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Multi-Agent Adaptive e-Learning System Based on Learning Styles

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Abstract

Most traditional e-learning system fails to provide the intelligence that a learner may require during their learning process. Different learners have different learning styles but the current e-learning systems are not able to provide personalized learning. In this paper, we discuss how intelligent agents can aid learners in their learning process. Three agents have been developed namely, learner agent, information agent, and tutor agents that will be integrated into a learning management system (Moodle). Learners are provided with a personalized recommendation based on the learning styles.

Keywords: personalized feedback, Moodle, intelligent agents, learning styles, recommendation.

1. Introduction

Following the advancement of technology, instructors and learners are currently leaning towards e-learning systems/applications for learning purposes. The traditional learning model usually provides a lot of learning materials for all the students despite that they have different learning styles, preferences, and interests (Hosni et al., 2020). Learners have various ways how they learn and acquire knowledge (Balasubramanian & Margret Anouncia, 2018). Some students dwell on data and algorithms, others prefer theories and mathematical models to understand. Some students understand better with pictures, diagrams, and all visual forms, others are better with verbal form and spoken explanations. Besides, some students like to learn actively with groups while others prefer learning individually (Lakkah et al., 2017). Furthermore, individual differences among learners have a significant impact on their learning outcomes. Various researches have indicated that provision of the same learning resources and using the same instructional conditions to all the learners lead to reduced performance without the consideration of the different background features, prior knowledge, and learning outcomes (Wu et al., 2018).

In the physical classroom, the instructors ought to understand the preferences and learning styles of the learners they teach. This might be a very difficult task for them to understand the learning styles of all the students. With the advancement in technology, this is possible in

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virtual classrooms through the use of adaptive e-learning systems. For instance, the use of agent technology seems to be the key method for addressing this challenge. The use of intelligent agents makes it possible to achieve a robust system that caters to the needs and the preferences of the students which provides adaptability and intelligence to the e-learning system through the use of the utilization of agents (Nadrljanski et al., 2018).

In this paper, we propose the use of intelligent agents to achieve adaptive learning through the identification of the student learning style using the VARK Learning style model. Adaptive learning will be through the provision of learning materials whereby intelligent agents provide the students with learning materials that match the student's learning style.

2.0 Literature review

This section reviews literature on the various learning style models, personalized e-learning, adaptive e-learning, some literature on intelligent agents, and also how intelligent agents can support adaptive e-learning.

2.1 *Learning style models*

Numerous researchers have proposed various meanings of learning styles. For instance, Chick (2016) defined learning style as a way of describing how learners are involved in gathering, sifting through, interpreting, organizing, and coming to conclusions, and storing information for further use. Jaleel and Thomas (2019) define learning style as the concept that people differ regarding what mode of instruction or study is the most effective for them. According to Kumar et al (2017) learning style is the most favorite approach that a learner uses to learn. They also described it as a characterization of attributes, qualities, and preferences that people gather, memorize and execute information.

Numerous learning style models exist that are used by pedagogical experts in the provision of adaptivity in e-learning. Over seventy learning style models exist but the most adopted are the Felder-silver model (Zagulova et al., 2019), Kolb model (McLeod, 2017), Honey-Mumford (Kumar et al., 2017), Myers-Briggs Type Indicator, and the VARK model (Imran Hussain, 2019), as discussed in Table 1 below.

In this paper, we use the VARK model to demonstrate how the learning style of a student can be identified and apply intelligent agents to provide adaptive materials as per the student learning style. We chose the VARK model as the basis for adaptive e-learning because of various reasons. It has been accepted by specialists and is also appropriate for most educational systems. It is also user-friendly and also very easy to understand the results (Daoruang et al., 2018). Furthermore, it is mostly based on the personality type of an individual (Kumar et al., 2017) which suits our case as we are interested in the learning characteristics (learning style) of the students. The VARK model dimensions are described in Table 2.

Table 1. Summary of most adopted learning style models

Learning Style Model	Learning Style Dimensions	Description	Learning Style Instrument
Felder Silverman Model	Active /reflective	Active learners are more inclined towards learning in groups and being correspondent to one another. Reflective learner likes to think and reflect about their ideas. They opt to work on their own and are not excited to learn in correspondence with the other learners.	

	Visual /Verbal	The visual learners remember best what they see, for instance, illustrations, graphs, images, or diagrams. They use the mapping learning idea and usually take shady coding notes. Verbal learner collects more from words and talks clarifications of illustrations and graphs listen to their classmates and takes notes.	Index of Learning Styles (ILS)
	Sequential/ global	Sequential learners' study in straight spaces and with consistent little incremental paces to discover arrangements. Global learners are dependent on holistic thinking and bounce to expansive paces. They prefer irregular learning material and, in the process, discover the best way to solve complex problems.	
	Sensory /intuitive	Learning here through sensory or Visual thinking with an orientation towards the facts and concepts in exchange for abstract thinking and orientation towards theory and beyond.	
Kolb model	Converging	A student usually depends on theoretical conceptualization and dynamic experimentation.	Learning Style Inventory (LSI) Revised Inventory
	Diverging	Students focus more on concrete experimentation and reflective perception.	
	Accommoda ting	Learners focus on concrete experimentation and active experimentation. Prefer performing assignments, plans and getting involved with new thoughts and are great at adjusting to changes in circumstances and taking care of problems intuitively and experimentally.	
	assimilating	Learners prefer abstract conceptualization and reflective perception. They like inducing ideas and hypothesizing models and are more concerned about the thoughts and theoretical ideas than with the individuals and believe that thoughts are intelligently solid than handy.	
Honey & Mumford Model	Activist	They learn by doing and usually have an open-minded method whereby they prefer a diverse task to learn from experience.	LS Questionnaire (LSQ)
	Reflector	They learn intuitively and by watching scenarios. They prefer to study from new experience, analysis and making reports.	
	Theorist	They learn and understand learning resources as per their setting like models, ideas speculations, and certainties while keeping their goals in mind.	
	Pragmatist	They find opportunities for implementing what they have learned and prefer experiments, trying out new ideas and theories from experts.	
Myers Briggs Types Indicator	Perceive/ju dge	Judging leaners are conclusive, arranged, and self-controlled. They concentrate more on completing their tasks/assignments Perceiving learners are interesting, versatile, and unconstrained. They prefer to begin with assignments to know everything about their undertaking.	Myers Briggs Types Indicator (MBTI)
	Sense/intuit ive	Intuitive learners find out examples and also connections among the realities which they have assembled. Sensitive learner favors how they consume data in original universes.	
	Think/feel	They focus on how individuals react to a situation and also how they deal with the external world.	
	Extraversio n/introversi on	Introversion learners focus on ideas, concepts, and abstractions Extraversion learners prefer actions and interacting with the others.	
VARK (Visual, Auditory, Read/Write, Kinesthetic)	Visual	Visual learners prefer to use figures, pictures, and symbolic tools such as graphs hierarchies models, and arrows which represent printed information.	VARK Questionnaire
	Auditory	Students prefer to listen rather taking down notes from lectures and engages in a discussion of the taught topics with other students.	

	Read/write	Learners lean toward printed words and text to acquire information.	
	Kinesthetic	Learners learn best by doing. They are inclined more to hands-on experience and preferences not to watch or listen and generally do not do well in the classroom.	

Table 2. VARK model categories/dimensions with the various teaching strategies and learning objects

Learning style dimension	Teaching strategy	Learning object
Visual	Images/diagrams, charts, slides posters, videos, poster, graphs, mind maps	Video PowerPoint slides
Aural/auditory	Topic discussion, talk thoughts, remembering stories, recording notes	Presentation slides with audio, audio videos, and recorded notes
Read/write	Headings and Lists Written notes Definitions and text manuals	PowerPoint slides Text documents
Kinesthetic	Doing practice tests Experimental methods	Practicals Hand on exercise

2.2 *Personalized e-learning*

Personalized e-learning involves customization of the e-learning so that the specific needs of the learners are met (Pandey, 2017). This personalized e-learning can be provided by determining the basic level options of the learners, managing the various learning styles of the learners (Zagulova et al., 2019), customizing the learning path which has various option include role selection whereby the learner chose the appropriate path instead of having to go through the entire content, through pre-assessments which is determined by the performance of the learner and lastly through surveys thereby a learner choose their area of interest (Pandey, 2017). Personalizing e-learning enables the learners in setting their own goals, setting manageable milestones, selecting their learning path, taking learning at their own pace, selecting the kind of interaction level that they feel is relevant, getting personalized feedback, and using it in assessing their progress and using the recommendation offered to them to enrich their learning (Pandey, 2017).

