Article

A model for open access institutional repositories usage for university libraries in Ghana

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Abstract

The aim of this article was to develop a model for the usage of Open Access Institutional Repositories (OAIR) in university libraries in Ghana. The article adopted the Technology Acceptance Model (TAM), which was then modified to fit the study. The variables were adapted to improve the fit between data and the theoretical model, keeping the characteristics of TAM. Accessibility, availability and visibility were proposed in addition to the conventional variables of TAM. Positivist paradigm, quantitative methods research and survey design were used for the study. Simple random sampling and stratified random sampling were the sampling procedures and methods employed. A total of 998 respondents completed the questionnaires distributed. The questionnaire was used as a research instrument to gather relevant data for the study. Descriptive statistics (frequencies, percentages, means and standard deviation) and inferential statistics (multinomial logistic regression and Confirmatory Factor Analysis [CFA], using structural equation modelling [SEM]) were used as statistical tools to analyse the data. The study developed an OAIR Usage Model, which would be instrumental in the usage of OAIR in university libraries in Ghana. The model will enhance both user satisfaction and intention to reuse the OAIR, and make OAIR research outputs available, accessible and visible. This article adds to the body of literature on OAIR, as it is used in university libraries.

Introduction

The fourth industrial revolution, also characterised by the surge in information and communication technologies (ICTs) and the Open Access (OA) movement in libraries, has led to the establishment of Open Access Institutional Repositories (OAIR) (Dlamini and Snyman 2017). Uzoigwe (2013) accentuates the fact that libraries in institutions of higher learning play a vital role in meeting the institutional requirements of academic staff and students. Due to changes occurring in the information and knowledge society, university libraries are constantly expanding their roles of conducting research to ensure that the expectations of different users on the creation, dissemination and preservation of knowledge available in the library are realised (Abrizah, Noorhidawati and Kiran 2017).

Global research suggests that the growth of OAIR in Higher Education Institutions (HEIs) has increased significantly with the implementation of an open source initiative in the field of scholarly communication and software development (Campbell-Meier 2011). Campbell-Meier adds that the demand for OAIR has increased as a result of improvements in

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scholarly communication models and the need to develop. In additional studies on the use of OAIR, Lynch and Lippincott focused solely on the United States, while Van Westrienen and Lynch focused on 13 Western countries in Europe (Fralinger and Bull 2013). These researchers were among the first to examine the use and expansion of OAIR.

Academic libraries need to incorporate technological solutions into traditional information products and services, including integrated information systems, digital information systems, computing, radio frequency recognition software and local area and wide area networks (Makori 2009). Libraries have traditionally been a source of information and knowledge. This gives university libraries the ability to impact academic education, teaching and science. University libraries acquire, store, organise, distribute and manage information tools for students in connection with reading, teaching, study and community services (Makori 2015). Library staff provide high-quality information services to students, staff, scholars and the university community in order to promote higher satisfaction and better return on investment, which in turn fosters national and institutional growth.

Since the OA campaign gained momentum as a global effort to provide free online access to scholarly research, the movement to adopt the OAIR initiative in Africa has likewise grown (Otando 2011). OAIR is now the latest indicator of the quality, reputation and visibility of universities. Notwithstanding these benefits, a slow response to OAIR was recorded in Africa (Zaid and Okiki 2014) compared to other regions such as Europe, Asia and America. Therefore, the need to redesign the information products and services becomes necessary to meet the changing needs of patrons (Bryson 2017). The collection, processing, preservation and integration of information contents into OAIR are critical to the mission of the university, regardless of their format (Samzugi 2017). The universities of most less advanced nations are still grappling with making the results of their research accessible in OAIR (Adeyemi, Appah, Akinlade and Bribena 2017).

The state of OAIR in Ghana accordingly emphasises the need for an effective process of information collection and dissemination within the universities in the country. The repository policies are undefined and analysed; metadata reuse policy, the full data item policy, content policies, the submission policy and preservation policies are all explicitly undefined (Adeyemi et al 2017:301). Although research is compulsory for both academic staff and students in Ghanaian universities, either by job description or by a prescribed academic programme of study, the research outputs reside in obscurity and are not visible to those who may need them.

In light of this and the fact that the OAIR is not used, this article proposes a model for the usage of OAIR in university libraries in Ghana. The article concentrated on five university libraries situated on the main university campuses, which are the only ones listed in DOAR and ROAR. There were other university libraries with OAIR, but they were deemed not operational. It is expected that university libraries with operational OAIR have comparatively well-established libraries, and thus stand to gain more.

