IMPLEMENTATION OF A COMPETTENCY BASED AND TESTED TECHNIQUE FOR ENHANCE STUDENT e-LEARNING SYSTEMS

BY

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DEPARTMENT OF COMPUTER SCIENCE

FACULTY OF PHYSCIAL SCIENCES

UNIVERSITY OF BENIN,

BENIN CITY

February, 2023.

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BEING A PROJECT SUBMITTED TO DEPARTMENT OF COMPUTER SCIENCE, FACULTY OF PHYSCIAL SCIENCE, UNIVERSITY OF BENIN IN PARTIAL FULFILLMENT OF REQUIREMENTS FOR THE AWARD OF BACHELOR DEGREE (B.Sc) COMPUTER SCIENCE

February, 2023.

CERTIFICATION

This is to certify that this project was carried out by **Uwagbor Goodnews Osadebamhen** Mat No, **PSC1607181** of the Department of Computer Science, Faculty of Physical Sciences, University of Benin, Benin City under my supervision.

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Dr. (Mrs.) V.I. Osunbor **Date**

(Project Supervisor)

APPROVAL

This project is hereby approved in partial fulfilment of the requirement for the award of Bachelor degree (B.Sc) in the Department of Computer Science Faculty of Physical Science, University of Benin.

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Dr. (Mrs.) V.I. Osunbor **Date**

(Project Supervisor)

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Prof A.O. Egwali **Date**

(Head of Department)

DEDICATION

This project is dedicated to Almighty God for his Amazing grace upon my life and to my parents for ensuring my success all through my education.

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ABSTRACT

Thorough intensive effort have been made to design powerful and outstanding e-learning platforms or environment but little or no attention have been paid to creating also environment that will provide assessment to test the knowledge and skills which learners may acquire form these platforms. Competency based testing can be applied to various instance including real life or e-learning programmes with a focus of skill based learning outcomes. This study however is concerned with creating a competency-based e-learning platform for the regular desktop that teaches web development to students or interested learners. Web development here is a larger learning goal and is however divided or broken down into smaller component courses called competencies. Students or users of the platform must however go through each phase and must be classified Advanced, Competent or Master in order to advance to a next level as advancement to a next level component or competency would depend on the students tested competency level. Included also in this study is a model for testing student's competency level in relation with the 5-level scale which is used to classify student according to their competency level.

CHAPTER ONE

OVERVIEW

1.0 INTRODUCTION

This section in this chapter introduces the concepts of e-learning and competency-based learning, included in this chapter are the aim and objectives, the scope, problem statement of the already existing system of this study.

The concept of e-learning has existed for quite a while, although it has never been used in its history with such intensity as it is used today. With the emergence of the internet, the world wide web, social media, mobile gadget and pc's and the ict at large can be some of the reasons for its thrive, nevertheless, its effectiveness to deliver better learning environment than conventional classes(arguable by many).

E-learning can be seen by many as the utilizing of electronic technologies to access educational curriculum outside of a traditional classroom. In most cases it refers to a course program delivered completely online, although there are many other terms used to describe or define learning that is acquired online or via the internet or sometimes via software(e-learning platforms) ranging from distant learning to computerized electronic learning, online learning, internet learning and others too.

According to Davis et al. 2021, E-learning has been widely regarded as a new innovating methodology effectively delivering knowledge and skills and many disciplines, to large and scattered students communities. In another note, e-learning refers to the use of electronic equipment, computer-based devices and internet based applications to facilitate the process of teaching and learning (Nichols 2019, Benninck 2020).

On the other note, Competency-based testing which is also referred to by many as competency-based learning or competency-based education is also a factor of e-learning although it is not limited to the context of e-learning. The competency-based education was formed as an educational trend in the United States of America. Its initial idea was adopted from the so called generative grammar by N. Chomsky who declared in 1965, "…Fundamental difference between competency or knowledge of language and the application or actual use of language"(Yelena, 2021). Competency-based learning is an approach to teaching and learning more often used in learning concrete skills than abstract learning or the usual classroom learning. For competency-based learning, the unit of learning is extremely fine-grained, rather than a course or a module, every individual skill or learning outcome which is also known as competency is one single unit. Learners work on one skill or competency at a time which is likely a small component of a larger learning goal. The student is evaluated or tested on other individual competencies after they have mastered the current skill being learned.

The competency-based education was founded in entelechic form in the 1960s as a separation of the notions of "professionalism", "competency", and "competence". (entelechy: that which realizes or makes actual what is otherwise merely potential i.e. the application of potentials or knowledge which entails mastery), certainly these notions are widely being used for a long time, however before the competency-based education substantial components of these notions had always been confused. Competency-based education is dependent on the specification or definition of a particular competence of a larger learning goal or course of activity in which the required level of competency is formed by characterization and specification of the task which levels of performance are set. When the task characteristics have been identified and put on place in a hierarchy of the complex larger learning goal or phenomenon of reality (learning goals

which are broken into smaller components or easier-to-learn components hierarchically) institutional sequence shall be developed to enable students or learners partaking in any activity be more efficient in achieving the set objectives of the learning goal or complex phenomenon.

The starting point of competency-based learning can be based off of the fact or idea that different individuals (not specifically students) may prefer different learning technologies and also have different learning styles. Since the main objective of the competency-based approach to education is not ranking the students but teaching them to achieve their goals, this approach implements an attempts to increase the students probability of success by providing various institutional routes, where-from the future, specialist may choose that one that suits his personal learning style.

On another note competency-based testing as its name imply is basically testing a student on a learner's competency after they have acquired knowledge from each small component competency of a larger learning goal before advancing to higher level of acquisition in the larger learning goal. (Yelena, 2021).

According to The Standards for Educational and Psychological testing, 1999, Test is defined as an evaluative device or procedure in which a sample of a learner's behavior in a specified domain is obtained and subsequently evaluated and scored using a standardized process. Testing is often a process of gathering data and returning results, instead of a process of providing opportunities for learning. An assessment is a more general process of gathering data to evaluate a student. Data from several assessments are used to make decisions about a learner's performance level. (Martens, 2018). In addition, competency-based testing in application to e-learning could only be relevant and useful to interested learners concerned more about skill

acquisition in a learning goal than the knowledge only. However In this study, competency-based testing technique is a method devised to test the competency of a student or a learner but in this case emphasis are laid on its application to e-learning and self-development, where learners or students who gets interested on a larger learning goal have to master each level of competency hierarchically before advancing to a higher level of competency, beginning from the smallest component of the larger learning goal.

1.1 STATEMENT OF PROBLEMS

In competency-based learning, students learning achievement is determined by performance in assessment or by mastery of skills, the time it takes to acquire mastery of a particular skill or potential is no longer relevant, extra credits, class attendance are no longer relevant, studying for grades improvement is quite also no longer relevant. Students demonstrate mastery of every applicable skill or competency regardless of the time it may take before advancing to higher competency. Here are some existing problems.

- Learning is unsteady and time is invariable, most students are used to the normal class attendance, with a class ending after 12 weeks no matter how much the student has achieved or learned.
- Students often seem to lack interest in a particular course of study due to passiveness, applicable to the course and its impractical nature, so they study for the just the knowledge sake or the extra credits that follows, in competency-based learning, a competency does not end until the student demonstrate mastery, students must be mentally prepared to work for as long as it takes.
- For the common classroom learning, getting good grades is mostly always the students drive or say for the regular e-learning platforms, getting a certificate is always the

learning motivation, but it shouldn't be so, students or learners should always be committed to studying and practicing until mastery is achieved, since sliding with a C or D no longer suffice.

1.2 AIM AND OBJECTIJVES OF STUDY

The major objective of a competency-based learning programme is to endow students with mastery of a versatile study field in an inconstant and adaptive educational skill acquisition programme, however this study is aimed at the following

- To empower students to advance upon mastery achieving in learning or skill acquisition.
- To reveal to students that education in major times considers that emphasis should be exclusively on what people can do.
- To implement the self-assessment testing technique in unison with manager's assessment testing techniques for e-learners though most e-learning platforms do not provide this medium.
- To reveal the relevance of competency-based learning platforms as applied to e-learning of a larger learning goal or study field
- This study is also aimed at implementing an offline competency-based web development skill acquisition e-learning platform for the regular desktop.

1.3 RESEARCH MOTIVATION

Generally, people want to get better at what they do, at their work because it is what makes them happy. Not only is a job well done more satisfying but in today's standard based world, mastery of learning is essential. It is nothing new to our now learning system that a student most times have to buy their success, passing a course with a D just because they brought a 12 canned

packaged bottle water or soft drinks does not help the student's success. Student must be able be able to demonstrate mastery of knowledge and skill whether paper/pencil or e-learning wise.

