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A multi-agent based model for self motivated learners: self study tool

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Abstract

The formal education system in Kenya is faced with many challenges such as shortage of resource persons essential for the rapidly changing and more diverse economy. This sector is also faced with the challenge of limited access to knowledge and learning opportunities. There are cases of learning disparities among learners and when they are unable to cope they opt to dropout. To increase access to knowledge and learning opportunities this study explores the potential of self-study as a tool to improve access and ensure quality of education for all.

Keywords

Formal education, Informal sector, Multi-agents, Access.

1. Introduction

The education sector in Kenya is charged with the responsibility of creating a knowledge-based society that upholds justice, democracy, accountability and encourages issue-based and results-oriented activities. Integration of Science, Technology and Innovation (STI) in national productive processes is considered crucial in the Kenya Vision 2030 for meeting the demands of global economic competitiveness and sustainable development. Development of scientific and technological infrastructure, as well as the technical and entrepreneurial skills is a vital requirement towards transforming Citizens into a knowledge-based society. A recent study by Ojiambo [1] stresses that education is an essential tool in the development process of any nation.

With the recognition of this noble role the Kenyan Government has spent a lot of resources on education to improve both the access and quality of education, in an effort to achieve the education related Sustainable Development Goals (SDGs). But despite this enormous investment the education sector is still not able to meet the demand for education and so has been its impact on national development.

According to Ojiambo, [1] since education is a central component of any nation‘s development learners should be transformed into problem solving agents. Also World Bank report indicates that youth account for approximately 60% of the unemployed in Kenya, and that 72% of adolescents in Sub-Saharan Africa live below the “$2 a day” poverty line [2]. This calls for the education system to present knowledge, skills such as creativity, flexibility and independence among learners. This will transform them to successful thinkers able to understand current problem complexities and solve such using innovative solutions. Wainaina, [3] in his study reported that there has been a rapid expansion of programs in universities today and they are endangered by various socio-economic circumstances given drive by globalization forcing universities to transform in an effort to increase their capital base in the face of consistently decreasing capitation by the government.

These challenges can be addressed by adopting innovative techniques to increase access to knowledge and learning opportunities. In this regard this study proposes a self-study tool to increase access to knowledge and also optimize scarce educational resources.

2. Problem statement

Demand for university education in Kenya is on the rise and competition for access grows every year as new sets of candidates complete their secondary

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education. In addition to this there is need for new skills at workplaces which necessitates further education and training and this adds more pressure to the inadequate opportunities in our universities. Nevertheless Vision 2030 is relying on the education sector to provide the skills required to steer Kenyans to the economic and social goals of this vision. Formal education is limited and it cuts out many people, who cannot qualify due to poverty as shown by global education fund where children are forced to drop out of school to provide for the family, girls are forced into early marriage and motherhood to raise their siblings.

Formal education is also expensive and most people in need of education cannot afford. Adoption of a self-study tool can provide access to knowledge and learning opportunities to these people at whatever stage in life to compensate for the chance they lost.

3. Objectives

The following are the objectives of this study:-

1. Find out to what extend knowledge is accessible
2. Assess the learners' readiness in terms of access to internet , ownership of laptops or smart phones
3. Make recommendations on effective adoption of self-study to increase access to knowledge and learning opportunities

4. Methodology

This study adopts a descriptive survey and it involves use of structured interviews. The interviews were conducted on secondary school leavers' mostly domestic workers and informal sector workers. The study was interested in finding out to what extend knowledge is accessible to these people, if they have access to internet, and if they own laptops or smart phones.

4.1 Population Sampling

Data for the study was mainly drawn from respondents in Nairobi County due to the fact that Nairobi is the country's economic hub and most people leave their rural homes to Nairobi in search of Job opportunities.

