course (Bundy, 2004), therefore lecturer-librarian collaboration is crucial. Engineering librarians should consider participating in a teaching course or recognized qualification to be part of the faculty's information literacy endeavor.

F.1 Starting the program. Engineering students need to experience, reflect and apply information literacy at all levels of their studies through the programme. However, this is not always the case, especially at the beginning of the IL programme. Lecturers and librarians should avoid taking too long before IL is integrated into the course offerings. Below are guidelines on how to start and run an information literacy program/course (Bundy, 2004; Stripling, 1999).

- A clear focus on an IL standard or standards for every IL engineering activity
- Work on standards one by one if you cannot work on all standards at the same time
- Get assistance from the Directorate of ICT if one needs to know how to create a course
- Promote your IL activity well—by whatever means you may have
- Work in teams—any activity can be done by more than one Engineering Librarian
- Appoint a leader for all library IL efforts if possible
- Remember that IL is not the solely domain of the library—there is need to collaborate with the different lecturers at the engineering faculty
- Be clear about IL objectives with any type of activity

F.2 Information literacy needs differ. Engineering librarians and lecturers should be aware that needs differ from one student to another. Individuals and groups of students have very different competencies at the outset, and probably, more importantly, differing motivations regarding fulfilling needs and extending competencies. Mining engineering students or students from certain secondary school, or students who studied from a certain region, for example, may appear to be a homogeneous group with similar needs, skills and motivations. However, recent experience (particularly when widening participation is taken into account) contradicts this view of the homogeneous body of student populations. In teaching and learning terms, these factors are expressed as "presage" factors where individual students come to a learning situation with prior experiences, characteristics and conceptions of learning that, in turn, are affected by developmental factors and social factors as well as learning styles and approaches. Writers such as Biggs and Moore (1993) suggest that it is imperative that these are taken into account (Walton, personal communication, November, 2004).

G. INFORMATION LITERACY LEARNING MENU

G. 1 Part of regular individual lecturers' courses. This type of IL facilitation is done as part of a general course conducted by the lecturer. It is a good starting point for IL work and provides an opportunity to convince engineering lecturers of IL benefits. The following are some actions that engineering librarians can take to facilitate this process:

- Meet faculty administrators (Dean, Deputy Dean & Heads of Department) and share IL benefits with them
- Meet individually or in groups all the teaching staff
- Distribute documents stating the benefits of a faculty-wide IL programme
- Offer information literacy services to lecturers in their course planning
- Prepare IL learning exercises as examples of how to focus the course on information literacy learning
- Make the library the information laboratory
- Prepare a workshop for lecturers where IL concepts and the importance of implementing them in the classroom are discussed

G. 2 Independent curricular courses. These courses are offered independently and solely devoted to information literacy, but they are part of the students´ curricula. Full responsibility is given to engineering librarians in the information learning process. Guidelines to planning an independent IL course:

- Plan the IL course or courses to coincide with the faculty curriculum design
- Base the course on constructivist pedagogy—incentive is on students to practice concepts
- Make the course interesting and appealing to students according to teaching engineering subjects
- Exercises should focus on something that will benefit students in their regular classes
- Partner with a lecturer's course, so that IL exercises are on the same subject
- Adjust course length according to the available time
- Courses should not be too long—four to ten hours is ideal
- Divide topics and distribute them in more than one course if necessary

G. 3 Extra-curricular courses. An extra curricular course is easier to plan, because it is independent from faculty curricula. However, the long-term goal is to have IL courses as part of the curricula. The following are suggestions for extra-curricular courses:

- Follow the format and procedures for any regular faculty course
- Choose course dates when students may have less academic work

- Students have less time to take this type of course at the beginning and end of terms
- Provide some recognition to those who take the course, such as a certificate
- The library can have its own information certificate program
- Take this independent road only if it is necessary, remember that embedded programmes are more successful

G. 4 Independent short courses. They are the means for training specific IL objectives and for updating skills of the lecturers and students. Because they need to be linked in a deliberate way to the curriculum, these courses should only be taught as a last resort. Effective learning only takes place when it is contextualized and embedded (the very core of constructivist theory (Walton, personal communication, November, 2004). If you do offer them, a series of short courses can be integrated into a full course. The following steps can be equally applied to embedded as well as independent generic courses/modules:

- Plan information literacy workshops to enhance specific skills
- Workshops should be focused on engineering subjects
- Time length should be short and scheduled when students have a study break, i.e., lunch periods or evenings
- Create a programme for the whole term with different workshops options
- Workshop facilitation can be shared among librarians, if they are available
- Keep the sessions lively
- Name the workshop with catchy words focused on the actual content

G. 5 Courses for lecturers. Lecturers are the key actors for the engineering information literacy programmes' success. Lecturers need to learn new information competencies, although sometimes, they may not recognize it. Therefore, lecturers should be offered a diverse and flexible IL training. Librarians should keep the following in mind when training lecturers:

- Lecturers are the most important members of the faculty of engineering to convince of IL benefits
- Create a course or courses tailored to the needs of lecturers
- With each course facilitated, faculty of engineering IL advocates will be achieved
- Design a hands-on experiential course to facilitate the IL learning that lecturers can adapt for use in their classrooms
- Offer the course before or after the term ends
- Make the IL course part of faculty training programme curriculum
- Promote the course among those faculty members who are library advocates
- Offer the course at a special time and include a coffee break

- Prepare learning activities that participants can reflect upon, taking into consideration their own teaching needs
- Remember that participants who are faculty members can be more demanding, so prepare you course content and materials well

G. 6 Other activities. They can include demonstrations, lectures, library visits, and training sessions. A good information literacy program should include a broad menu of regular and complementary IL options to support learning that include:

- Offering lecturers on-request information literacy training sessions
- Creating a menu of options with ready-to-go to teaching sessions
- Providing information about objectives and benefits for participants
- Preparing and distributing handouts for each type of activity
- Providing sessions in classrooms or other venues that may not be as well-suited as the library
- Recognizing academics who offer library IL opportunities
- If your time is limited, reserve dates and times to do this IL work

H. PERSONNEL DEVELOPMENT

Engineering librarians will best use their time to teach students and faculty how to locate, evaluate, and use information. They shall focus on training individuals in information searching and use, rather than on just source location and retrieval. However, librarians will train themselves to look for opportunities to learn or enhance their learning facilitation skills.

H. 1 Need for instructional librarian role (Goldfarb, E. K., as cited in Stripling, 1999). New pedagogical methods used in teaching STEM courses at universities require librarians to play an active part in the learning processes. Therefore, librarians ought to:

- Take the new roles as knowledge and instructional facilitators
- Provide essential expertise on:

  a) accessing information,

  b) selecting information resources, and

  c) facilitating the use of information in the learning process (Kuhltahu, as cited in Stripling, 1999)
- Learn and teach new information formats (linear and non-linear)
- Facilitate non-traditional or constantly changing points of access as information media and resources evolve

H. 2 Librarians´ self-growth (Goldfarb, E. K., as cited in Stripling, 1999). Professional growth of librarians shall depend on self-learning processes and actions. Librarian shall have to:

- Develop their own information literacy skill
- Develop the ability to facilitate learning and to teach critical thinking and inquiry
- Be responsible for their own learning, and their own technological skills
- Receive constant library training, a crucial form of learning new skills and concepts
- Participate in professional organizations, attend conferences, and purchase technical literature
- Allow adequate time for opportunities to collaborate with peers, have/give ongoing support, and offer/receive task-related curriculum advice

H. 3 Institutional training. The library shall provide proper training according to its means. A programme to enhance or develop teaching skills shall include the following:

- Comprehensive training programme for the IL team, including Engineering Librarians and lecturers
- The programme shall be divided into separate sessions for basic, medium and advanced training
- Suggested timeframe for workshops and courses that take place over more than one year
- Include at least four types of courses: pedagogical, technological, self-management, and information-related competencies:

- The pedagogical component of the programme shall include topics on how to create a course, instructional design, assessment and evaluation, class communication, conflict and group management, among other basic teaching skills;
- The technological training shall include courses on office software, course management, web software design, reference management, and equipment management;
- Under self-management, the programme must include time management, planning, motivational workshops, and general management;
- The information-related training shall make librarians proficient in the tools and information resources available in the library as well as on the Internet, including search engines, databases, and electronic publications, among other information content available within or outside of the library.