In May 2017, I enrolled in an online e-learning programme for skill acquisition in Linux operating system, an e-learning platform which name would be inappropriate to mention. Linux OS is a large learning goal and for this platform it has eighteen competencies, more like eighteen chapters. What this platform basically does is give materials for study for all the eighteen competencies and is expected for the learner to come back after a certain amount of time for a certification based objective exam. I can tell that all I achieved from this platform is literally just the certificate because I read the materials I was given and I could answer all the questions that was set from them, but shockingly the skill I hoped to obtain was nowhere to be found in me, but of course this is not supposed to be. For interested learners like I was, the skill is always the drive, mastery is the motivation.

1.4 SCOPE OF STUDY

The scope of this study would be to implement a competency-based web development skill acquisition in an offline e-learning platform for the regular desktop. In this context skill acquisition in web development is the larger learning goal or study field containing different competencies and an algorithm that tests the student's competency using both the objectively scored assessment and the performance-based assessment is implemented.

1.5 SIGNIFICANCE OF STUDY

Generally, competency-based learning or education requires students to be self-confident, disciplined, motivated and determined and be able to pan to work independently and ask for help essentially when needed. It is important to note that just like every other educational programmes

or platforms, competency-based learning programmes or platforms also offer certification to students or learners on achievement of mastery of a particular skill or competency of a large learning goal.

Consider two graduate students who are applying for a job, one certified only on a particular course and the other certified competency-based on a particular course too. If the two applicants are tested based on what they can do and not just what they know, it is no doubt that the competency-based student is the one who gets the job, because not only does he know, he can also do. The competency based student has achieved a mastery level threshold on assessment of the required skill or competency.

Some competency-based learning platforms allow students unlimited attempts to demonstrate mastery of each competency, if a student hasn't demonstrated mastery in a challenging competency after seven tries, then he will have to keep working and prepare for the eighth attempt, hence if he finally succeeds then an achievement is made and the significance is mastery.

1.6 METHODOLOGY

A Java based algorithm is implemented in an offline e-learning platform (precisely an application for the regular desktop), specifically a platform for skill acquisition in web development, involving all the web development required languages as a curriculum to master. In this platform also, interested learners will be allowed to study or practice each web development language beginning from the smallest component language of the web development languages and then learners competency will be tested after each level(language) covered or learned before advancing to a higher level or language of requirement. The test that will be given

to learners is a means for learners to prove their competency after they have mastered the current skill being learned. Advancement will depend solely on their performance in the test. This project fits into the wider context of e-learning.

1.7 LIMITATIONS OF STUDY

The limitations of this study include the following;

- Power failure which was a major issue in terms of completing the project work.
- Lack of efficient materials concerning the study as the study however seem abstract therefore it wasn't easy to fetch written text on the subject matter from libraries and internet.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews in details competency-based learning and some of its related concepts.

2.0 COMPETENCY-BASED LEARNING (CBL)

Before defining competency-based learning, it is necessary to start by defining a credit-hour based education. According to Zipper (2020) in an interview with Dr Jeremy Korr, In a traditional model, achievement of students learning is determined by a combination of how many hour students attends class, how they perform on various assessment, how late they may or may not arrive to class, how they behave in class and how much extra work they do if given the opportunity by any given instructor among other factors (Zipper, 2020). By contrast, in competency based learning, achievement of students learning is determined by mastery of assessment, the time it takes to achieve a particular skill, knowledge or ability is no longer relevant, squeaking by a D is no longer possible, student must demonstrate mastery of every applicable competency no matter how long it takes (Zipper, 2020).

Hernandez-de-menendez et al (2021) quoted that it is essential that student require not only specialized knowledge but also the needed skills to apply it and succeed in highly demanding and ever changing world. However competency based learning is defined according to Hernandez-de-menendez et al (2021) as an educational system or program that measures the knowledge, skills and experience in place of or in addition to the use of credit-hours. The purpose is to make a beginner, in this case a student become an expert in a specific field

2.1 COMPETENCY

Competency is defined as the ability based on behavior, competences are differentiated to different levels; behaviors from the basics to make framework, this phenomenon is a deep understanding of a characteristics required to perform in a superior way. It is a most important success factor for achieving organizations objectives. Competencies represent the knowledge and skills required for reforming and supporting the business processes, they represent the basis for creating value in an organization, competency are observable and measurable, this is according to Sumithra (2017). The term competency refers to a combination of skills, attributes and behaviors that are directly related to successful performance on the job.

However O'Sullivan and Burce (2017) noted that competency as defined by European bodies as well as educational experts to consist of three interrelated ingredients;

- A knowledge component (the understanding part)
- A behavioral component
- A value component including values, beliefs and attitude.

So a competent person performing a task will possess a combination of skills, knowledge, attitudes and behaviors required for the effective performance of the task or activity. A competence is defined as the holistic synthesis of these components (O'Sullivan and Burce, 2017). At another level, a competence again maybe divided in three components or aspects, it is the ability of a person to show;

- A particular behavior in something
- A particular context
- A particular quality

O’Sullivan and Burce also found that defining competency is a complex and even more, educational competency. The organization for Economic Cooperation and Development (OECD) through the Program for International Student Assessment (PISA) has done much work on defining competency and created a framework for comparing student competencies for the purpose of assessment. A report completed by PISA according O’Sullivan and Burce (2017) states that “A competency is more than just knowledge and skills; it involves the ability to meet complex demands by drawing upon and mobilizing psychological resources including skills and attitude in a particular context. For example the ability to communicate effectively is a competency.

Competency however according to Sumithra (2017) refers to a cluster of skills and abilities needed by a person in order to act effectively in s given situation, competencies cannot be taught in a single day, they are required to be developed over a period due to changes in the job roles and responsibilities, however conducting such competency based training cannot happen effectively through traditional methods of training due to various time constraints etc. in such situation a well-organized competency based corporate e-learning system would provide immense support to the employee and the organization

Competency based learning is obviously not applied for some kind of dictatorial, genocidal purpose but rather with the best interest of people, the economy and society in mind (Preston, 2017). Preston (2017) also found that competency is a familiar trope in contemporary education, although there have been many definitions of the concept, the central idea of competency based learning and training that the “evidenced past behavior of an individual is a direct indicator of their competency to perform future process” has been highly influential.

The aim is to inculcate in students scientific and technological knowledge of practice and skill they may apply in diverse field of study and competitions. Despite many definitions of competency, the use of the term competency-based testing is both central and in itself unproblematic (Preston, 2017). Although competence in competency-based learning is very different from dictionary or common sense conception, it does have a defined meaning in terms of a set standards or performance which an individual is expected to meet to pass as assessment in that area (Preston, 2017). Course development in competency based learning consist of establishing standards for mastery of knowledge, skills and abilities that demonstrate learning as opposed to a seat-time in class to grant credit towards college graduation (Simonds et al, 2017). Simonds et al (2017) also mentioned that in a professional training literature competency based learning is concerned as a development progression through which student acquire skills, knowledge and attitude with the ultimate goal of serving the public as competent professionals. It is the pragmatic, common sense and populist nature that makes it more appealing (Preston, 2017). Competency based learning considers that emphasis should be exclusively on what students can do (Preston, 2017). Students can earn college credit by demonstrating competence rather than accruing a certain amount of seat-time, the conventional metric (McClarty et al, 2020). Simonds et al (2017) noted that student whose learning is accomplished by projects have been shown to learn more than their counterparts who experienced the traditional methods of teaching and learning and hence project-based learning.

2.2 PROJECT-BASED LEARNING

According to Simonds et al (2017), project based approaches focuses on the student use of knowledge, skills and abilities to design a product, "deliverable" or experience that offer meaningful solution to relevant question. The connection between project based learning and

competency based learning offers a promising link. The project based platform requires that students move beyond stating what they have learned to using what they have learned to create change and advance solutions. Exams are not used to measure outcomes; outcomes are measured via projects that demonstrate the student knowledge.