2.3 *Adaptive e-learning*

An adaptive system refers to a system that automatically adapts to the learners on the basis of its assumption about the learner. This means that the systems must be flexible to the needs and also the characteristics of the learner (Leka et al., 2016). The key thing to consider when building an adaptive e-learning system is determining which learner characteristics to make adaptive to come closer to the learner demands which is an important factor indicating its success. Various adaptivity parameters are considered when developing adaptive e-learning systems including learner knowledge, learning styles, cognitive abilities, and learning behavior and motivation. Learning resources and adaptive learning are significant in the subject of the learning process of every learner (Diaz et al., 2018)

Adaptive e-learning systems are the new trend in e-learning whose goal involves the personalization of learning material and their sequences in matching the needs of the individual student as close as possible. These systems combine the student features like learning styles, affective state, and knowledge level to provide personalized services and recommend the appropriate learning materials to the student. The main challenge with designing these systems is identifying the student needs or features that need to be adaptive (Leka et al., 2016).

The approach of adaptivity is dependent on the idea that learners can study more effectively provided with the learning materials per their learning style. Many people have different learning styles and thus adaptive e-learning is another form of e-learning that satisfies the needs of each individual in learning. To ensure effective learning for all learners, adapting teaching strategies and content that meet the individual learner is termed as the central and persistent issue in the learning process. In contrast to difficulties in identifying the individual differences in traditional classroom settings, adaptation to different learners is easy in e-learning environments. This is due to the advancement in educational technology through the provision of powerful tools for the implementation of adaptive systems for determining the learners' needs in their learning process (Wu et al., 2018).

2.4 *Intelligent agents*

Artificial intelligence provides the facilities for the creation of intelligent agents which have intelligent behavior which can act as human whereby each intelligent agent is able to understand its environment by sensors and act upon the environments by actuators (Oskouei et al., 2014). According to Xu, Huang and Heales (2014), an intelligent agent is a program that can accomplish repetitive and expectable missions. Intelligent agents have various characteristics like autonomous, they can learn/reason, they are reactive and goal-oriented, communicate with each other, cooperate and they are mobile as discussed: (i) Autonomous – an intelligent agent senses its environment and act based on its perceive and knowledge obtained from the environment and the rules provided by the designer. This means that each agent has control over the task that is done on their own. (ii) Learn/reason – intelligent agents have the ability to learn experiences and use those experiences in the adoption of their behavior in the environment. (iii)Reactive – Every intelligent agent reacts based on the information that they get from the environment. (iv) Goal-based – intelligent agents have some goals on the basis of the information they have from the environment as it attempts to achieve those goals. (v) Communication – every agent has to interact with the environment for instance humans or other agents to achieve their goals. (vi) Cooperation – when working on complex tasks they need to cooperate with the other agents to increase their abilities in order to achieve their goals and do the task easily. (vii) Mobile – an intelligent agent can navigate with electronic communication networks.

 Numerous e-learning platforms do not provide better support thus smartizing these platforms by use of intelligent agents can be a solution to this problem by playing an important role in e-learning (Fasihfar & Rokhsati, 2017). Intelligent agents make a decision automatically without the need for user intervention and also assist users in communicating with computer programs in an efficient manner.

Many researchers find agents as entities that act in a collective manner with other agents thus a multi-agent system is used. A multi-agent system refers to a collection of independent entities which are known as agents that communicates and interacts with each other for the purpose of resolving a problem by completing certain goals. These agents are constantly in communication and are either homogenous or heterogeneous and they may or may not have common goals. The utilization of the multi-agent method in an adaptive e-learning system improves the quality of the learning process through customization of the contents to meet the learners' needs (El Fazazi et al., 2021).

2.5 *Intelligent agents and adaptive e-learning*

Adaptive e-learning systems focus on the adaptation of the courses to ones' learning characteristics. Many adaptive e-learning systems provide adaptivity at the course level through the generation of adaptive content activities and assessments that satisfies the needs and

preferences of the learners (Kolekar et al., 2019). With the advancement of technology, determining some of the learning features of the students like learning style is made easy. For instance, the use of intelligent agents enables automatic detection of learning styles in adaptive systems that support individual learning and also the provision of customized learning as per the student preferences. This in turn boosts the e-learning process making it easy for them to improve in their learning progress.

Numerous adaptive e-learning frameworks are dependent on multi-agent concepts. Intelligent agent characteristics like autonomous, proactive, and cooperative improve the level of the learning process by customizing the needs of the learners. The use of intelligent agents in intelligent tutoring system is very significant as it brings study environment near to the learners and also bring out the studying aspect of humans than any methods of learning (Alexandru et al., 2015). An adaptive e-learning system includes components that generate a process of teaching and learning that cater to the learners' needs and preferences. It is a challenge to adapt learners' needs in e-learning systems as studying is made easy when a learner is engaged in looking for a solution to real problems, activating acquisition of advanced knowledge and the usage of the currently acquired knowledge to provide a solution to problems and also use it their daily activities. Therefore, the process of gaining the knowledge must be strengthened to include flexibility and understand the needs of the learner (Alexandru et al., 2016).

Intelligent agents can be used to understand and capture the needs of the learners like their knowledge, learning styles, cognitive abilities, and learning behavior and motivation thus enabling the provision of adaptation in the e-learning system. This paper provides an adaptive solution by identifying the learning style of the learner using the VARK model with the help of intelligent agents. The next section discusses the methodology which captures the system architecture and the implementation, prototype testing, and lastly conclusion and future work.

3. Methodology

The study adopted Prometheus methodology because of the nature of the system as well as its rigor it employs for evaluation, concentrated design, and development phase. In relation to the study, the following are the processes adopted in the design of the system as indicated below:

- System specification/problem identification – this phase involved determining the learning style of the students since every learner has different styles when it comes to how they consume information. They also have different preferences and characteristics hence they need to have different approaches when it comes to learning

- Architectural design – Developing three agents including tutor agent, learner agent, and information agent to aid the students in their learning process

- Detailed design and testing phase-this involved determining how the three agents interact and communicate with each other for the appropriate outcome and also integrating them into Moodle to determine their results.

3.1 *The system architecture*

The first step in providing adaptivity is dependent on identifying the learner's style through the VARK model. Once the students login in, they administer the VARK questionnaire to capture the learning style of each learner. The learner should know their responses and the impact of their answers. This is to ensure that there is a guaranteed accurate response in the

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questionnaire. The responses are stored in the system which is used to determine the resources that match their learning style. The recommendation of the learning materials to learners is based on their learning style. Adaptive e-learning is upheld through the provision of learning materials that correlate to the learners' goals and their style of learning. Upon the expression of learners learning achievements as well as their learning style, the learner agent will look for the content from the repository/database. For instance, if the student is read/write, the system will recommend to the learner content in a link in form of pdf, presentation slides, textbook, or lecture notes.

Various links (presentation slides lecture notes, videos, slide player) were collected from the web to train the deep neural network which was integrated into the learning agent. A programming course was chosen (C language) whereby four topics including arrays, functions, data types, and control structures were applied to provide data for training.

Our system suggests a multi-agent adaptive learning system depended on the learning style of the student. In the architecture, the three agents are integrated into Moodle backend where the learner information is retrieved from the database. Once the student logins in, they are subjected to the VARK questionnaire where their learning style is captured by the learner agent and then stored in the Moodle database. The tutor agent communicates and interacts with the other agents, i.e., the learner agent and the information agent whereby it coordinates the learning in the system. First, it has the details of the students (student profile) such as the name, user id, and their learning style since it has access to the Moodle database. Once the study student starts learning it check what the students' accesses such as the module/topics uploaded, assignments and forums. It then communicates this information to the learner agent. The learner agent which has been integrated with artificial techniques using deep neural network recommends the most appropriate materials for the student based on their learning style. After the learner agent determines the most appropriate material for the student it communicates this to the tutor agent which in turn communicates this information (recommended materials/resources) to the information agent. The information agent then displays the feedback to the learner through the Moodle user interface.