H. 4 Distance learning and e-learning. The task of facilitating IL to several groups of learners is more easily attained when distance and e-learning are used. This shall be a solution to the limited number of librarians currently experienced at the Engineering Library. Engineering librarians shall master new education and training modalities that employ networks, and especially the Internet, as virtual classrooms, instead of traditional physical classrooms. Engineering Librarians shall interact with their students online, such that the student may complete his/ her research and assignments from home, the office, or anywhere there is access to a computer and telecommunications networks, and similarly the librarian may undertake his/her tutorial work wherever there is access to a computer.

I. LEARNING ASSESSMENT

Assessment is the careful judgment from close observation of learners throughout their learning process. It requires the phases of collecting, analyzing, and reporting data through the whole process of information literacy learning (AASL, 1998). Evaluation differs from assessment in the sense that it usually places value on when the student finishes a task. Assessment is a more comprehensive process, because it gathers information on students´ performance during their whole information literacy learning process, as well as when they finish their task. Another important difference between these two terms is that assessment "…is done with the student, while evaluation is done to the student's work. Assessment should engage students in the inquiry and production to communicate and demonstrate what they know" (AASL, 1998, pp. 67). The librarians and lecturers shall take into account the following aspects as the main factors when assessing information literacy learning:

I. 1. 1 Why assess?

- Improve student growth (formative)
- Improve instruction (formative)
- Recognize accomplishment (summative)
- Modify or improve the program (summative)

I. 1. 2 Importance of assessment

- Students´ achievement is linked to the assessment techniques (Wiggins, 1998)
- Assessment is critical in determining if student learning is occurring (Jones, A. J. and Gardner, C. as cited in Stripling, 1999)
- Find superior ways to evaluate students´ abilities to use academic skills (Baron, 1995)
- Unlock students´ success through assessment (Baron, 1995)
- Performance-based learning and assessment can be implemented at all grade levels and among all disciplines
- Ability to merge assessment and instruction into a single strategy
- Can conduct ongoing, continuously measuring of student performance throughout the learning cycle (Jones, A. J. & Gardner, C., as cited in Stripling, 1999)
- Information literacy assessment should be integrated into the rest of the curriculum across all levels and all disciplines

I. 1. 3 Focus on independent learning

- Assessment should be performance-based, so that students are prepared for life not just for school
- By promoting self-assessment techniques, students learn how to evaluate information to solve problems, make decisions and become independent learners
- Enable students to create a set of assessment strategies and criteria to monitor their work (Donnahan, J. and Stein, B. B., as cited in Stripling, 1999)

- Help students in self-reflection
- Assessment should be deliberately designed to improve and educate student performance
- Authentic assessment means measuring student performance based on tasks that are relevant and used in real life (Baron, 1995)
- Design and use assessment focused on the learner's needs

I. 1. 4 Focus on higher level thinking

- The new information literacy focus is on information searching, evaluating, and utilizing, rather than on source location and retrieval. Information literacy should emphasize higher level thinking processes (applying, synthesizing, and evaluating information), in addition to lower thinking activities (recalling and comprehending information) (Donnahan, J. and Stein, B. B., as cited in Stripling, 1999);
- Teach information processes, such as decision making and problem solving, rather than just knowledge of information, so that students master the ability to learn
- Make information processes explicit in all the assessment techniques
- Assignments and assessments must link process skills with information presentation (Jones, A. J. and Gardner, C., as cited in Stripling, 1999)

I. 1. 5 Questions of the IL learning facilitator (Librarians and Lecturers)

- What am I trying to assess?
- What have students learned?
- How do participants feel about their own learning?
- Are students really learning?

I. 1. 6 Questions for the assessment process (Wiggins, 1998)

- Does the assessment measure what it says it measures?
- Is the scoring criteria clear, objective, and explicitly related to the standards?
- Is the scoring system reliable and does it adequately discriminate degrees of work quality?
- Is the task being assessed a challenging one?
- Does the assessment technique offer an appropriate learning challenge for students?
- Does the task being assessed reflect real-world challenges, contexts, and constraints?