2.3 CBL MODELS

Competency based learning is workable on so far as it measures of learning yield trustworthy data about student prospects for future success (McClarty et al, 2020). However Glaesser (2019) noted two types of models: models of competence structures and models of competence level. The former assume the existence of several aspect of a particular competence and they examine the relationship between the aspect and they relate to the overarching competence under study, whereas the latter describes various levels of competence which differs quantitatively in terms of the task a person is able to perform given a particular competence (Glaesser, 2019)

Also Schaffhauser (2018) postulate four logic models of competency based learning;

- Student's experience of learning including instructional strategies, assessment practices and other element that makes up student success.
- Professional practice, what teachers do to promote student success and how they are supported themselves.
- The district and school system, the component that facilitates competency based learning at the student, class, and district state levels.
- Culture, or the condition necessary for helping student and educators succeed with competency based learning

2.4 CBL ELEMENTS

Hernandez-de-menendez et al (2021) found that a student competency consist of three elements; knowledge, skill, and attitude/values. These three components are integrated to perform a specific activity with measurable outcomes that clearly indicate what the student is able to do. McClarty et al (2020) also noted that most competency based programs include two common elements; a competency framework and a competency assessment. However, according to Torres et al (2019), four common elements of competency based learning were discussed by administrators and highlighted in state and district policies.

- Student must demonstrate mastery of all required competencies to earn credit or graduate.
- Student advance once they have demonstrated mastery and student have more time to demonstrate mastery if needed.
- Students are accessed during multiple measures to determine.
- Students earn credits towards graduation in ways other than seat time and course taking (such as apprenticeship, blended learning, dual enrollment)

The competency framework describes the skills, abilities and knowledge needed to perform a specific task, competencies must be clearly defined, measurable and related to the knowledge and skills needed for future endeavors such as additional education or employment. The second common element competency based learning according to McClarty et al (2020) is the competency assessment, because competency assessment are used to determine mastery and award credit, the value of competency-based learning credentials hinges on the reliability and validity of those assessment.

2.5 TRADITIONAL EDUCATION VS CBL

The most important characteristics of competency based learning is that is measures learning rather than time, student's progress by demonstrating their competence, which means that they prove that they have mastered the knowledge and skill (called competencies) required a particular course, regardless of how long it takes while more traditional models can and often do measure competency, they are time-based, courses lasts about four months and students may advance only after they have put in study or application time. This is even true even if they could have completed the course work and passed the final exam in half the time. So while most colleges and universities hold time requirement constant and let learning vary. This is according to O'Sullivan and Burce (2017)

Deimann and Bastiaen gave a brief comparison between traditional educational and competency based learning as follows

Table 2.1 - Traditional education vs competency based learning

TRADITIONAL EDUCATION	**COMPETENCY BASED LEARNING**
The curriculum is based on knowledge contents and discipline-oriented skills	The curriculum is based on competences displayed in accomplishing a task and dealing with practical or problem situation.
Learners study pre- determined content	Learners carry out learning task either with or without other learners
All learners go through less or more the same curriculum	A made-to-measure curriculum is put together depending on the entry level.
Knowledge and skills are tested	Mainly testing of competencies
Trainer or teacher controlled testing	Also self-assessment and peer-assessment
Separate skill modules	General skill are integrated into learning tasks
Training units are delivered from separate discipline	Training units to a significant degree are inter disciplinary

In competency based testing, learners are no longer primarily trained to pass their examinations but to learn independently and to manage their own learning process; testing on the basis of the authentic task is an essential feature of this. However Torres et al (2019) postulate a motivation for adopting competency based learning reforms;

Interviews with administrators revealed several motivations for adopting competency based learning reform. Several administrators reported that they had adopted competency based learning to ensure that all students achieved competency, especially at-risk students.

Administrators explained that the current system based on seat time and credit requirements resulted in widely varying learning levels students could pass a class by achieving a minimum average on assignment and attending class regularly. Several administrators recounted that students could pass a math class without, for example learning statistics because statistics was averaged into the grade. Students were granted diplomas sometimes lacking mastery of concepts. Administrators believed that at-risk students would not be able to slip through the cracks in a competency based learning system where students more at their own pace and receive support specific to the competencies they are struggling to master, another motivation was to ensure that students graduate with the skills and knowledge for post-secondary success.

Torres et al (2019) however quoted that "…we are past the point of being ready for the world if you are literate and numerate but not able to apply those skills of literacy and numeracy".

2.6 CBL CHARACTERISTICS

Hernandez-de-menendez et al (2020) noted some characteristics of competency based learning as follows;

- An emphasis on result
- A focus on development of abilities
- The demonstrations of competency mastery rather than time based teaching and the student as a learning unit a focuses on evaluate student regarding what they are able to do for the society.

In another note, Hernandez-de-menendez et al(2020) categorized competencies as disciplinary or transversely; the former as the name suggest comprises those competencies that are particular of

a discipline, the latter which is also known as generics are those competencies to common to the different field of study and facilitates the acquisition of the other ones.

Competency based learning require specific and non-traditional teaching methods. Repetitions and memorization of information do not allow students to understand the challenges and problems of this century, it is advisable to teach with learning experiences that stimulate them in developing this skills demanded by the industrial market. The competency based learning teaching methods allow students to be self-directed learners, practice what is taught and receive training activities that matches with their learning style. These activities acquire continuous practice as the acquirement of competencies is an on-going process; this will move to the long term memory. Competency development is an incremental process.

2.7 CBL ASSESSMENT DESIGN

McClarty et al (2020) noted that competency based learning assessment can take a variety of formats: Objectively scored assessments (for example those with multiple choice or true-false questions), performance based assessment (for example those including essays, group project or simulated environment) and real world observations (for example, pre service teachers in the classroom). One of the main characteristics of competency based learning is the continuous evaluation required to verify that the competencies are developed (Hernandez-de-menendez et al, 2020). Hernandez-de-menendez et al (2020) however argued that competency assessment is perhaps more challenging that the traditional model; it requires gathering and analyzing diverse information, testing the student repeatedly and offering personalized attention which demands significant time. The most important step in assessment design is defining the competency (McClarty et al, 2020). Competencies must be clearly defined and measurable; otherwise they cannot be considered competencies. However, Hernandez-de-menendez et al (2020) quoted that;

competency based learning assessment methods include published papers, tests project, scoring rubrics, metacognitive reflection, portfolio, learning journals, self-appraisal, peer evaluation and behavioral observation scales (BOS).

In order to effectively and efficiently access competencies, it is first and foremost critical to have formed competency models that are measurable. The top three methods that have been used to assess competencies are as follows;

- The self-assessment method: While not to be used alone, self-assessments are a great method for providing individuals with the opportunity to rate themselves against a competency model that is measurable. Self-assessment allow individuals to reflect on their own strength and weakness while getting a sense of the areas in which they need further development, to match the competency model needed for that. It is important to note that self-assessment is used in unison with the manager's assessment because of the bias nature of humans, individuals may not be in their own be able to provide accurate assessment, they may either rate themselves below or above the competency model
- The manager assessment method: A competency assessment completed by a manager can only be completed or conducted after the manager has had enough time to monitor and access the individual. A good way to do this is to provide the student with projects and task that test the student competency in the competency model for his or her level. Managerial assessment is typical easier for beginners in all learning program where competencies are fairly introductory. Similar to the individual's bias self-assessment, it is important for manager to be aware of their own biases in order to be as objective as possible.

- The 360-degree assessment: 360-degree assessment will yield the most results because they rate the individual as objectively as possible form every possible angle. Due to this, 360-assessments are one of the most popular and widely accepted methods for measuring competencies. To complete a 360 degree assessment, begin by getting the individual to rate themselves against their level of competency model. After this is completed, seek out others who directly work with the individual such as his or her supervisor, co-workers, subordinates and even internal or external customers, suppliers. Once all assessment has been collected, the average score is taken to find the individual's competency score. This type of assessment is majorly job-employee based assessment.

Simonds et al (2017) aimed at outlining the development and implementation of two sections of a competency based introduction to psychology course, one online and one in person, that employed a project based approach, however, Simonds et al posed question were

- How can competency-based education work in a traditional undergraduate semester based setting?
- How can a letter grade requirement be achieved in a competency based model?
- Do competency based learning outcomes differ between online and classroom based environment?
- What competency based learning experiences are reported by students accustomed to more traditional college classroom?
- What were the course design and instructional experiences and challenges faced by the course designers and instructors?
- What do the authors recommend for others approaching a competency based design and course delivery process?

Simonds et al (2017) selected course competencies based on their relevance to an introduction to a psychology course and grouped them into six different badges; Scientific investigation information literacy, Ethical/social responsibility, Effective communication, Academic best practices and Applied content. Badges are referred to as learning goals in this context.

2.8 BADGES

Fosmire (2018) quoted that with the aid of transparency enabled by badges, potential employers have greater access to student achievements so a better determination can be made of whether the student has the skills needed for a particular position. The badge framework combines the richness of an e-portfolio with an assessment component that indicates which competencies of a particular piece of work fulfills, providing an organizational structure for the e-portfolio. Since badges are awarded by certified faculty or instructor, one can be sure that student did indeed demonstrate a particular competency.