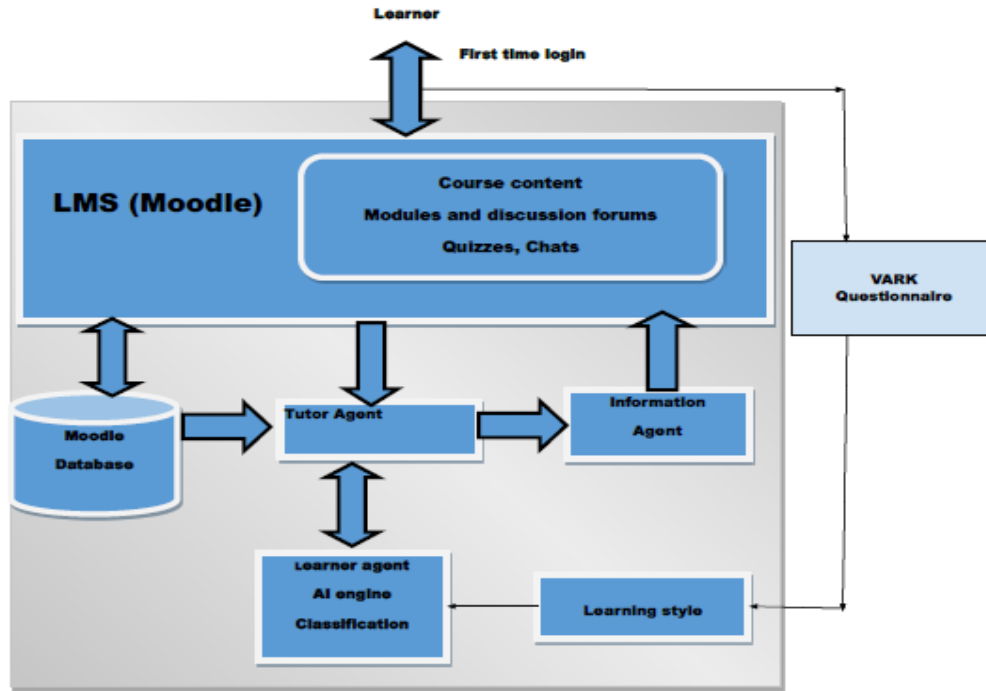Below is the system architecture diagram presentation.

Figure 1. System architecture

The table below summarizes the functions of the various intelligent agents, i.e., the learner agent, tutor agent, and the information agent.

Table 3. Function of the various intelligent agents.

Agent	Function
Learner Agent	Have the AI (Artificial Intelligence) engine that uses deep neural network which helps in the recommendation of the appropriate learning resources to the learners according to their learning style.
Tutor Agent	Coordinates learning in the system. It communicates and interacts with the learner and the information agent. It has access to the Moodle database whereby it has the details of the student (student profile). Tracks the learning process of the student/ activities the student performs in the system and communicate that to the leaner agent for recommendation.
Information Agent	Displays the recommended materials to the Moodle user interface which it receives from the tutor agent.

3.2 Implementation

A learning management system (Moodle) is used whereby the existing Moodle database is used which is accessed by the tutor agent. An additional table is added to the Moodle database to store the various learning style of the learners. Once a student login for the first time, they have to administer the VARK questionnaire, if not their first time they are directed to the dashboard. Once they are done answering the questionnaire their learning style is captured and stored in the database. After the capture of the learning style, they are then directed to the content that matches their learning style. For instance, once they access a certain topic like arrays and their learning style is visual, the learner agent checks the most appropriate content from the database and provides the recommendation to the student in a link to a video on that particular topic. The learner agent communicates the video link to the tutor agent which in turn passes it to

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the information agent which displays it in the user interface. When answering the questionnaire it can happen that a learner have more than one learning style, but the learner agent picks the learning style with the highest personality score as the learning style.

4. Prototype testing

A course (Introduction to programming in C) is created in Moodle containing four topics as mentioned for testing purposes. Once the user is enrolled for the course for the first time, they first administer the VARK questionnaire as shown below: The questionnaire is administered once when a user login into the system for the first time.

Figure 2. Sample of the VARK questionnaire

After responding to all the questions in the questionnaire they are notified of their learning style as shown below.
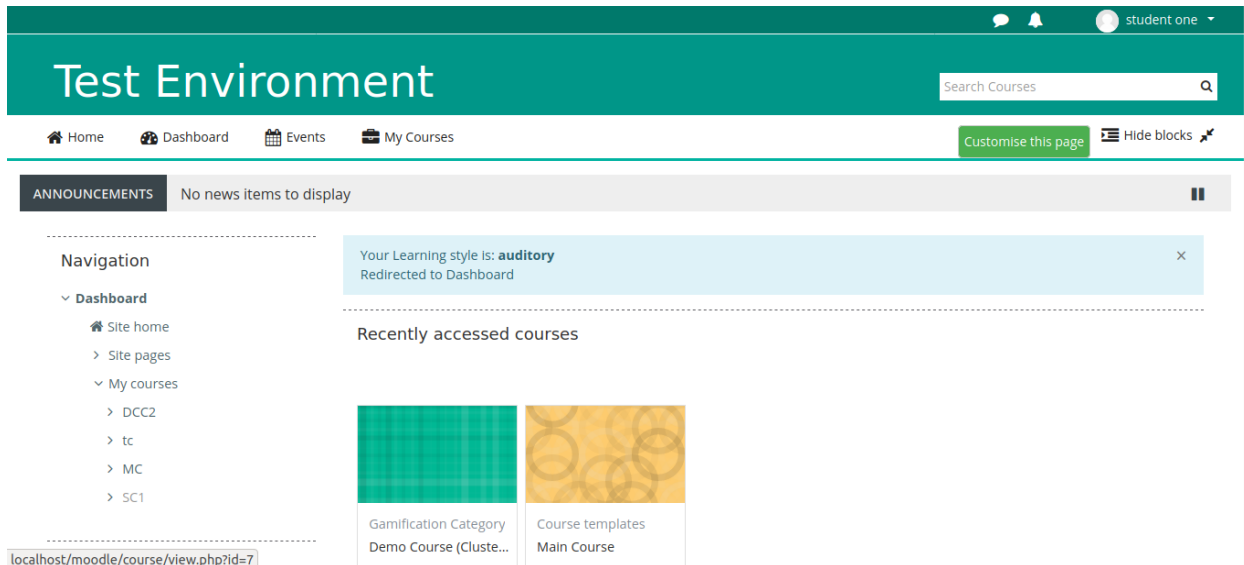
Figure 3. Notification of the learning style

Depending on what they access on the course content, they are recommended materials according to their learning style. For instance, if their learning style is auditory, they will get the recommendation of a link to a video which they can listen to as shown below:
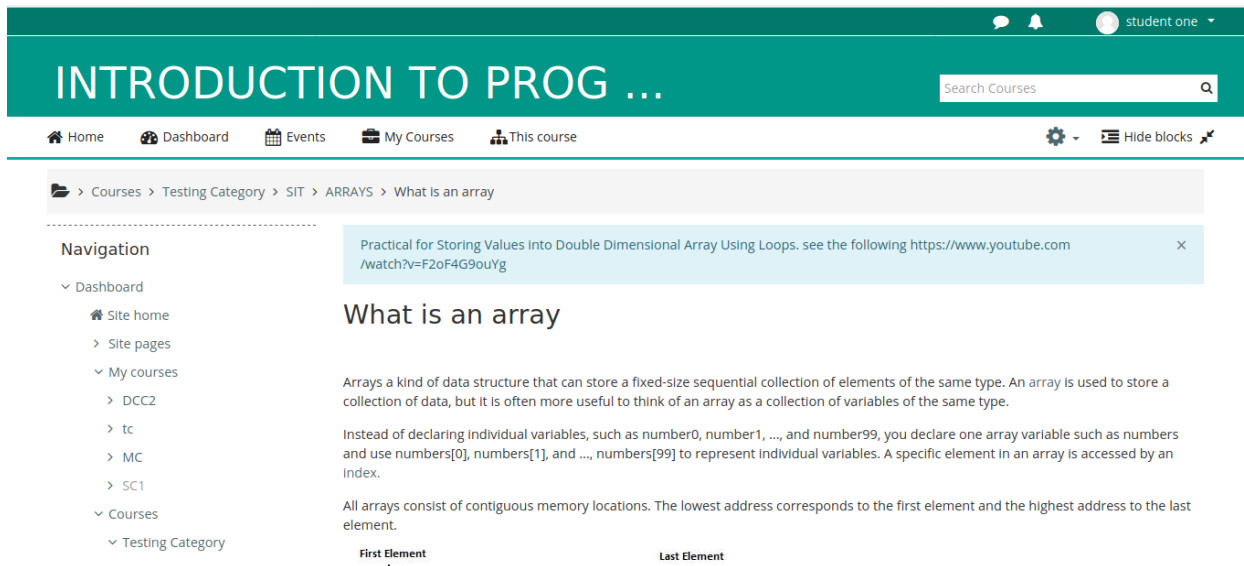
Figure 4. Sample of the feedback /recommendation

5. Conclusion and future work

In this study, we have successfully integrated three learning agents into a learning management system (Moodle) to provide adaptive learning based on the learner's learning style. The learner agent has been trained using deep neural network to learn on how to select the material based on the learning style. This integration allows learners who are using Learning Management System such as Moodle to learn based on their learning style which is more effective than non-adaptive learning.