Example (Stec, E., 2004). "Select the major assessment criteria and break it into smaller components. These units not only clarify your assessment criteria, they should be the basis of curriculum design. Here is an abbreviated example:

- What have students learned?
- Can the students incorporate appropriate journal articles into their research papers?
- Can the students locate appropriate journal indexes? In print?
- Can they use computers for electronic searching?
- Can students create a useful search strategy?
- Do they know sufficient words for keyword searches?
- Do they understand controlled vocabulary & use it?
- Do the students employ Boolean search strategies effectively?
- Do students select peer reviewed articles for their research?" (p.3)

I. 2 TYPES OF LEARNING ASSESSMENT (Stec, E., 2004). The three types of assessment are:

- Prescriptive or diagnostic. It assesses the knowledge and skill of participants before the instruction is designed. These can take the form of standardized or instructor developed tests, auditions or review of a student's prior work.
- Formative. It provides feedback about student learning while the instruction is ongoing and allows the instructor to adjust teaching methods during a course. For example, requiring students to write a one page 'reaction paper' to a reading assignment, or prepare an annotated bibliography of research materials several weeks before the research paper is completed.
- Summative. A final evaluation of the criteria for assessment occurring at the end of instruction, i.e., multiple choice question, essays given under controlled conditions, or an evaluation of citations used in the student's research paper or a portfolio review. The latter two examples require development of an assessment 'rubric'. Assessment of students' feeling about instruction can take the form of questionnaires or focus groups. These techniques do not evaluate learning and are often mistakenly used for that purpose (p. 3).

I. 3 ASSESSMENT TECHNIQUES

There are different assessment methods to support STEM students throughout the information literacy learning process. Here are the primary recommended tools:

I. 3. 1 Checklists. These are lists to guide students in the accomplishment of their assignments. They include the different stages, levels or items necessary to complete the assignment. Checklists should be visual task reminders to improve student growth. Checklists should be provided at the beginning of the assignment so that they can be used during the whole learning project or task for self-feedback.

I. 3. 2 Rubrics. A rubric is a precisely structured assessment that guides students to achieve a successful performance. It normally includes a graded list of the attributes students ought to perform in their learning tasks. The successful and unacceptable range of performance levels should avoid evaluative language, i.e., judgment labels. Terms should be descriptive of the success outcome the student is to obtain

(Donnahan, J. & Stein, B. B., as cited in Stripling, 1999). The rubric can be divided according to the process steps with clear indication of each element to be considered to reach the desired goal.

I. 3. 3 Conferencing. A technique that is based on a discussion with the learner, among learners, or among the whole class to orally reflect on the information literacy processes. It can be done at the different stages of the information tasks, as well as at the end of the process. It uses questions posed by the lecturer/ librarian (facilitator) inquiring about the process of learning.

I. 3. 4 Portfolio. It consists of the accumulation of student work over time and integrated into a final package of IL process products. Portfolios are useful assessment techniques because it gives students the possibility of seeing their learning products become integrated into a final product. They show that students learned (content standards) and/or are able to do (performance standards) (Jones, A. J. & Gardner, C., as cited in Stripling, 1999). They are an excellent way to measure the efficiency of attaining the learning goals, and evaluate the effectiveness of learning strategies, and the clarity of knowledge presentation.

I. 3. 5 Reports. These are useful essay exercises as long as they are not cut and paste exercises or a repetition of the information in printed or electronic sources with little synthesis or no evaluation of the retrieved information. Merely producing printed reports defeats the purpose of teaching (Jones, A. J. and Gardner, C., as cited in Stripling, 1999).

I. 3. 6 Traditional tests. The list of questions with open or structured answer options is also useful, as long as it does not focus on content of knowledge. Tests can be used when time is limited or when the assessment is specifically focused on a certain aspect of learning.

I. 3. 7 Other approaches. An integral evaluation shall emphasize the need to triangulate the intended learning outcomes with teaching interventions and assessment into a seamless whole (Bligh, 1998). A similar method is proposed by Biggs, (1999), whose SOLO (Structure of Observed Learning Outcomes) model offers a structure for assessing thinking skills.

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