2.9 BASIC COMPETENCIES

Hernandez-de-menendez et al (2020) noted that the important traversal competencies were grouped in four categories based on similarities related to the expected outcomes in the performance of the student.

- Personal performance: contains competencies which will aid student to have a major impact in any context in which he works, such as networking, team working, cross cultural communication, self-taught, world knowledge, effective communication etc.
- Intellectual competencies will ensure the work will be done with excellence such as critical thinking, creativity, innovation, decision making, intellectual risk, problem solving, constructing knowledge, analysis capacity etc.

- Supporting competencies will improve the job performance, such as information technology virtual competency, argument construction, entrepreneurship etc.
- Ethics and legal competencies will help student proceed with integrity and within the law such as humanism, ethical practice, professionalism, sustainability, civil engagement etc.

2.10 THEORETICAL CONTEXT: CREDENTIALING

Horohov (2017) found that competency based learning at its core aims to replace the black box of the credential with the objective assessment that can prove what the students know and can do. In removing the black box, it also shifts the status of the institution of higher education from one of authority, to one that must be held accountable. American higher education has historically been characterized as a diverse and decentralized system of autonomous institution. Unlike other institution that can manage clear and consistent products, the educational outcomes of colleges and universities are difficult to measure, however, emulating external expectations of what a higher education institution should look like, these educational outcomes degree and other credentials have assumed value in the society.

However, Credentialism has been defined by Horohov (2017) as the increase of education requirement for jobs, despite no change in the actual education and skill needed for those jobs.

2.11 CBCEL

Corporate e-learning systems can be more successful only if when it becomes a self-initiated program by each individual at work place (Sumithra, 2017). Sumithra also found that; Todays organization are corporating such a competency based approaches in order to be more successful to utilize the human capability at its maximum level. Competency based corporate e-learning (cbcel) systems is a human resource tool which enable corporate enterprise to map employee

team performance gap analysis and to appropriately address through learner's centric e-learning courses and develop employees for betterment of business result at a reduced cost. Corporate e-learning trains people in various fields as required. This means it takes care of challenges faced by companies by delivering the right kind of knowledge at the time. The utilization of latest communication tools by delivering skills, knowledge and train employees is a more apt tome called as corporate e-learning. The corporate e-learning has knowledge, group knowledge which comprises of both tacit and explicit knowledge. E-learning helps in capturing this knowledge and frames it for using as re using them. By and large most organization believes in this statement called "knowledge is power". This is according to Sumithra (2017).

2.12 PLP – PERSONAL LEARNING PLAN

Sumithra found that; Personal learning plan is addressed as a best vehicle for competency based e-learning system. It makes both the students or employees and managers understand about address the issue of prior learning (retrospection of past learning) assessment of the present, prospecting for the future by understanding where the gap or the need to develop is. Choosing from e-learning portfolio and correct method to achieve the required level of training resources focuses on particular learning needs of individual employees. It is a catalogue with personal learning space. It is linked to het performance of employees or student.

2.13 CBL CONSIDERATIONS

O'Sullivan and Burce (2017) stated some pedagogical considerations in competency based learning. Competency based learning must include attention to the learners need and styles, providing the time needed for the learner to acquire and repeatedly perform or demonstrate the expected competency (knowledge, skill, professional behaviors). Competency based learning

places emphasis powerful or learning environment that enable student engage in meaningful learning. However the most distinctive features of this approach as follows;

- Meaningful context: The teacher will create sensible context in which the student will naturally experience the significance and the meaning of the competency or knowledge or skill to be acquired.
- Multi-disciplinary approach: competencies are holistic and as a consequence the educative approach needs to be integrative.
- Constructive learning: The philosophy of competency based learning roots from social constructivism. So learners may engage in creating their own knowledge with which ever learning methods and learning styles by interacting with their environment rather than engaging in the normal tradition seat-time classroom learning.
- Cooperative interactive learning (with peers, teachers). The general idea behind competency based learning is to help learners, make them able to develop their own knowledge and seeks ways to make optimal use if other people's competencies in their learning experience. This entails social constructivism for learning outcomes aimed at developing individual and personal competence; this approach must take diversity of learners need into consideration to meet the learner's goal and objective.
- Discovery learning: Discovery learning means making the content of a study available and accessible and the way of acquiring these knowledge or competencies may not just be a process of providing information but knowledge embedded in a discovery based approach.
- Reflective learning: Competence based learning also places an emphasis on the learning process of the learner. As the learner reflects in their own needs, motivation, approach,

progress, result etc. they develop learning competencies that may be considered "learning to learn."(O'Sullivan et al, 2017).

- Personal learning: In the competence oriented theories, learning is conceived as a process of constructing the learners own personal knowledge and competences, information, knowledge, strategies, only become meaning for a person if a become an integral part of their own personal body of knowledge and competencies (O'Sullivan et al, 2017). In education this implies that students need to be able to identify with the context, the person, the situations and interest that are included in the learning domain involved (O'Sullivan et al, 2017).

2.14 DEVELOPMENT OF COMPETENCY MODELS

According to Russo (2020) "*a competency model is a list of competencies which are derived from observing satisfactory or exceptional student performance for enhancement or employee performance for a specific occupation. The model can provide identification of the competencies students need to develop in order to improve performance in their skills or that employees need to develop in order to improve performance in their current job or to prepare for other jobs via promotion or transfer. The model can also be useful in a skill gap analysis, the comparison between available and needed competencies of individuals or organizations. An individual development plan could be developed in order to eliminate the gap. Important variables to be considered during the development of a competency model are the use of skill dictionaries, or the creation of customized ones and the competency identification and verification methods – surveys, interviews, focus groups, etc.*"

Russo (2020) also stated that competencies are the building blocks of competency models and each competency in the model is defined by means of behavioral descriptors. These descriptors can be defined by determining the highest and lowest levels of proficiency.

A simplified taxonomy coined from the huge literature available on the topic competency based learning group competencies into three main categories:

a) *Knowledge*. It encompasses everything that can be acquired from educational/formative systems and training courses and everything which involves cognitive processes (i.e. perception, learning, communication, association and reasoning). It represents the theoretical understanding of something such as a new or updated method or procedure, etc…

b) *Know-how*. It is related to personal experiences and working conditions and however represents the practical understanding of a new updated method or procedure. It is learned by doing, by practice, by experience. It is the practical knowledge consisting in "how to get something done".

c) *Behavior*. It is referred to individual characters, talents, human traits, or qualities that drive someone to act or react in a certain way under certain circumstances.

The built-up of the model should be made according to the following guidelines; (Russo, 2020)

The behavioral competencies could be included according to the general definition provided by the literature. They don't depend on the nature of the class or area of study for students or the nature of the business for employees but are "embedded" in the resources. Several taxonomies of the behavioral competencies are available and could be adopted.

Russo (2020) also figured that the knowledge competencies for employees are related to the specific business environment. For example, the business processes of an engineering company require technical competencies like the networking theory or the programming languages. The

choice of the knowledge competencies to be included into the model is driven by the business sector of the firm. The know-how competencies are strongly connected to the organization of the firm. They are basically referred to the "rules" (for example, the internal/external regulations) and the procedures (for example, the IT systems).

Russo (2020) however gave sequential steps that should be followed to build up and use competency models

a. to build up the model:

1. Create the processes list

2. Detect the processes roles

3. Create the matrix process/role vs. required competencies with appropriate rating

4. Integrate the competencies taxonomy including the owned competencies not included in the required competencies set

5. Create the matrix employees vs. owned competencies

6. Create the matrix process/role vs. employees reporting the employees' effort figures

7. Calculate the competency gaps

b. to use the model:

8. Analyze the data

9. Plan the corrective actions

10. Repeat the measurement on regularly basis

2.15 RELATIONSHIP BETWEEN COMPETENCIES AND PERFORMANCE

Kolibacova (2014) stated that the relationship between performance as a dependent variable and competencies as an independent variable is expressed by the regression equation

$$Y_{i(t+L)} \sim \beta_0 + \beta_1 x_{it} + e_i$$

The data obtained from the Performance Management System (PMS), processing and storing students' performance evaluations of the selected learning platform, are input data for calculation. The coefficient of performance evaluation of each student ranges from 0 to 2. Its value is calculated based on the evaluation of several monitored goals formulated as key performance indicators (KPIs). The key indicators include at least one key indicator related to the performance of the entire learning platform, one key indicator related to the performance of a department and not more than 5 key indicators evaluating individual performance. One of them is a personal evaluation of student by direct superior. (Kolibacova, 2017)

The others are measurable or evaluable. Each KPI has an objective (100% fulfillment of the objective corresponds to coefficient 1) and weight. The KPI weight expresses the importance of given KPI. Numerically, the sum of all KPI weights is 1. The lowest limit of the coefficient is 0 and means "disastrous performance". Extraordinary, unique performance is evaluated by the coefficient 2. The coefficient 1 expresses the fulfillment of expected performance. Each competency of an individual is assessed by comparing the current state of competency of the student with the requirement arising from his/her assessment or task description. The evaluation uses integer values from 1 to 5. The value 1 means unsatisfactory, 3 means satisfactory and 5 means exceeding. The value 2 can be verbally expressed as almost satisfactory and the value 4 as slightly exceeding. The values of all evaluations of individual competencies are first averaged.