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In the future, other efficient artificial techniques will also be applied to access large datasets for instance from the web where the learners would get the most appropriate learning material as opposed to the ones limited to the repository. In addition, there is a need to apply other learning style models for identifying learning styles such as Felder-Silverman model, Kolb learning style model, or other learning style models and also perform an experimental study on how effective they are in adaptive learning through the use of intelligent agents.

Acknowledgements

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Social Media Marketing for User Engagement: Evidence from Bosnia and Herzegovina

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Abstract

Internet enabled the emergence of social media platforms, opened new markets and changed the way businesses and organizations operate, communicate with their target audience, promote their activities and achievements. Non-profit organizations worldwide use social media platforms and strive to increase user engagement and the number of reactions to achieve their goals. Although in Bosnia and Herzegovina, non-profit organizations use social media platforms, there is no empirical evidence of their success in increasing user engagement and the number of reactions. This study investigates which social media factors have an influence on user engagement, particularly on the number of reactions on Facebook posts. The real data from the period of 15 months were collected from a Facebook business profile of a non-profit organization from Bosnia and Herzegovina. SPSS and Excel were used to analyze the data. According to the research results, the period of publishing and the number of photos have an effect on the number of reactions on Facebook posts, while the amount of text and the day of publishing do not have an effect on the number of reactions.

Keywords: social media, social media marketing, user engagement, the number of reactions on Facebook posts, Facebook.

1. Introduction

The number of Internet users is constantly growing, and it is not only because of the search engines but also because of the social media platforms which emerged from the Internet. There are 4.6 billion Internet users (Clement, 2020) and 3.6 billion of them use social media (Tatnkovska, 2020).

Social media platforms can also be seen as a market that connects the whole world. Withing few clicks marketers are able to reach their target audience and present them with new products and services, but customers can also be heard publicly through their comments and the number of reactions. The era of one-way communication where marketers were addressing their customers on traditional media ended. Now customers also create fan pages, share ideas and thoughts. Customers are able to support brands publicly and ruin them as well if they were dissatisfied with them. Regardless of disadvantages, the marketers use social media platforms to reach buyers (Gao et al., 2018), support brand evaluations (Naylor et al., 2012) and build closer connections with customers (Rapp et al., 2013). Social media advertising became the dominant

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tool to influence buying behavior (Chen & Lin, 2019). Marketers strive to increase user engagement on social media because it may help them increase review, become industry leaders and game-changers.

User engagement is defined as "a desirable-even essential-human response to computer-mediated activities" (Laurel, 2013). User engagement is used as an indicator of the success of marketing efforts (Jaakonmäki et al., 2017). Social media platforms have their own analytics and track user engagement.

Facebook tracks engagement at the individual post level as well as the on-page level (Jessica, 2021). Facebook post engagement is measured through post shares, post reactions, post saves, post comments, post likes, post interactions, 3-seconds video plays, photo views and link clicks (Post Engagement, n.d.).

The main objective of the study is to understand the effects of social media marketing on users' engagement, particularly on the number of reactions. The study aims to examine if the period of publishing, day of publishing, amount of text, the number of photos affect the number of reactions.

2. Literature review

2.1 *Social media marketing*

Despite the widespread understanding of social media sites, there are many definitions of social media marketing, but not a commonly accepted definition. Boyd and Ellison identified social media as:

web-based services that allow individuals to (1) construct a public or semipublic profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system (Groundswell, 2011, p. 211).

Kaplan and Haenlein defined social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content" (2010).

Before the emergence of social networks, we know today, there were many attempts that had some of the characteristics of today's social networks. Open Diary was one of them. It resembled a social networking site – it gathered online diary writers in one place. Almost twenty years later, namely in 1979, Usenet was created by Tom Truscott and Jim Ellis from Duke University. It was "a worldwide discussion system that allowed Internet users to post public messages" (Kaplan & Haenlein, 2010: 60).

The development of the Internet and the growing accessibility of high-speed Internet led to the development of social media. "One of the first social network sites was SixDegrees.com launched in 1997 by Andrew Weinreicht" (Barker et al., 2017). Weinreicht had the "six degrees of separation" theory on his mind – "the theory that any person on the planet can be connected to any other person on the planet through a chain of acquaintances that has no more than five intermediaries" (Arnold, 1989).

Adrian Scott wanted to help professionals make business contacts, so he created ryze.com in 2001. Unfortunately, it never grew into a big community (Barker et al., 2017). In 2003, Friendster was founded in California. It was meant to be a social networking site, but due to its unsuccess, it became a social gaming site in Malaysia and was eventually shut down. In 2002 LinkedIn was launched and Myspace started its music platform. LinkedIn now has almost 740 million members with over 55 million registered companies (Maddy, 2021). Facebook as we know

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it today was different when it was created in February 2004. It was called TheFacebook.com and it was created only to connect people with a harvard.edu email. Since then, Facebook became a global social networking site. It acquired Instagram, WhatsApp, and Oculus, and independently developed Facebook Messenger, Facebook Watch, and Facebook Portal. In 2005 YouTube was launched and a year later Tweeter was created. In 2007 David Karp founded Tumblr – a microblogging and social networking website. In 2010 Instagram was founded, and a year later, Google created Google+ and Snapchat. Ben Silbermann left Google and together with Evan Sharp, and Paul Sciarra founded Pinterest in 2010. Pinterest gathers those who love to share ideas and find inspiration for various interests and projects. In 2012 it became a social scrapbooking site. TikTok was released in 2016 and nowadays it is a fast-growing social media network whose content is created by its customers, mainly the young generation.

According to Statista (2020), Facebook is the most used social media platform, then WhatsApp, Facebook Messenger, and Instagram.

As it can be seen, social media network sites emerged one after another, and some were even inspired by one another. We cannot ignore the fact that social media sites have had a significant impact on the traditional marketing approach. Companies saw an opportunity to use social media sites to achieve their business and marketing goals, and this led to the emergence of social media marketing.

Social media marketing is a "connection between brands and consumers, [while] offering a personal channel and currency for user-centered networking and social interaction" (Chi, 2011).

It changed the way companies and clients communicate. In traditional marketing, marketers send messages to their potential clients, and the voice of clients is hardly heard. Social media marketing enabled two-way communication between marketers and clients. Now social media users, clients and potential clients can provide unique perspectives on what they consider personally meaningful (Di Gangi & Wasko, 2016). Social media users, empowered by social media sites, take control of the marketing communication process by commenting, reviewing, creating content and collaborating with brands. This is beneficial for both, clients and companies, also because companies are able to get feedback on what they do well and what they do wrong, and thus improve their products and services and establish long-term relationships with their clients.

Thanks to social media sites, marketers can remotely perform their activities 24/7 and reach almost every part of the Earth. The pool of potential leads drastically increased, and costs decreased. Social media marketing activities cost much less than traditional marketing activities. Social media marketing is not limited to time, geographical space, and there is no need for a seller in an online shop and the shop is always open.