Statement of the problem

According to Abrizah et al (2017), OAIR has the potential of increasing the availability, accessibility, visibility and prestige, ranking and public value of researchers and research outputs in universities (Dlamini and Snyman 2017). OAIR improves the prominence and reputation of the institution's research interests. Despite the potential benefits associated with the usage of OAIR by universities, the researcher observed that most universities in Ghana have not started the application of OAIR in their innovative practices. This is evident in the low number of deposits in OAIR, and analysis has also shown a lower number of OAIR users. Many university libraries in Ghana still battle to make their research outputs open and accessible through OAIR. Against this backdrop, this article develops a model for the usage of OAIR in academic libraries in Ghana.

Purpose of the study

The purpose of the article is to develop a model for the usage of OAIR in Ghanaian university libraries.

Literature review

Overview of Open Access Institutional Repositories

Globally, ICT systems developments are increasingly becoming the core and vital component for organisational operations. Organisations, including universities, increasingly seek ICT-based approaches to provide and enhance the delivery of quality services to clients (Ondieki Makori 2013). ICT has eliminated many of the limitations traditionally associated with access to knowledge, including geographical barriers,

time constraints and delays in dissemination and usability barriers, restricting the range of sources that a single person can access (Rahman and Panda 2012). According to the Association of College and Research Libraries (ACRL), more institutions are setting up repositories to house the publications of their faculty to provide open access to these papers as a way to disseminate and view the academic performance of their institution (Dawson and Yang 2016). In terms of research performance, developing countries in Africa are ranked the lowest (Dlamini and Snyman 2017). Most of the research outputs by African academics and researchers gather dust in the various departmental offices and institutional libraries without getting published (Mohammed 2013). According to Dlamini and Snyman (2017), African academics strive to publish in internationally renowned peer-reviewed journals in order to ensure academic promotion.

Many scholars do not succeed in publishing in these journals, and when they do, the journals are unavailable in most African university libraries. This makes the African researcher highly dependent on research generated in developed countries, which is often largely irrelevant to African information consumers (Ezema 2011). One of the pathways used to enhance the availability, accessibility and visibility of content from Africa is through OAIR (Dlamini and Snyman 2017). The usage of OAIR in African academic institutions is therefore a serious developmental issue that urgently needs attention (Ivwighreghweta 2012). OAIR provides authors with an audience worldwide that is greater than any subscription-based journal, no matter how prestigious or popular the journal, thereby demonstrably enhancing the exposure and influence of their research (Ali, Jan and Amin 2013). Abrizah et al (2017) state that many universities around the world have launched projects to build repositories that enable faculty and researchers to upload and access academic literature and use it to share resources within the institution or across the country.

In this way, sharing resources could lead to improved teaching and learning efficiency, sharing good practice, greater consistency, and an increased sense of community. Abrizah et al (2017) attempted to use a survey approach to demonstrate the use of OAIR and its content in universities across 13 countries, including Australia, Canada, the United States and 10 other European countries. Wilson and Jantz (2011) found that OAIR deposits among American research libraries (ARL) show great variation across disciplines and are lagging behind in humanities scholarship, especially in History, English and Linguistics. While highlighting the importance of OAIR, Ali et al (2013) reveal that knowledge workers in developing countries are gaining access to academic and scientific publications and online resources at a historically incomparable pace. This can be attributed to the movement for Open Access (OA), and the growing number of OAIR, which guarantee to provide even greater access to previously inaccessible resources and publications. Technology and interoperability requirements also provide libraries in developing countries with great opportunities to disseminate local research and bridge the knowledge gap.

Open access

OA may be described as a philosophy to achieve the goal of accessing and making available free of charge electronic content that may or may not be free of restrictions on copyright and licensing (Narayana, Biradar and Goudar 2008). There are a number of open access concepts and the term continues to evolve. Nevertheless, the best current definition of this concept is collectively comprised of several main documents that build on each other. These include the Budapest Open Access Initiative (2002), the Bethesda Statement on Open Access Publishing (2003), the Berlin Declaration on Open Access to Knowledge in Science and Humanities (2003) and the Bangalore Open Access Commitment (2006) (Mgonzo and Yonah 2014). The common definition of OA is referred to as the 'BBBB' and describes OA as electronic, online, free-of-charge, free-of-copyright and licensing literature for everyone with Internet connection (Mgonzo and Yonah 2014). The increasing interest in OA scholarly communication is because of the great opportunities OA initiatives provide for wider dissemination of research findings, particularly among developing countries. Access to scholarly information has traditionally been restricted by subscriptions, licences or other fees to commercial publishing houses (Bjork 2017). The OA movement evolved as an alternative to the high cost of journal subscription among libraries (Lewis 2012). It is a platform that offers researchers greater opportunity for wider dissemination of findings without article processing charges (Van Noorden 2013).