As arithmetic means of evaluations ranging between 1 and 5 they enter the calculations monitoring the relationship between competencies and performance.

2.16 DETERMINING MASTERY

McClarty et al (2020) noted that one particular relevant approach for setting out scores and determining mastery is Evidence Based Standard Setting (EBSS) which is especially useful when as assessment makes claim about future performance (for example, a test taker's ability to pass future courses or succeed in the work place). In an EBSS approach, the judgment of subjects matter experts are combined with data from research studies to determine the cut scores for different performance levels (McClarty et al, 2020). The task of determining the level of performance required to receive credit in an educational assessment, is known as standard setting. Standard setting is the process of defining discrete levels of achievement on assessment and setting cut scores to operate those levels. In some cases, two performance levels are sufficient: pass or fail, standard setting not only related assessment scores to performance levels which performance levels are sufficient to receive credit (McClarty et al, 2020). McClarty et al also stated five steps of Evidenced Based Standard Settings as follows;

- Define the relevant outcomes
- Design appropriate studies
- Conduct studies and synthesize results
- Stake holders renew and recommendations
- Outgoing monitoring

Competency based learning and its teaching approaches have received a good deal of support in education systems in recent years. Competency based learning is characterized by the learners

engagement and activity in all aspects of acquiring the knowledge, skills and professional behavior needed to demonstrate practice in a specific discipline. Many contributors state that competency based learning must involve teaching and learning strategies that facilitate the development and the demonstration of a competency. A critical feature of competency based learning must include a clear, evidenced-based definition of the learning outcomes and objectives. The learning objectives must include demonstrations for performance criteria for the specific competency. The clarity is vital to the teachers and student, the expected outcomes of learning, how performance is measured and how the learning objectives relate to the out must be clear. This is according to O'Sullivan and Burce.

CHAPTER THREE

METHODOLOGY

This chapter discusses the methodology of the study to determine the competency level of a student in e-learning using the student's performance in a given assessment in any course of study. Specific in this study is skill acquisition in web development as an e-learning course of study for students.

3.0 OVERVIEW OF THE MODEL USED

The owned competency of the student was the major concern after the study process or competencies. Level scales can be used to access both the requested competency and the owned competency and however, a 5-level scale was adopted to measure the owned competency of the student. The requested or required competency level describes the level of competency to perform a specific process successfully. Different processes require different level of competency for a successful performance but with regards to the owned competency, the use of graduated scale facilitates the identification of the degree of skill or mastery. Divide and conquer method of problem solution was however used to determine mastery of the larger learning goal, web development.

3.1 THE 5-LEVEL SCALE

The 5-level scale was adopted to access to the owned competency of the student relative to the equation

$$1 \leq C \leq 5$$

Where C = competency level

The 5-level scale used is specified as follows;

1 – Incompetent

2 – Limited

3 – Advanced

4 – Competent

5 – Master

Incompetent: Students are aware of the required or supposed information, ideas and situation related to the competency or course of study in view but have not had the opportunity to practice it, students with very poor assessment performance are classified incompetent and would be required to go through the learning process over again.

Limited: Students that grasp understanding of the course of study or competency in view to a certain extent are classified limited. Students that know exactly what they want to do, but don't know exactly how to go about it and also have a considerable assessment performance would be classified here as they are literally limited.

Advanced: Students actions and performance in assessment usually meet their expectations and the expectations of their superior. They look for opportunities to apply this competency in reality and try as much, to always improve. They display average or little above average performance in assessments or task given to them.

Competent: The student has reached his overall goals and often thinks about opportunities to practice this competency. They consistently meet the expectations of themselves and others.

Their learning is considerable and they appreciate the significance of this competency in a relationship to their experiences. They demonstrate high quality work and professional performance in a task and assessment that has a positive impact to their skills and knowledge.

Master: Students here have an overall mastery of the competency. They understand and demonstrate it in all task related areas of opportunity. They are considered to be role models by others and regularly exceed expectations. Their work is of a very high or exceptional quality and always yields a significant impact. Their performance is tasks and assessments are always signified excellent and perfection has been obtained.

3.2 DIVIDE AND CONQUER

Divide and conquer is a method of problem solving whereby a large problem is broken down into various smaller problems and are solved differently, a combination of the solution to these smaller problems gives the solution to the large problem. The entire learning goal is the large problem here which is separated or broken down into several competencies or processes or levels, the combination of the determined student's competency in each level gives the student competency of the entire learning goal.

Advancement to a next level is achieved if in a previous level the students' competency level is classified Advanced, Competent or Master. The requested skills or competency would be detected for every task of the process, in order to identify the competencies correctly, all activities of the process were described with the same level of details and in order to obtain a homogenous and detailed definition of the student's competency in each activity, considerations were given to the result or output of the activity together with the method, technology and product required to perform an activity.

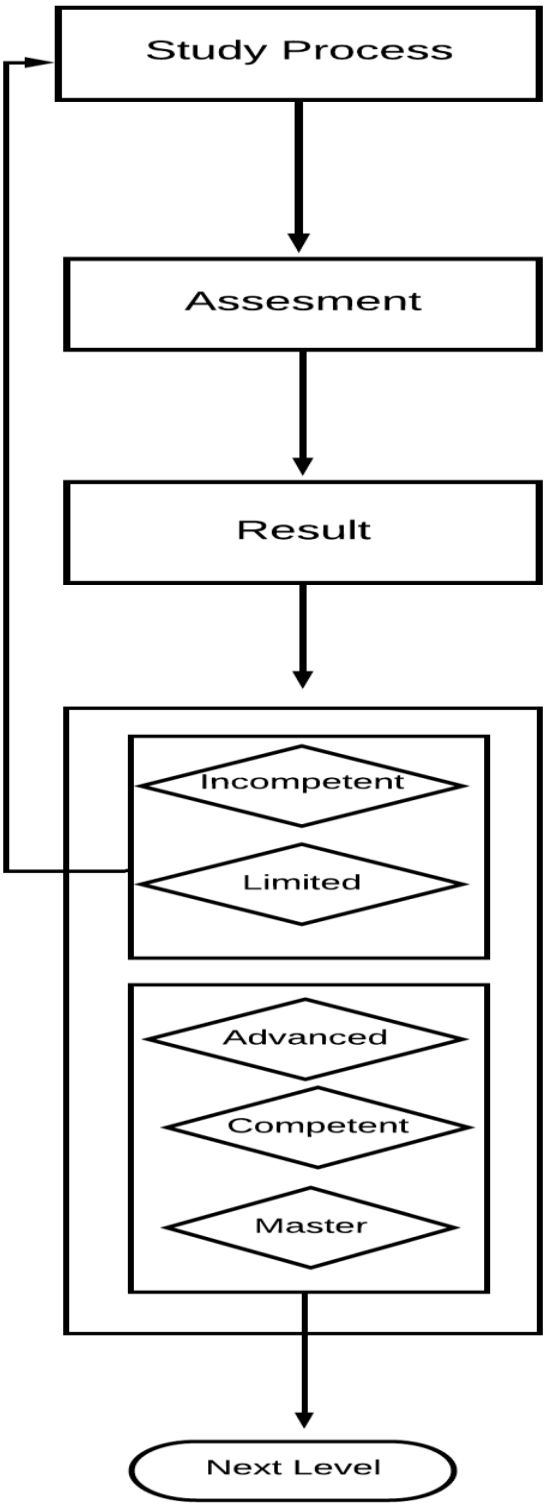

Fig 2.1 – Divide and conquer process model.