Table 1: Population Sampling

Population Sampling			
Category	**Population**	**Sample**	**Percentage %**
Domestic Workers	50	36	72
Informal Sector workers	50	39	78
Total	**100**	**75**	

5. Findings

5.1 Respondents Status

Out of the 36 domestic workers interviewed 28 (78%) had cleared secondary school and had a great desire to pursue higher education. With their Kenya Certificate for Secondary Education (KCSE) grades most of them could qualify for technical education and later advance their education. But due to poverty their parents could not afford to pay their higher education fees so they were forced to look for domestic work to support their siblings and make little savings in an effort to pursue their dream in future. As time goes by they feel they can not fit in the formal education system and end up abandoning their dreams all together.

In the Informal sector some of the workers are secondary school leavers, while others are standard eight leavers. Some especially small business owners have some form of technical education either at certificate level or diploma levels. But due to limited job opportunities they opt to start their own small businesses. 26 out of 39 (67%) desire to pursue higher education but they claim formal education is too costly and they cannot afford.

5.2 Access to Internet

Some of the respondents access internet in the cyber cafes during their free time either in town centre or in the estates where they live in. The cost of internet access has really gone down and currently internet charges on average are 1 Kenya Shilling per minute which is reasonable. The respondents reported that they can also access internet on their phones since most of them own smart phones and the leading mobile providers in Kenya have provided variety of affordable data bundle plans. Some domestic workers indicated that in the households where they worked there was unlimited internet access and it is possible to have internet access during their free time.

6. The Self-study Process

Self-study is also known as Self Directed Learning (SDL) and Knowles [4] defines SDL as "A process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating their learning outcomes p.18". Brockett and Hiemstra [5] defines SDL as "The process where the learner assumes the primary responsibility of planning, implementing, and evaluating the learning process p.24"

Self Study continues to meet many challenges associated with keeping up to date with the dynamic knowledge. Giving learners some learning responsibility is more advantageous than the formal education approach because they are in control of their study and can learn at their own convenience as reported by Hiemstra [6].

7. Overview of Multi-Agent Systems

7.1 Multi-Agent Systems (MAS)

Multi-Agent System is a branch of Artificial Intelligence. A multi-agent system (MAS) is a system of intelligent agents which interact with one another through cooperation, competition, coordination or negotiation usually to accomplish some goal [7]. MAS consist of a number of agents, which interact with one another, typically by exchanging messages through a computer network infrastructure [8]. In order to successfully interact, agents operate in a multi-agent system (MAS) where they can cooperate, coordinate, and negotiate with each other the same way that humans cooperate, coordinate, and negotiate with each other in everyday lives [9].

MAS is preferred to develop the Self-Study tool because of the following benefits:-

1) Ability to solve complex problems which for a single agent could result to performance bottleneck
2) Ability of the agents to interact in their society making load balancing easy to implement
3) Multi-agents systems are suitable in situations where expertise is distributed and diverse.
4) Enhanced performance through parallelism which increases speed and efficiency in execution of tasks.
5) Multi-agents systems are robust and reliable, flexible and scalable

7.2 Agents

Russel and Norvig, [9] describes an Agent as anything that can be viewed as perceiving its environment through sensors and acting upon the environment through actuators. Agents are characterized by the following:-

1) **Autonomy**–agents are able to act independently and exercise control over their internal state.
2) **Reactiveness**–ability to react and interact with its environment that is responding to changes as they occur.
3) **Proactiveness**–ability of agents to generate and attempt to achieve goals due to their own initiative for example as a result of recognizing opportunities.
4) **Social Ability**–Agents are able to cooperation, negotiation, communicate etc. when working to achieve their goals.
5) **Learning/adaptation**-Agents can improve performance over time.
6) **Personality**–Agents have distinct personality behavior, name, and role.
7) **Mobility**-Ability to move around network platforms.
8) **Veracity**-avoid communicating false information knowingly.

8. Related Work

8.1 A personalized mobile learning system using Multi-agent

According to Ko, Hur and Kim, [10] this is an English Learning System which can be used without any restriction by making use of popularized cellular phones. The system consists of three main agents for the server and a client and three databases for personalized service as shown below:-.