Besides the above-mentioned advantages of social media marketing, marketers are still struggling to engage the audience to be able to build long-term relationships with them. Corporations realized that without a correct plan and social media strategy they have no chance to stand out in the rapidly changing digital freedom (Sining & Yanxia, 2012). They are striving to create effective inbound marketing strategies to be able to increase user engagement, achieve regular communication and eventually establish long-term relationships. Although there is no clear understanding of effective social media strategies, marketers heavily rely on social media analytics (SMA) to gain better insights into their target audience, their behaviors, wants and needs. „Social media analytics is concerned with developing and evaluating informatics tools and frameworks to collect, monitor, analyze, summarize, and visualize social media data, usually driven by specific requirements from a target application" (Zeng et al., 2010). E.g., Facebook analytics measures user engagement, impressions, reach, referral traffic, page likes, follows, ad metrics, video metrics, etc. Though SMA does not offer answers to all questions of marketers, it is

still a marketing intelligence source that is beyond human capacities and a great asset to marketers.

2.2 *User engagement*

Thanks to the Internet, the way people perform their daily activities changed. Now we are able to buy goods and services from any part of the world from the comfort of our homes. Around 78 percent of Internet users are active on social media (Tatnkovska, 2020) and are creating content and engaging with brands daily.

Though marketers have access to a large number of users from all around the world, they are struggling to come up with a strategy that will help them engage their audience enough, so they become their loyal customers.

There is not a widely accepted definition of user engagement. Laurel defined user engagement as "a desirable-even essential-human response to computer-mediated activities" (2013). User engagement is also defined as "a user's response to an interaction that gains, maintains, and encourages their attention, particularly when they are intrinsically motivated" (Jacques, 1996: 103). O`Brien and Cairns built upon Jacques` description of user engagement and said it is "a quality of user experience with technology" characterized by the perceived usability and aesthetic appeal of the system, focused attention, novelty, felt involvement, and endurability" (O'Brien & Cairns, 2016: 3).

Richard Jacques wrote that engagement consisted of six attributes, each of which operated along a continuum: the degree of attention (divided or focused), motivation to continue the task, perceived control (presence or absence), needs satisfaction experienced by the user, the user's perception of time ("dragging on" or "flying by") and attitude (negative or positive) (Jacques, 1996: 67).

There are many companies online publishing their content daily, so people are oversaturated with information that they simply scroll over social media posts without stopping to interact with brands. Marketers know that without user engagement there is no trust in a brand, and thus no long-term relationships.

To improve user engagement, companies invest not only in functionality but also in design for a more engaging user experience. Social media sites offer many functionalities that serve both types of users – companies and individuals, and they both rely heavily on them, especially marketers who are heavily relying on SMA as a marketing intelligence source. Since all companies and brands on social media sites have the same starting point, they need to come up with strategies that will help them stand out from their competition and attract the attention of potential buyers and convert them into regular buyers who are regularly interacting with their brands.

Before creating unique and engaging content, companies need to understand their audience and their motivations. Different motivations, attitudes and needs influence their behavior and inevitably social media marketing success, so marketers' goals are to create content their target audience will like. Design should be appealing to the eye and stand out from the competition. Besides design, marketers invest a lot of time creating a content strategy that will communicate the brand's benefits clearly and in the best way, but also in a target audience's language. They are facing the limitation of characters they can insert in social media posts, so they have to shape the message accordingly. Saying the right thing to the right audience became a must in order to create trust in a brand. There are many statistics on the Internet saying which day in a week and at what time is best to publish on social media. Social media analytics can help marketers to figure out when their target audience is online. Publishing content to the right audience has to

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be at the right time so they can see it. Although 90% of information transmitted to the brain is visual (Smart Insights, 2020), marketers are struggling to figure out which visual will attract the viewers' attention and increase the number of reactions on posts. These are some of the many factors that may affect user engagement on social media. Good social media strategy that encourages people to react to posts increases user engagement.

The number of post reactions indicates the relevance of a post to the target audience and social media AI helps those posts perform accordingly.

When people react to a post, they automatically start following further reactions and comments, which can engage them in an ongoing conversation on your business Page (Post Reactions, n.d.).

User engagement is a key performance indicator for digital organizations; user growth (e.g., followers, subscribers, etc.) and interactions (e.g., likes, comments, shares, etc.) are common measures of a company's success and indications of user satisfaction (Aldous et al., 2019).

The success of user engagement can be also measured by positive changes in society, behavioral change, personal growth, civic engagement, knowledge transfer, etc. This indicates that user engagement manifests differently within different contexts, that is why there is no widely accepted definition and metrics for user experience.

3. Methodology

3.1 *Data collection*

The data used in this study were manually collected from a Facebook business page of a non-profit organization from Bosnia and Herzegovina. 98 posts published in the period from January 2020 until March 2021 were examined. Variables in the dataset were in multiple forms: categorical, discrete, interval, and nominal.

3.2 *Sample*

In this research, Facebook posts of a non-profit organization that awards grants and invests in small businesses were examined. Most of the posts had a purpose to announce an open call for grants and/or small businesses and also to promote the results of those activities. Fewer posts were focused on promoting events the organization organized, as well as, promoting the attendance of the members of the organization on events organized by others.

3.3 *Statistical analysis*

For the purpose of data analysis, the multiple descriptive (central tendency and dispersion statistics) and inferential statistics (Regression, ANOVA, sample t-test) were applied using Excel and SPSS software packages.

3.4 *Research model*
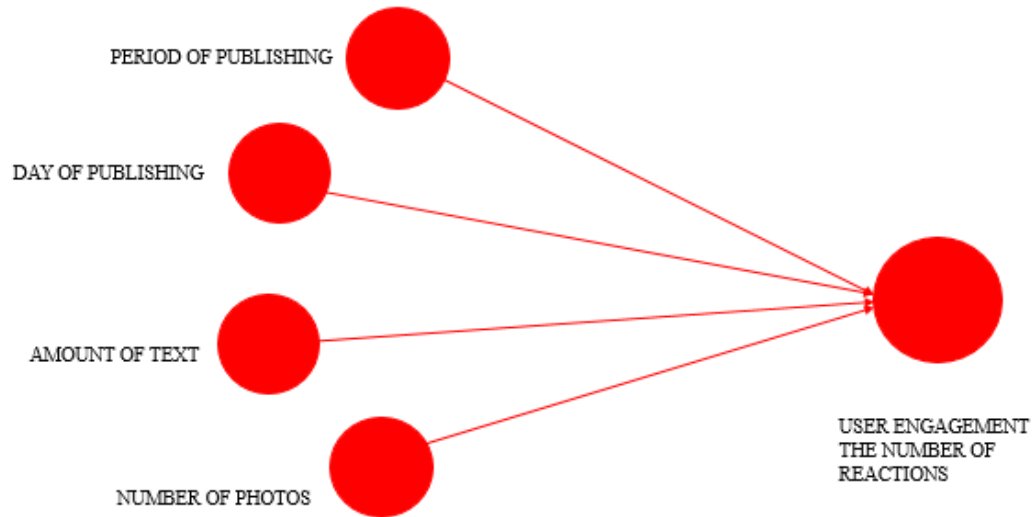
3.5 *Research questions*

● Does the period of publishing posts on Facebook affect the number of reactions?

● Does the day of publishing posts on Facebook affect the number of reactions?

● Does the amount of text of posts on Facebook affect the number of reactions?

● Does the number of media elements (photos) posted on Facebook affect the number of reactions?

4. Results

4.1 *Period of publishing posts on Facebook → Number of reactions*

In order to find answers to the research question, ANOVA analysis was performed in SPSS, whereby the effects of independent variables on the dependent one(s) were investigated. The results of the analysis are presented in the table below.

Table 1. SPSS outputs: Research question 1

ANOVA		
Number of reactions (like, love, care, haha, wow, sad, angry)		
	F	Sig.
Between Groups	3.636	.000

The effects of the period of publishing on Facebook on the number of reactions were investigated. The SPSS output indicated that the effects are statistically significant (Sig.=0.000 which is lower than 0.05).

If the manager would like to stimulate the number of reactions, he should consider the period of publishing posts on Facebook, as it appears to be a statistically significant independent variable.

4.2 *Day of publishing posts on Facebook → Number of reactions*

In order to find answers to the research question, ANOVA analysis was performed in SPSS, whereby the effects of independent variables on the dependent one(s) were investigated. The results of the analysis are presented in the table below.

Table 2. SPSS outputs: Research question 2

ANOVA		
Number of reactions (like, love, care, ha-ha, wow, sad, angry)		
	F	Sig.
Between Groups	1.433	.220

The effects of the day of publishing on Facebook on the number of reactions were investigated. The SPSS output indicated that the effects are statistically insignificant (Sig.=0.220 which is lower than 0.05).