The owned competency set C_o is defined as the rates of all the owned competency of a process

$$C_o = f(C_{o(1)}, C_{o(2)}, \ldots C_{o(k)})$$

Where k = number of competencies in a process

$C_{o(n)}$ is determined using assessments, assessment completion time and result accuracy and performance variables which is determined by a percentage unit.

If $0\% \leq C_{o(1\ldots k)} \leq 20\%$ value 1 is assumed

$21\% \leq C_{o(1\ldots k)} \leq 40\%$ value 2 is assumed

$41\% \leq C_{o(1\ldots k)} \leq 60\%$ value 3 is assumed

$61\% \leq C_{o(1\ldots k)} \leq 80\%$ value 4 is assumed

$81\% \leq C_{o(1\ldots k)} \leq 100\%$ value 5 is assumed

Result accuracy and assessment completion time are given in percentage and minutes as units respectively with their benchmark defined as follows for the competency determination;

$b_m(RA) = 100\%$

$b_m(CA) = 60\text{mins}$

Where $b_m(RA)$ = bench mark for result accuracy and

$b_m(CA)$ = benchmark for assessment completion time

However RA determines $C_{o(1\ldots k)}$, therefore;

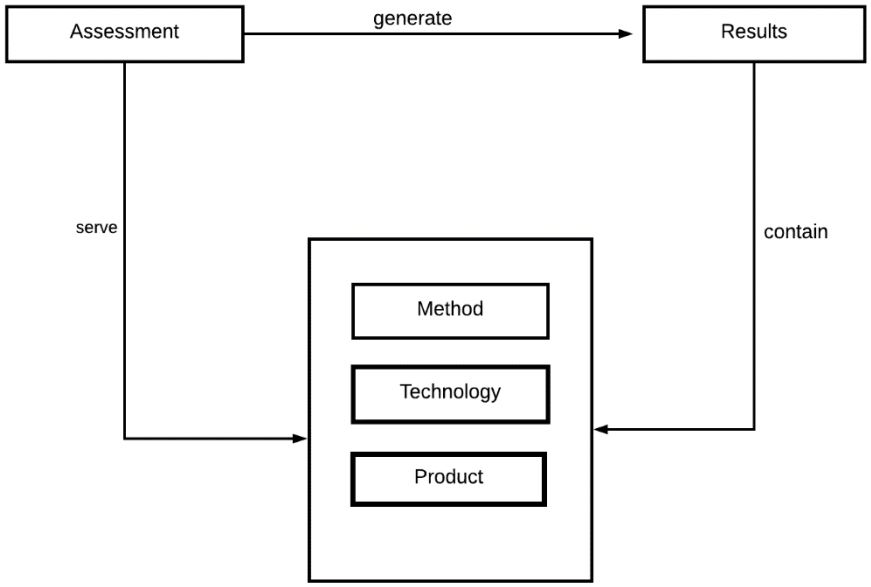

Fig 2.2 - Competency Identification

$C_{o(1\ldots k)}$ = RA

The manager's assessment method of competency determination was adopted as the manager is assumed to be a master of a given competency or learning goal and give assessment based on a perfectly predicted assessment completion time. The assessment completion time is dependent on the strength of the assessment

However the equation $C_{o(1\ldots k)}$ = RA is dependent as RA depends on CA because RA is inversely proportional to CA

$$RA \; \alpha \; \frac{1}{CA}$$

Therefore RA increases as CA decreases. However a graph of RA against CA is plotted for a perfectly increasing competency of an individual as shown below as the competency of a student is always meant to be increasing based on lessons taken

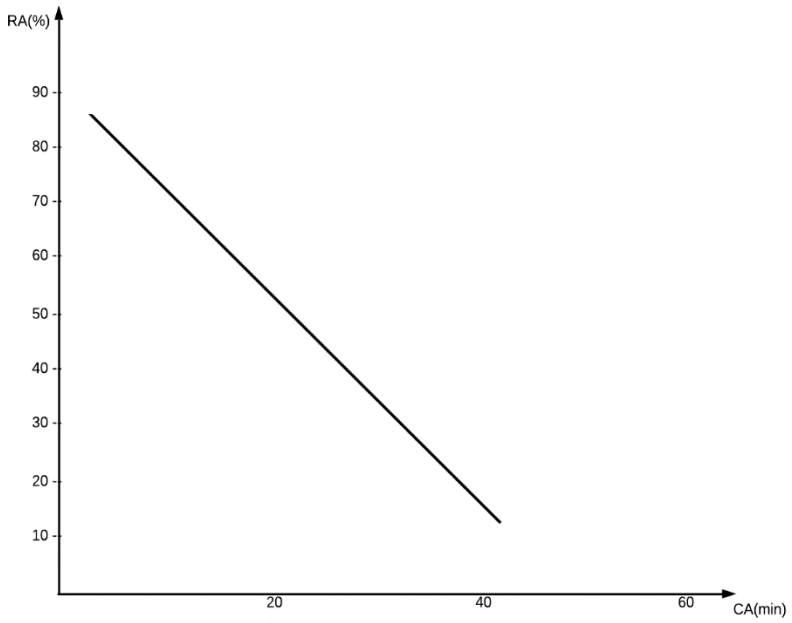

Fig 2.3 – Competency graph of result accuracy against assessment completion time

The line on the above graph would be described as the line of best fit as the result accuracy (RA) as the assessment completion time (CA) may vary for each assessment taken by the student in view. The equation for the line of best fit above would be given by the following derivations. A more accurate way of finding the line of best fit is the least square method for a set of ordered pairs;

$(CA_1, RA_1), (CA_2, RA_2),\ldots(CA_n, RA_n)$

Then the mean of the mean of the RA values and the mean of the CA values;

$$\overline{CA} = \frac{\sum_{i=1}^{n} CAi}{n}$$

$$\overline{RA} = \frac{\sum_{i=1}^{n} RAi}{n}$$

However the following formula gives the slope of the competency line of best fit;

$$m = \frac{\sum_{i=1}^{n}(CAi - \overline{CA})(RAi - \overline{RA})}{\sum_{i=1}^{n}(CAi - \overline{CA})^2}$$

Then computing the RA intercept of the line using;

$$b = \overline{RA} - m\overline{CA}$$

Now the values m and RA intercept, b forms the equation of the line;

$$RA = mCA + b$$

But if RA and CA are given single character variable say R and T respectively, then the equation becomes; $R = mT + b$

Where R = RA = Result accuracy and

T = CA = Assessment completion time

Now given the equation above, the competency of a student can be predicted and however determined depending on the time it takes the student to complete a competency assessment, if it takes much less time for a student to complete an assessment, then a higher competency is assumed for the student.

However since $Co = f(C_{o(1)}, C_{o(2)},\ldots,C_{o(k)})$ then C_o can be determined by taking the mean or average of all the smaller competency $C_{o(1)}, C_{o(2)}, \ldots C_{o(k)}$ therefore;

$$C_o = \frac{\sum_{i=1}^{k} C_{o(i)}}{k}$$

Where C_o is the overall competency of the whole learning goal and C_o is assumed values 1-100% and then values 1 – 5 of the 5-level competency scale.

CHAPTER FOUR

SYSTEM IMPLEMENTATION

System implementation is the development, installation and testing of system components and delivery of that system into production. The purpose of this chapter is to build the system, install it and replace the old system, preparing system, user documentation and train users.

4.0 System Requirements

All computer software needs certain component resources to function and execute effectively. These prerequisites connote the system requirements for this chapter.

4.0.1 HARDWARE REQUIREMENTS

The minimum hardware or physical computer resources requirements of the system are as follows:

- 1.30GHz Pentium M DUO Core
- 2GB RAM
- UPS (Uninterruptible Power Supply)
- Backup Hardware Device
- Network Devices and Internet Connection
- Personal computer (PC)
- 50GB Hard Disk Drive (HDD)

4.0.2 SOFTWARE REQUIREMENTS

This defines the software resource requirements and prerequisites that need to be installed on the computer to provide optimal functioning of the software.