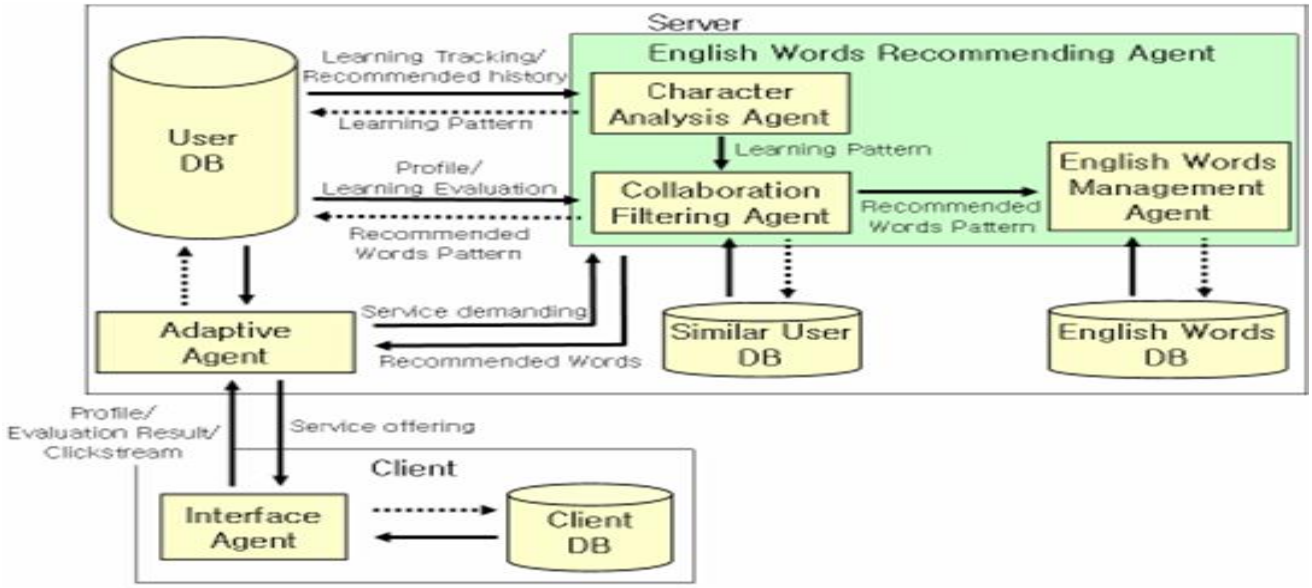

Figure 1: Multi-Agent System Structure for English Words Learning System [10]

The Interface Agent classifies clients who access the server and offers a personalized service to them. The English Words Recommending Agent enables learning based on levels using the information of users and it consists of:-

i) The Collaboration Filtering Agent compares and analyzes the user with the user group with similar characteristics to the user based on his profile and learning pattern. Then, it recommends an English words pattern suitable for him.
ii) The Character Analysis Agent analyzes the English words learning tracking and recommended history of the user and recommends a suitable English words learning pattern for the user.
iii) The English Words Management Agent is in charge of the management of the English Words Database including the classification of English words suitable for the user.

The third agent is the Adaptation Agent which updates the User Database through the learning results of the user. It changes the User Database using the feedback on learning evaluation results or click stream through learning or evaluation of the user on the client. Then, it stores the adaptive user information in the User database. On the server side, there is a User Database and an English Words Database. On the client side, there is a Client Database. The Client Database stores the English Words Learning System setup information and downloaded English words form the server.

8.2 An adaptive e-learning system

An adaptive e-learning system based on multi-agent technology using a distributed intelligent blackboard agent, which provides an easy way for agents to communicate, collaborate, and coordinate their actions and resolve conflicts (Hammami and Mathkour, [11] . This system has the ability to be adaptive to the learner's preference and needs and also allows teachers to advice their students. The adaptive system adopts a distributed intelligent blackboard agent that ensures the communication among participating agents.