4.3 *Amount of text → Number of reactions*

In order to find answers to the research question, REGRESSION analysis was performed in SPSS, whereby the effects of independent variables on the dependent one(s) were investigated. The results of the analysis are presented in the table below.

Table 3. SPSS outputs: The main research question 3

Coefficients[a]			
Model	Standardized Coefficients	t	Sig.
	Beta		
Number of words in a post description	-.020	-.194	.846
a. Dependent Variable: Number of reactions (like, love, care, ha-ha, wow, sad, angry)			

The effects of the amount of text on the number of reactions were investigated. The SPSS output indicated that the effects are statistically insignificant (Sig.=0.846 which is higher than 0.05). Beta is -0.020. If the independent variable (amount of text) increases by 1 unit, the dependent variable decreases by 0.020.

4.4 *Number of photos in posts on Facebook → Number of reactions*

In order to find answers to the research question, REGRESSION analysis was performed in SPSS, whereby the effects of independent variables on the dependent one(s) were investigated. The results of the analysis are presented in the table below.

Table 4. SPSS outputs: Research question 4

Coefficients[a]				
Model		Standardized Coefficients	t	Sig.
		Beta		
1	Media elements (number of photos)	.259	2.622	.010
a. Dependent Variable: Number of reactions (like, love, care, ha-ha, wow, sad, angry)				

The effects of the number of photos in posts on Facebook on the number of reactions were investigated. The SPSS output indicated that the effects are statistically significant (Sig.=0.010 which is lower than 0.05). Beta is 0.259. If the independent variable (the number of photos) increases by 1 unit, the dependent variable decreases by 0.259. It is recommended not to increase the number of photos.

Table 5. Summary of research questions

RQ 1	Does the period of publishing posts on Facebook affect the number of reactions?	Sig. .000	Statistically significant
RQ 2	Does the day of publishing posts on Facebook affect the number of reactions?	Sig. .220	Statistically insignificant
RQ 3	Does the amount of text of posts on Facebook affect the number of reactions?	Sig. .846	Statistically insignificant
RQ 4	Does the number of media elements (photos) posted on Facebook affect the number of reactions?	Sig. .010	Statistically significant

All the results presented in this section will be further discussed.

5. Discussion and conclusion

With 2.85 billion monthly active users, Facebook is the biggest social network in the world (Statista, 2021). There are more than 60 million business pages on Facebook (Kit, 2019). Non-profit organizations use social media sites to increase their user engagement. Although non-profit organizations in Bosnia and Herzegovina use social media sites, there is poor empirical evidence.

Facebook post engagement is measured through post shares, post reactions, post saves, post comments, post likes, post interactions, 3-seconds video plays, photo views and link clicks (Post Engagement, n.d.). This study investigated which social media factors had an influence on user engagement of the non-profit organization in BiH - particularly on the number of reactions on Facebook posts – if the period of publishing, the day of publishing, the amount of text and the number of photos in Facebook posts affect the number of post reactions.

When people react to a post, they automatically start following further reactions and comments, which can engage them in an ongoing conversation on your business Page (Post Reactions, n.d.).

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98 posts published in the period from January 2020 until March 2021 were examined and analyzed in SPSS.

The SPSS output indicated that the period of publishing Facebook posts has statistically significant effects (Sig.=0.000 lower than 0.05) on the number of post reactions. If the organization wants to stimulate the number of post reactions, it should consider the period of publishing.

Unlike the period of publishing, the day of publishing posts on Facebook does not have a statistically significant effect on the number of post reactions (Sig.=220 higher than 0.05).

The amount of text in Facebook posts also does not have a statistically significant effect on the number of post reactions (0.846 higher than 0.05).

The number of photos posted in a Facebook post has a statistically significant effect on the number of post reactions (Sig.=0.010 which is lower than 0.05). It is recommended not to increase the number of photos in a Facebook post because it may negatively affect the number of reactions.

Acknowledgements

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The Impact of Information Communication Technology (ICT) on Procurement Processes: Case of Zimbabwean Urban Councils (2009 to 2018)

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Abstract

The research aimed at determining the impact of ICT applications on procurement processes. The population of study was composed of 110 respondents from Chegutu, Kadoma, Kwekwe, Chinhoyi and Gweru urban councils with a representative sample of eighty-six participants all drawn from the procurement, finance and works departments of the five councils. Quota sampling was used in this research with strata based on the level of employment in the three different divisions. The research utilized a proportion of 78% from each stratum to select eighty-six respondents. Both primary and secondary data was used. Primary data was collected through questionnaire which was designed to satisfy research objectives. Secondary data came from relevant literature review, journals, business magazines, conference papers, and internet. Questionnaire responses were tabulated, coded by use of Statistical Package for Social Sciences (SPSS) version 16 to analyze quantitative data. Qualitative analysis was used to obtain in depth knowledge of the level of ICT utilization and why users were operating at different levels. Findings of the study indicated that although ICT infrastructure with procurement application is in existence and available, utilization of Information Communication Technology is at basic level. Acceptance and adoption of ICT in procurement was driven by both organization and personal objectives. The view that technology adoption is based on the Technology Acceptance Model was applied in this study by testing the perceptions of ease of use and usefulness of ICT. The study revealed that ICT adoption in procurement improves the process and benefits other operations of the business. ICT training and skills development, coupled to organizations' leadership commitment and availability of financial resources were cited as critical success factors in the acceptance and improved utilization of ICT in procurement. The researchers recommended further studies on the topic of ICT adoption in business operations by public entities.

Keywords: Information Communication Technology, e-procurement, council.

1. Background of the study

Local government authorities have been slow to adopt electronic procurement systems despite the existence of basic information communication infrastructure. This is probably because of some resistance to change by being blinkered to papers and files (Chimberengwa et al., 2015).

Sixty percent of the government's expenditure in Zimbabwe is allocated to public procurement which is very high when considering the liquidity challenges accompanied by a balance of payments deficit (Mushanyuri, 2014). This is the main reason why the public has placed much blame on public procurement as a result of its failure to provide public services and utilities (Chigudu, 2014). Poor service delivery in Zimbabwe is indicated by shortages of medicinal requirements and poor quality of procured goods and these problems are emanating from poor planning, poor execution of contracts and the major one being unavailability of adequate technologies in public procurement (Chimberengwa et al., 2015). With the adoption of ICT, procurement processes can be approved online and the order fulfilled within minutes where the required item often arrives in real time (Chigudu, 2014). Main Information Communication Technological systems currently used in public procurement contracts are the Systems Application Programmes (SAP) and websites of which are not fully adopted as some local authorities even do not completely use it (Chimberengwa et al., 2015). The websites should be used by local government authorities to invite suppliers to bid and call for submission of quotations (Musanzikwa, 2013). Templates for bidding documents as well as the contract formation templates are all available on the Procurement Regulatory Authority of Zimbabwe (PRAZ) website. The platform is being used by the PRAZ to communicate mainly with its stakeholders being public entities and suppliers of different categories of goods and services.

It is against this background that this research aimed to find out the effect of information communication technology on effective procurement management in local authorities.

2. Statement of the problem

Councils are yet to fully adopt and utilize the benefits of employing high level information communication technological tools such as online supplier registration and e-procurement. The impact of these tools on the procurement process is not yet known.

3. Research objective

The objective of this research was to determine the impact of ICT applications and infrastructure that affect councils' procurement processes.

4. Literature review

4.1 *Theoretical framework*

Theoretical framework used in this study was the technology acceptance model (TAM) by Davis (1996). This model supports the concept that perception of users influences the degree and level to which technology is used in business and other organizations. According to this theory, emerging technologies cannot improve organizational effectiveness and performance if the change has not been accepted by the technology users. The theory of technology acceptance is one of the most popular theories in understanding adoption of computer technologies. It avers that adoption of any innovation requires investment in computer-based tools to support decision making, planning and communication (Kamel, 2014). Before accepting any technology, users should be aware of the benefits and security and other risky issues involved.

This theory is important in this research as it provides the factors that influence people to accept technology. The study of the impact of technology on procurement process revolves around this theory because the research is about exploring the extent to which ICT is utilized by individuals employed in municipalities.