- Operating System (E.g. Window XP and above, Mac OSX etc.)
- JAVA

- JDK (JAVA Development Kit)
- JRE (JAVA Redistribution Environment)
- JDBC (JAVA Database connection) – For Database connectivity
- Apache NetBeans 11.0 IDE
- Cygwin
- Apache Maven

4.1 COMPETENCY PROCESSES

We consider a simple case of competency-based learning in e-learning in platform which covers all the necessary basics of web development. Web development here is a larger learning goal and is however broken down into smaller components namely HTML, HTML5, CSS, CSS3, JAVASCRIPT, PHP, PYTHON, JAVA etc all of which are languages required for a student interested in the learning and skill acquisition of the web dev. Depending on the considerations above, "DeGrande web dev portal v1.0" e-learning portal is developed to offer teaching in web development as a study field however. The portal was developed with the Java Abstract Windowing Toolkit (AWT) and Java swing using Apache Netbeans 11.0 IDE, the latest version of Netbeans. To use this IDE the newest version, Cygwin was required and installed however in a compatible PC with considerable memory properties which enables Linux code or programs to be run on windows operating system, Apache Maven was also installed to enable the actual compilation of the Java programs. DeGrande web dev portal is a competency-based learning portal that test learners' competency or learning achievement after each course learned. The purpose is to ensure that interested learners acquire mastery of each competency or course learned. However, displayed below are pictorial representations or description of this portal which would initiate better understanding for the reader of this study.

Fig 4.1 – Start page of the DeGrande web dev portal v1.0

Fig 4.2a – Competency course content display page

Fig 4.2b – Competency course content display page

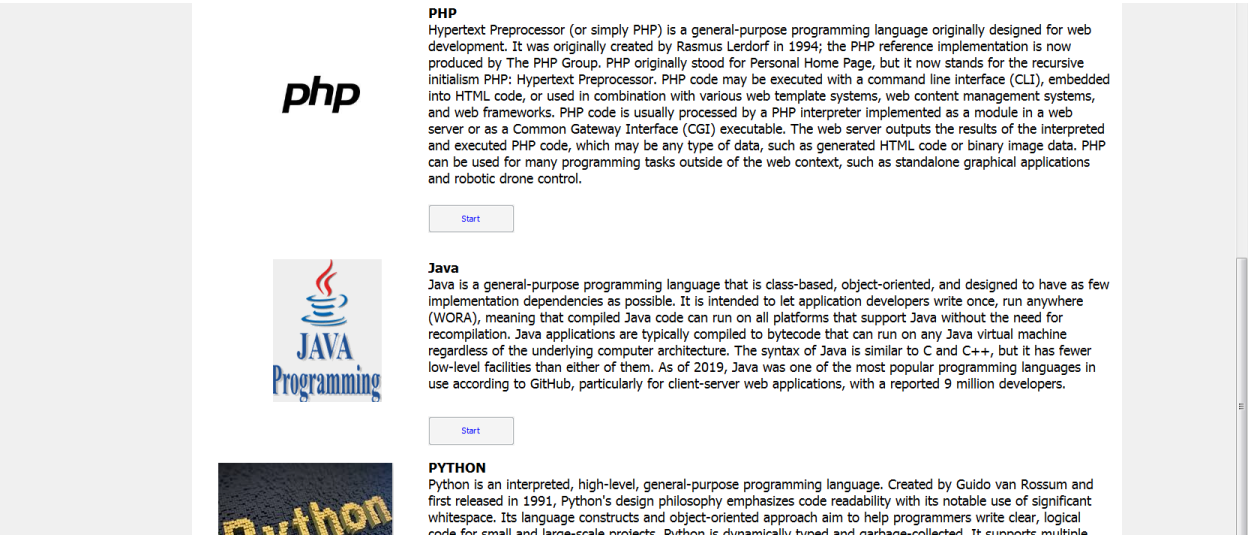

Fig 4.2c – Competency course content display page

Fig 4.1 above shows the start page of the portal and the necessary instructional or guiding information the user need to know, clicking the “continue” button however takes the user to the

competency course content display page which shows all the smaller component web development courses available in the platform. However, it can be recalled that Competency-based learning is an approach to teaching and learning more often used in learning concrete skills than abstract learning or the usual classroom learning. For competency-based learning, *the unit of learning is extremely fine-grained, rather than a course or a module, every individual skill or learning outcome which is also known as competency is one single unit. Learners work on one skill or competency at a time which is likely a small component of a larger learning goal. The student is evaluated or tested on other individual competencies after they have mastered the current skill being learned.*

The above italicized paragraph above however explain the reason why HTML is the only enabled course component for any absolute beginner user of the portal and a comprehensive assessment would be given the user when he is ready to advance to the next component. The user starts study with HTML and then to subsequent competencies as long as the student is determined competent in a previous competency or component, as explained in Fig 3.1 of the previous chapter in this study. Activation of the disabled "start" buttons of all other subsequent competency depends solely on the student's performance in assessment of a previous competency.

4.2 COMPETENCY DETERMINATION TECHNIQUE

The 5 level scale as described in the previous chapter is the technique used to determine student competency level in terms of the student skills and knowledge. The accuracy of the determined students' competency level would be as a result of the several assessments the student may take. A graph of result accuracy (RA) against assessment completion time (CA) as described in the previous chapter would be plotted and a line of best fit would be obtained and however the

equation of the line which would make easy prediction or determination of the student competency level given the assessment completion time of the student (CA).

Although competency as described in chapter 2 of this study can be seen as a function of the knowledge, skills, and attitude of the student as;

$C = f(K), f(S), f(A)$

Where K = knowledge, S = skill and A= Attitude

However in this context we have that;

$f(A) = 0$

as application here is e-learning based and therefore the student behavior can't be used as a judgment criteria. In other words we have that

$C = f(K), f(S)$. And K and S are owned competencies of the student. Therefore we have that;

$C_o = f(K, S)$. But the students skill would depend on the knowledge acquired by the student however we can have that;

$C_o = f(S)$. But since competency is broken into smaller other component here, in other words

$$C_o = f(C_{o(1)}, C_{o(2)},\ldots,C_{o(k)})$$

Where k = number of competencies in a process or learning goal, as described in the previous chapter above.

4.2.1 COMPETENCY DETERMINATION

Assuming for example a student completed the study process of a particular competency say the first, HTML and then is given several assessment as there's no doubt that performance would vary for each of the several times assessment is taken say, six times. If the student obtains values of RA and CA as shown in the table below; RA values are however determined by the manager, as the method of competency assessment used is the manager's. we have;

RA(%)	30	48	60	52	65	75
CA(min)	40	35	28	25	19	15

If the graph of RA against CA of the above is plotted, then we have;

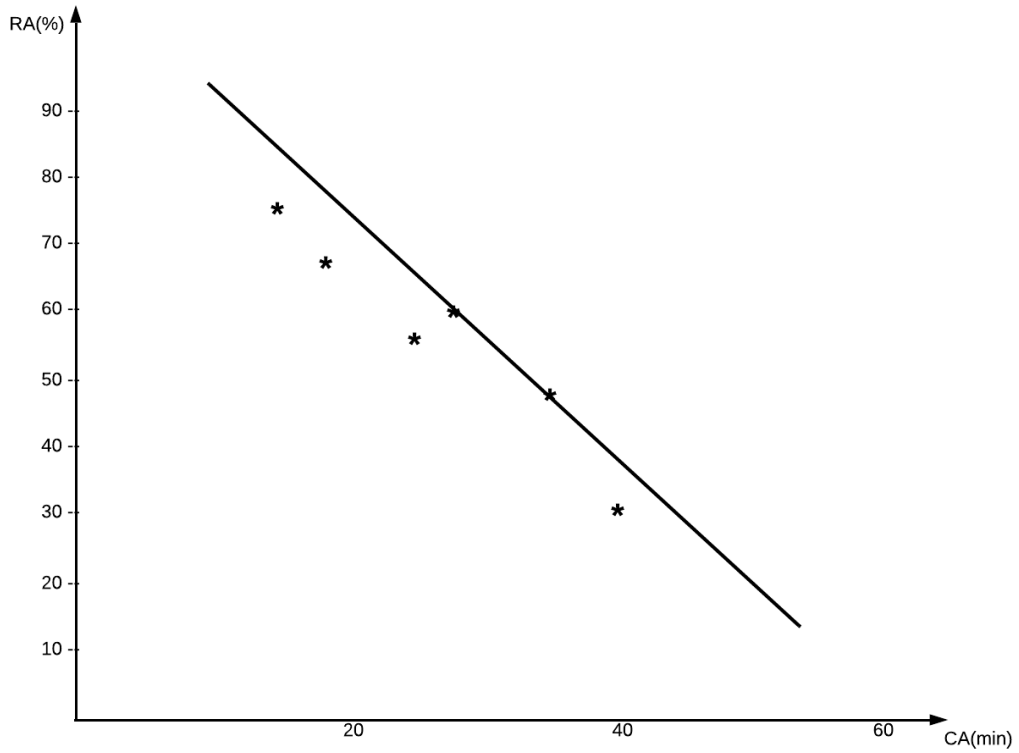

Fig 4.3 – Corresponding graph of result accuracy against assessment completion time