9. Development

9.1 Architecture of the Self-Study Tool

The Self-Study tool will have a central knowledge base and it will be composed of two intelligent agents namely:-

i) **Administrator Agent:**-This agent facilitates all the administrative tasks of the tool such as creating the knowledge base and organizing the knowledge
ii) **Technical Support agent**:-This agent will offers technical support to the system users

and also ensures users' requests are channelled to the right respondents

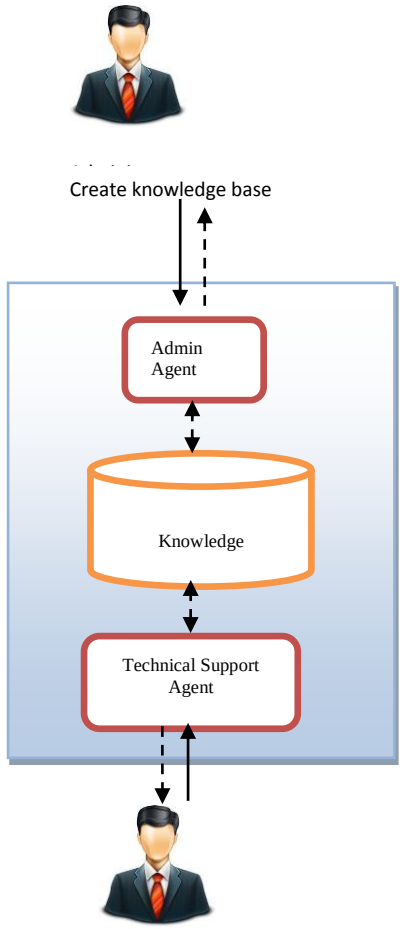

Figure 2: Self-study tool architecture

9.2 Model of the Self-Study Tool

This study proposes a web based model for self-study tool, which can be accessed by the learners easily as long as they have internet access. The Administrator of the self-study tool will create the knowledge base and categorize it according to the knowledge domain areas. Self-motivated learners are expected to register and choose the area they would like to study. Once they are registered they will be able to access the self-study resources and learning content in their area of study.

If they face any challenges the technical support agent will assist them by answering their questions or giving them directions when they get stuck.

10. Potential Benefits of the Self-Study Tool

The Self-study tool will improve access and quality of education for many and as a result steer Kenyans to the economic and social goals of Vision 2030. It will also offer learners flexibility to learn at their own convenience despite busy schedules or age limit. Self-study will also empower learners with skills such as creativity, flexibility, independence and cognitive abilities which will transform them to successful thinkers. Skilled citizens will result to increased employment opportunities since some of them will become job creators for others and this will in return reduce poverty and improve the standards of living.

Despite the many potential benefits of the Self-study tool there are some implementation requirements which could be costly. For example, there is need to partner with a body like Kenya Institute of Curriculum Development (KICD) or an Institution of higher learning to help in curriculum development for the target groups, or the Kenya National Examination Council (KNEC) to address the assessment and certification of the learners. There is also the need to host the Self-study tool in an environment where there is a stable, secure and reliable network infrastructure to ensure fault tolerance and guarantee availability. Enough bandwidth is also another requirement to ensure fast concurrent access by the learners.

11. Motivation and Impact of The Study

This study focuses on empowering the less privileged in the society by facilitating access to knowledge and learning opportunities. The Self Study tool entails various activities and resources and it will also enable learners to assess their learning outcomes which will make them develop confidence in their own abilities and become more goal-oriented as they enjoy their learning. Self-study also improves learners cognitive abilities such as problem solving and also enhance encoding and retention of learning content [12].

12. Conclusions and Recommendations

With Self-study learners will be able to take responsibility for their decisions associated with the learning endeavor. The Self-study tool will increase access to knowledge and offer quality education to many despite poverty and age. Self-study will also offer flexibility and independence to learners'. In that regard this study recommends adoption of the self-study tool to bridge the gap and meet the need of those who desire to pursue higher education later in life. There is also need for further research on the best way to develop and implement the tool in terms of knowledge creation, assessment and certification of the target groups.

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