4.2 *Impact of ICT on procurement processes*

Varma and Khan (2014) in their study of Information Technology in Supply Chain concluded that many scholars have advocated for paperless transaction in procurement by adopting the use of System Applications and Products (SAP) in Data Processing by using Enterprise Resource Planning (ERP) systems, Automatic Identification and Electronic Data Interchange modules. These systems guarantee transparency and security of the systems to both the user and the businesses. From the research conducted by Nair (2012) titled RFID for supply chain management, the findings were that the respondents thought that procurement based on ICT tools easily controls and manages information interchange within key business functions, products, external and internal financial resources and contributes to business profitability by enhancing quality and alleviating coordination costs and trading risks.

Numerous analysts have debated on the role between ICT tools in procurement among them Nair (2013) published a study titled E-Supply chain management using software agents. Their findings had a common agreement that ICT enhances information sharing, improves the performance and eradicates supply chain risks by providing system and procedure-based execution of tasks and presents information to decision makers in formats that it's needed. Moon (2007) conducted research on Enterprise Resource Planning (ERP) and concluded that ICT played critical role in the integration of suppliers and customers to ensure the right quantity and quality of products are supplied. Auramo et al. (2005) in their exploration of Benefits of IT in Supply Chain Management to Finnish Companies found out that ICT was being applied to data entry, real time processing, and regularization of transaction that were expected to create a balance between supply and demand among procurement chain members. Brooks and Davenport in their 2004 study of Enterprise systems and the supply chain concluded that ICT was as a critical requirement for managing and control of procurement processes.

Bertschek, Cerquera and Klein (2013) measured the impact of broadband internet on firm performance asserted that the internet had become the major source of information, products and services and e-procurement has become one of the most discussed topics in supply chain management and will revamp the mechanics and methods of purchasing in the coming years. Craig, Carter and Washispack (2018) noted that both developed and developing nations have adopted ICT to improve public service delivery, enhance the general populace's access to information and increase civil society participation in economic and political affairs. Chebii (2016) studied the Kenya situation and concluded that most nations have realized public involvement in government bidding processes and were on a trajectory that creates opportunities for all suppliers to improve public service delivery.

Ambe (2016) studied public procurement trends and developments in South Africa acknowledged that e-procurement adopted by most nations in the world economy as a means to lessen the burden of obtaining information. Cheptora (2018) studied the impact of ICT on procurement performance in manufacturing firms in Kenya and found out that the e-procurement system is comprised of indent management, e-tendering, electronic auctioning, vendor management, catalogue management and contract management and further defined indent management as the software package that involves tender or bids preparations. Brooks (2004) in research that explored enterprise systems and the supply chain, observed that indent management permits online purchase requisitions, ordering, and tracking of ordered products and management of stocks.

Waigwa and Njeru (2016), in their study on the factors influencing management of procurement contracts in public security agencies, concluded that public sector entities utilize e-procurement to obtain gains such enhanced efficiency and cost savings, shorter procurement cycles and enhanced accountability to reduce corruption in procurement by avoiding face to face dealing with service providers. Adebanjo, Tickle, Lin and Bourlakis (2016), on e-business capabilities in developed and developing countries, posited that the public sector had widely accepted e-procurement and its utilization graph has grown exponentially. According to Chimberengwa et al. (2015), in the research on procurement processes at Gwanda Provincial Hospital, Matabeleland South Province Zimbabwe stated that Zimbabwean public sector is still to fully embrace e-procurement. Chigudu (2014) conducted research on public procurement in Zimbabwe and concluded that the rewards that entities benefit from the acceptance and utilization of e-procurement networks and systems are enormous. Local authorities in Zimbabwe must establish ICT frameworks for improved service delivery noted Dzuke and Naude (2017) in their study on the problems affecting operational procurement process in Zimbabwe.

However, beyond the use of emails and adoption of mobile payments by urban councils, the applications adopted for procurement by local authorities in Zimbabwe are not known. The levels to which ICT applications are utilized in procurement by local authorities need further research. The impact of these applications in procurement process of local council is relatively unknown and therefore this warrants further research.

5. Research methodology

This study utilizes the pragmatist research philosophy that provides the researcher with the freedom of choosing the research methods and techniques that best satisfy the needs and objectives of the research. A deductive approach was used. The targeted population of 110 respondents was drawn from Chegutu, Kadoma, Kwekwe, Chinhoyi and Gweru municipalities. Selected individuals were drawn from the Procurement Management Unity and the Department of Works and Treasury Department since these are the departments which are directly responsible for the implementation of procurement and contract management within the councils.

The population was divided into strata according to their work department; procurement, finance and works as they exist in urban councils which are mutually exclusive. These departmental strata were further subdivided according to job titles and sample size was determined using the mathematical formula $n = N/1 + (N * (e)^2)$ at 95% level of confidence to determine the representative proportion of each sub-stratum as shown below.

Table 1. Sample size

Sample Size				
Quotas	**N**	**n/N**	**n¹**	**n²**
Procurement Department				
Town Clerk	5	78%	3.91	4
Procurement Managers	5	78%	3.90	4
Procurement Officers	10	78%	7.80	8
Support Staff	20	78%	15.60	16
Procurement Population	**40**	78%	31.20	**32**
Treasury Department				
Finance Directors	5	78%	3.90	4

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Finance Manager	5	78%	3.90	4
Accounts Support Staff	20	78%	15.60	15
Treasury Population	**30**	78%	23.40	**23**
Works Department				
Director of Works	5	78%	3.90	4
Project Engineers	15	78%	11.70	12
Technicians	20	78%	15.60	15
Works Population	**40**	78%	31.20	**31**
	110			**86**
Legend				
N-population Size				
n/N: sample size ratio to Population				
n¹: calculated sample size				
n²: actual sample size				

The sample size has a total number of 86 respondents.

6. Results and discussion

The response rate was 84%.

6.1 *ICT level of usage*

The respondents acknowledged that ICT application in procurement promote accountability, transparency and integrity not only in procurement but in all organization functions. The above observations echoed Varma and Khan (2014) who advocated for paperless transaction in procurement by adopting System Applications and Products (SAP) in data processing by using Enterprise Resource Planning (ERP) systems, Automatic Identification and Electronic Data Interchange modules. These systems guaranteed transparency and security of the systems to both the user and the business.

The research revealed that use of ICT tools in procurement was at a very basic level although it was encouraging to note that most users acknowledged the benefits of using ICT tools, which means initiatives to push for the full adoption of e-procurement, would face less challenges. The respondents further added that most of the procurement tasks were being performed using manual work from generating purchase requisitions to issuing purchase orders and creating and generating tender documents and request for quotations creating challenges in keeping record secure and safe because of the volume of space needed. The tendering process was done manually from tender compilation, submission, evaluation and awarding and contract signing. This was also noted by Dzuke and Naude (2017), who observed that in Zimbabwe public procurement was underpinned by hardcopies in the tendering process. Further investigations showed hundred percent of the respondents use Google mail hosted personal email to communicate business issues with stakeholders. Requests for quotations and bid documents were sent to suppliers using emails and sometimes prospective bidders are notified to collect hard copies. Microsoft tools were being used in basic operations such as writing letters, creating Request for Quotations, tender

documents and general communications and simple Excel tools. This was supported by one of the participants, who mentioned that,

> *"We make use of many Information Communication Technology packages with respect to one's position and literacy to a specific package. But however, we mostly use Sage in our organization…"*

SAP as an ICT Application being used was scored high. Hence implying that SAP Application was highly used in the organization's participants. However, the use of Microsoft tools was ranked low this was due to the issues of Data Security and Data Management as they have minimum analysis tools hence making them less competitive and of minimum use. One of the participants mentioned that,

> *"Sage systems are highly used for order processing and creditors control and also Microsoft packages for simple use in the writing of letters…"*

6.2 *ICT Application in tendering process*

The majority of the respondents indicated that they agreed with the level on which the ICT packages were being used to perform the tendering tasks. The findings concur with Lysons and Farrangton (2012). The significance of these results is that the application of ICT in procurement contracts appeared to have not gained the required momentum.

This observation is in tandem with Chimberengwa et al. (2015), who noted that the Zimbabwean public sector is still to fully embrace e-procurement. Chigudu, 2014 concluded that the rewards that entities benefit from the acceptance and utilization of e-procurement networks and systems are enormous. Local authorities in Zimbabwe must establish ICT frameworks for improved service delivery noted Dzuke and Naude (2017) in their study on the problems affecting operational procurement process in Zimbabwe.