The line of the above graph is called the line of best fit and now we proceed to determine the equation of the line;

R = mT + b; as described in the previous chapter

Where R = RA = result accuracy and T = CA= assessment completion time

However the mean of the RA and CA values would be given as such;

$$\bar{R} = \frac{\sum_{i=1}^{n} r_i}{n}$$

Where n = 6, therefore;

$$\bar{R} = \frac{30 + 48 + 60 + 52 + 65 + 75}{6}$$

$$= 55$$

$\bar{T} = \frac{\sum_{i=1}^{n} t_i}{n}$ where n = 6

$$\bar{T} = \frac{40 + 35 + 28 + 25 + 19 + 15}{6}$$

$$= 27$$

m = $\frac{\sum_{i=1}^{n}(r_i - \bar{R})(t_i - \bar{T})}{\sum_{i=1}^{n}(t_i - \bar{T})^2}$, but in order to obtain m, we need a table of values as shown below;

r	T	r - $\bar{R}$	t - $\bar{T}$	(t - $\bar{T}$)^2	(r - $\bar{R}$)(t - $\bar{T}$)
30	40	-25	13	169	-325
48	35	-7	8	64	-56

60	28	5	1	1	5
52	25	-3	-2	4	6
65	19	10	-8	64	-80
75	15	20	-12	144	-240
330	**162**	**0**	**0**	**446**	**-690**

Having the values above, we can now determine the value of m by substitution of the required values for variables;

Therefore, m = $\frac{-690}{446} \cong -1.55$

Then computing the intercept b on RA using the equation; b = $\bar{R}$ - m$\bar{T}$, however;

b = 55 – (-1.55*27) = 55 – - 41.85 = 96.85.

Hence the equation of the competency line R = mT + b as described in the previous chapter becomes; R = -1.55T + 96.85

Where R = RA = result accuracy and T = CA = assessment completion time.

The above equation however for this particular student can be used to determined or predict the student's competency level in terms of time, the time it may take the student to complete an assessment depending on the strength of the manager's assessment as there would be an estimated completion time by the manager for judgment.

For example, as above equation has been formulated for a particular student given several assessments, on a general, result accuracy may no longer require necessary checking to

determine the student competency level but time alone. If for instance in a final assessment it took this particular student about 17mins to complete the assessment then the student's competency can however be determined as follows;

$R = mT + b$

$R = -1.55*17 + 96.85$

$R = -26.35 + 96.85$

$R = 70.5\%$

However described in the previous chapter is that RA determines $C_{o(1\ldots k)}$ and therefore

$C_{o(1\ldots k)} = RA$ where $C_{o(1\ldots k)}$ represents each competency smaller component of the larger learning goal. Since $C_{o(1\ldots k)} = RA = 70.5\%$ and for $61\% \leq C_{o(1\ldots k)} \leq 80\%$ value 4 is assumed as mentioned in the previous chapter too, it can however be stated that this student is **Competent** and can advance to the next level competency.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

As the findings of this study show the readiness of student to participate in e-learning is relatively moderate, but improvement and the preparation of the student in many ways is essential to implement an e-learning system. One of the appropriate approaches to success in implementing this system includes familiarizing students with the concept of e-learning and the advantages and disadvantages before they enter the e-learning system. Many students entering e-learning know little of the requirements to get to this area. There is a significant relationship between the users of cognitive and metacognitive strategies and student progress in virtual learning. Teaching these strategies from the start of course can influence student performance The rapid development of new technologies requires new set skills from all users in operating, using and maintaining digitized environments. The impact of the competency-based education model upon the educational experience is the most interesting thing, defining experience from the perspectives of both students and faculty. The issue of CBL providing a second-class version of higher education to those who cannot afford the traditional model is trues also of community colleges, but competency-based learning challenges the power that colleges and universities have had over defining college-level learning and knowledge. The equating of college coursework to life experiences – or a student's topical reading list – begs the question of what value college provides, particularly when tuition costs for students are rising. If what happens in the classroom is understood only be measurable outcomes such as employment, the benefits that a graduate enjoys within life are overlooked so that education is reduced to training, no matter the major. However, competency based learning is gaining space rapidly in the global economic sector of education. It seems it has had an organic growth as it aid to solve one important problem or

challenge which is the shortage of individual with competencies demanded by current and future industries. This learning method measures the skills, knowledge and experience the student acquire during a training period. It is focused on results. It ranges from formats in which competencies are taught and evaluated apart from the curriculum, in specific courses, to those in which, to gain the degree, the student must demonstrate solely the know-how acquired. Competency-based learning programs may well represent a viable alternative pathway to a postsecondary degree. Ideally, CBL students would progress at their own pace and demonstrate mastery of important competencies, free from the restrictions of traditional seat-time requirements. This would allow graduates to clearly describe (and provide evidence for) the knowledge, skills, and abilities they demonstrated to earn their degree. Employers could match their needs to candidates with relevant competencies. Practically speaking, though, the credibility of CBL credentials in the marketplace (and therefore the viability of the CBL model in general) rests on reliable and valid assessments. An important aspect to competency-based education is that practice-based learning requires direct supervision and multiple opportunities for the learners to demonstrate their competency in practice over a period of time. Competency objectives must include outcomes, criteria, and performance standards, conditions that are tangible, measurable and relevant.

Implemented effectively, competency-based learning can improve quality and consistency, reduce costs, shorten the time required to graduate, and provide true measures of student learning.

It is required to:

1. Measure student learning rather than time.

2. Harness the power of technology for teaching and learning. Computer-mediated instruction gives the ability to individualize learning for each student. Because each student learns at a different pace and comes to college knowing different things, this is a fundamental requirement of competency-based learning

3. For traditional education fundamentally change the faculty role. When faculty serve as lecturers, holding scheduled classes for a prescribed number of weeks, teaching takes place at the lecturers' pace. For most students, this will be the wrong pace. Some will need to go more slowly; others are able to move faster. Competency-based learning shifts the role of the faculty from that of "a sage on the stage" to a "guide on the side." Faculty members work with students, guiding learning, answering questions, leading discussions, and helping students synthesize and apply knowledge.

4. Define competencies and develop valid, reliable assessments. The fundamental premise of competency-based learning is that we define what students should know and be able to do, and they graduate when they have demonstrated their competency. This means defining competencies very clearly.

People learn at different rates and in different ways, so a handful of demonstrations or activities may be sufficient for one learner to demonstrate competence while the same level of performance of this skill with another will require much more to meet the same learning outcome. This understanding of the learner and learner needs is the primary reason why competency-based education may include direct observation of competency demonstration over time and the clear definitions and classifications of learning outcomes and objectives.

A useful starting point in drawing on the concept of competence is to decide whether it is appropriate to conceive of the field of interest as a competence rather than, say, knowledge. The example used throughout this paper illustrates this, given that a person engaged in web development learning should not merely acquire knowledge but also the capacity to apply what has been learnt. The competence of interest may then be conceptualized in terms of its structure and levels, keeping any dimensions specific and clearly defined so that they can be empirically tested in relevant situations. However, this leaves open the question of whether all learning in school can usefully be conceived of as aiming to acquire competence, as opposed to knowledge. It seems to me that this is not obviously the case for all the areas of study which currently form the content of school teaching and learning.

Many students appreciated the ability to follow their interests and take responsibility for their learning, while others had difficulty adapting to a system that didn't have the instructor as the central focus, telling students exactly what they need to know. Further, the idea of learning for mastery, in which students don't pass until they demonstrate acceptable work, was a challenge for most students.

On another note, any form of the competency-based learning (its forms are regularly updated, which is a key feature of such method) is dynamic kind of education or learning opposed to

statistical methods of the non-competency-based approach. The competency-based approach intensifies significantly the possibilities and facilitates the orientation process for learners at the practice of their future activities or interest, at strategic and operational side of expected educational outcome. In other words, skill orientation of the competency-based approach is actually an integral way of considering the educational phenomenon itself within objective goals stated by the modern world and set for young specialists. Moreover, the competency-based education is a humanistic trend that may refer to a professional competence along with a personal or social one of specialists, citizens, individuals.

In my opinion, in spite of the fact that the competency-based education implies a certain risk relating to decrease in directional functions of a teacher and increase in student's control, only this approach can result in high manifestations of competent activity as only competency-based higher education implies reduction of negative psychological effects of the learning process, integral development of professional and social skills of a student and as a result, it can significantly accelerate the speed and quality of preparedness and development of a skillful specialist for efficient working activity.

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