6.3 *ICT Applications in purchasing task*

The findings indicated that the respondents agreed with the views that the rate adoption of technology in public procurement is very slow as concluded by Chigudu (2014) and Dzuke and Naude (2017), who agreed that public procurement is characterized by a lot of hard copy paper work and further recommended that ICT adoption in procurement must be anchored on national policy.

6.4 *Challenges faced in adopting ICT in procurement*

High cost of introducing new ICT systems, lack of consultancy expertise in E-procurement, lack of leadership were the challenges that were ranked high. Slow rate of suppliers linking with system, difficult in measuring usefulness and potential of ICT and difficult in measuring ease of use were some of the cited challenges.

Further inquiry into the challenges brought the issues of resistance mainly from employees who perceive the introduction of technology take away their jobs. Most of the employees from forty-six years old and above preferred the status quo of paper files and hard copy paper pressing. Although most respondents acknowledged that ICT improves the procurement process, the researchers gathered from discussions that most users lacked the will and personal intent to utilize ICT. The participants blamed slow adoption and lack of capital investments on poor leadership, management's lack of foresight and unwillingness to adapt to dynamic business operations driven by technological automation as one respondent put it:

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"Management uses lack of funds as an excuse not to invest in ICT because they know once ICT is adopted in procurement their corrupt activities will be known".

This reflected that personal attitude and commitment of organizational leadership has a direct impact on the adoption of technology in municipalities. As reported by the World Bank (2013), organization leadership has the obligation of establishing the vision and mission of the firm, motivating their teams for change in process and organizational culture, and establishing the policies and strategies necessary to put an e-Procurement initiative in place If the e-procurement system does not have the full support of the top management team, there is every reason for it to fail The interviews and discussions that were held with respondents pinpoint the fact that as much as financial resources are scarce the major issue that prohibited the adoption of ICT in procurement is the attitude of executive management that lacks the tenacity and ability to raise funding for investments into ICT to adapt to the dynamic and ever changing demands of the people they serve.

6.5 *Solutions to challenges in ICT adoption in procurement*

From the study findings, the respondents indicated that early supplier involvement and capability development efficiency supply chain risk management, encourage user acceptance and readiness, employee training, capital investment on technology and senior management commitment were the possible solutions that underpinned this study.

The respondents appreciated that lack of capital investment was a challenge but they advocated for leadership change in municipalities blaming it for the slow adoption of technology in councils' operations and particularly in procurement. The respondents explain the basis of their ratings and they indicated that it was imperative for the municipalities to consider the acceptance of the technology by important stake holders such as suppliers and rate payers. They further indicated that it was necessary to adopt technology in procurement to create transparency and accountability but a balance has to be found between investing in technology or utilizing funds for the improvement of service delivery to rate payers. From the interviews most were of the opinion that for ICT to be adopted in procurement must be driven by the national government through the relevant ministry be considered a national policy that mandates municipalities to fully utilize ICT in procurement and promotes accountability and transparency as envisaged by the Public Procurement and Disposal of Public Assets Act Chapter 22:23 and the Zimbabwe National Policy for Information communication technology.

7. New conceptual framework

The figure below indicates the impact of organizational leadership as a primary independent variable that influences the secondary variables that impact on ICT usage levels in the procurement process.

The study thus recommends that the organizations should be sensitive of the changing business environment that dictates the competitive environment they operate in. As such, staying ahead of the competition through adoption of ICT would ensure that the organizations survive in the competitive environment. Embracing of Information Communication Technology (ICT) ensures that the supply chain balances its need to satisfy customer needs and manage costs in order to attain profits.
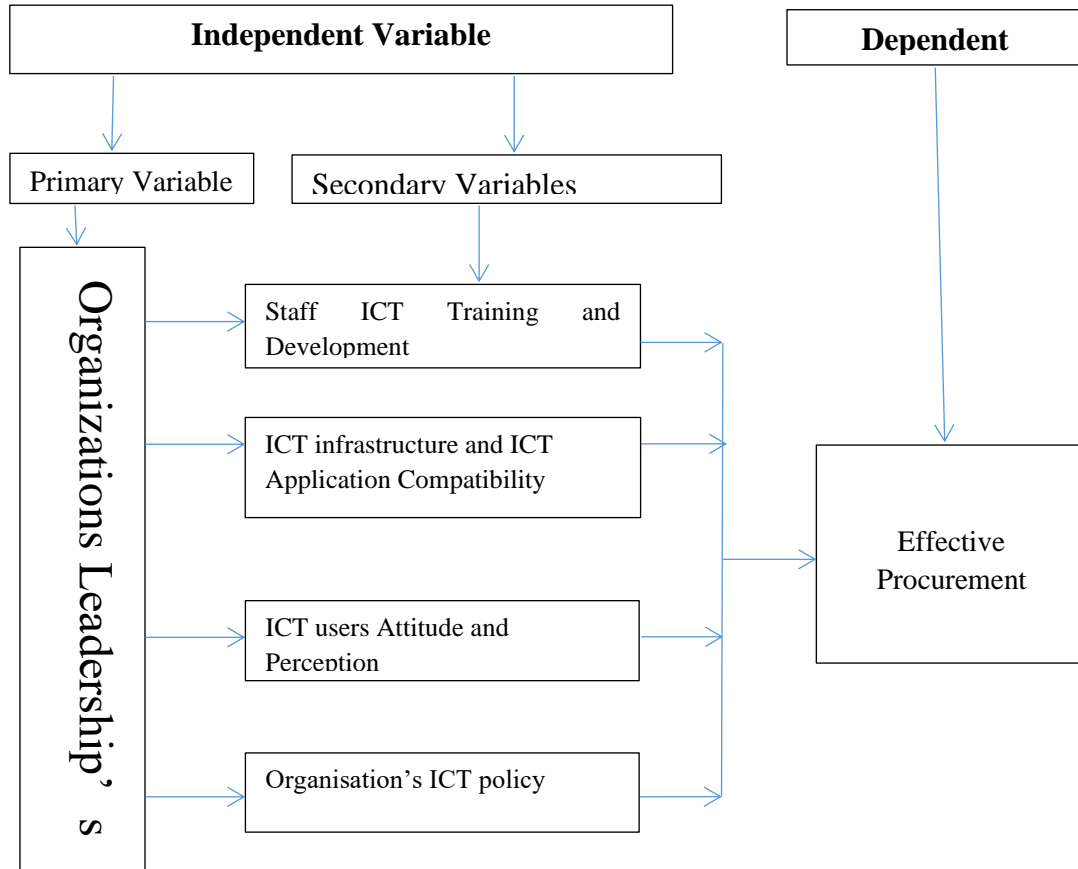
Figure 1. New conceptual framework

This conceptual framework was generated from above findings and still needs to be researched on.

8. Conclusion

On the issue of ICT skills, most respondents do not have formal ICT training except very basic ICT contributing to the slow rate of ICT adoption. The municipalities have basic ICT infrastructures and make use of computers and internet albeit at a very basic level, that is communication and supplier search on the internet. Most of the procurement tasks are still paper based. The tendering processes used to procure goods through the public procurement system is still very much paper based, with some municipalities refusing to accept bids submitted on emails preferring hard copy papers. The existing ICT infrastructure in municipalities is almost approaching the end of its life cycle creating challenges of compatibility and dynamic adaption of new technologies in procurement. The councils lack financial resources to invest in current innovative technologies in procurement. Although the national government has initiated the national policy on ICT, the municipalities lag behind in adoption.

On the impact of personal attitude and organization policy on the adoption of ICT in procurement it is concluded that most users adopt technology based on their perception of its usefulness and ease of use. However organizational policy enforces employees to utilize the technology since some tasks require the use of technology irrespective of the employees' perception. The leadership in the organizations have no commitment to ICT adoption as revealed by most respondents. The municipalities lack innovative leadership to adapt and survive in this economy and improve service delivery.

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9. Recommendations

From the conclusions above it is therefore recommended that organizations must equip their employees with the necessary skills through training and skills development in ICT. Recruitment policy must emphasize that employees must be ICT skilled and innovative. Further the municipalities must improve the ICT infrastructure in order for it to be compatible with new software applications. Further it must be made mandatory that procurement tasks be performed through ICT and that ICT task implementation be given first priority.

Executive management must take a leading role in advocating for ICT in procurement and all other functions of the organization. Established procedures and regulations must acknowledge and appreciate the perception of users and recognize that users' perception also plays an important role in the adoption and ICT and usage level in procurement.

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