Open Access Institutional Repositories

The OAIR idea was born out of the struggle of how, and who is responsible, to disseminate the intellectual output of an institution through the Internet (Alemayehu 2010). Therefore, OAIR is viewed as one of the strategies used by different groups to address user information needs, although they face several challenges to evolve as expected. Also, keeping a critical view of how the OAIR would be the best tool for disseminating research results and recognising its technical drawbacks, strengths and challenges are the most important things in operating an OAIR that clearly identifies its purpose. The undeniable fact here is that the contribution to educational and research institutions will be fruitful if OAIR is implemented and treated in a coordinated manner (Alemayehu 2010). OAIR is also known as institutional repositories or electronic repositories (Dlamini and Snyman 2017). Okumu (2015) describes OAIR as the means by which diverse digital materials produced locally can be collected and accessed. OAIR is the collection of the organisation's intellectual electronic resources (Okumu 2015). OAIR is the tool or system that allows the intellectual output of the institution to be recorded, stored, preserved and disseminated in electronic form. The author emphasises that such production differs from institution to institution; some will capture theses and dissertations, while others will capture published papers, unpublished preprints, working papers, conference presentations, data sets, teaching materials and other similar materials (Okumu 2015).

OAIR is a database that provides services to record, store, archive, preserve and redistribute research output in digital formats at a university (Dlamini and Snyman 2017). These are electronic intellectual product repositories created by an institution's faculty, researchers and students and are open to end-users within and outside the institution, with few if any barriers to entry (Ezema and Onyancha 2016). Dlamini and Snyman (2017) define OAIR as a digital archive for storing and disseminating the findings of institutional research. OAIR has great value-added services potential and provides academics, researchers, learners and institutions a range of benefits. In Crow's opinion, while publication by faculty members in scholarly journals could have an effect on the reputation of the institutions in which they reside, OAIR is likely to have a greater impact by centralising the research outputs produced by the institution and the researchers. Consequently, this will serve as a much better and simpler tool for assessing the performance of academic research, profitability and the reputation of institutions (Adeyemi et al 2017).

OAIR and Academic Institutions in Africa

The usage of OAIR in Africa has been an issue of great concern among scholars within and outside Africa (Ratanya 2017). Access to academic research in developing countries is growing as a result of the growth of OAIR and related advances in information technology. However, Ratanya adds that a growing number of academic institutions encourages students to send theses in an electronic format, making them increasingly accessible in the dynamic research environment. In addition to paper copies, higher education institutions request that electronic versions be made available for inclusion in OAIR, while many institutions also digitise. The growth of OAIR in African countries has been very slow, given the international recognition it has gained through conferences and workshops (Ezema 2011). South Africa, Kenya and Nigeria are more adaptable to the development of OAIR among the African countries. According to the DOAR (2018), of the 158 OAIR in Africa, 33 are situated in South Africa. Recent studies show that in terms of developing OAIR, South Africa is the leading country in Africa. Although not a university, the Council for Scientific Research and Industrial Research (CSIR) is also a major research institute with a wealth of available research information for the development of OAIR in South Africa.

The potential of Kenyan universities to become Africa's base for information technology has been fuelled by the giant international software business network set up by a research laboratory at the Catholic University of East Africa in Nairobi (Milimo 2013). The laboratory plays a key role in the advancement of OA in the academic research goals of the university. Jomo Kenyatta University of Agriculture and Technology recently adopted an OA policy as part of the university's strategic objective of investing and engaging in productive collaboration with national and international institutions and industry to facilitate the creation and exchange of information through OAIR. Research in Kenya shows that several universities have initiated the establishment of OAIR. University libraries in Kenya have been found to support OA in a number of ways, including setting up OA by means of author funds that, although limited, cover payment of OA journals. Universities in Kenya, including the

Catholic University of East Africa, the University of Nairobi, the University of Strathmore and the Jomo Kenyatta University of Agriculture and Technology, have begun creating OAIR, namely Dspace and Greenstone, while including them in library collections to promote learning and teaching (Milim 2013). According to Ezema (2011), factors contributing to the failure of OAIR in Nigeria were lack of awareness of OAIR, insufficient power supply, and the lack of trained personnel in information communication technology. While OAIR is a capital-intensive venture, no nation that wants to be part of the current information economy should neglect the critical role of OAIR in aggregating the research productivity of scholars.

Despite the importance of OAIR to the increasing visibility and better performance in the ongoing online ranking of world universities, the development of OAIR is still in its infancy in Ghana. According to Akintunde and Anjo (2012), Kwame Nkrumah University of Science and Technology (KNUST) was the first institution to create an OAIR in Ghana and West Africa in June 2008. The library implemented Dspace, an open-source self-archiving programme, Moodle to provide online learning, and Drupal to operate the website of the university as an open-source content management system. A KNUST University librarian first conceived the idea of setting up an OAIR for a university in Ghana after attending a workshop in the UK in 2006 in her capacity as coordinator for the Electronic Information for Libraries Network (eIFLnet) in Ghana. In June 2007, a workshop was organised by the Consortium of Academic and Research Libraries in Ghana (CARLIGH) and eIFLnet to introduce the OAIR concept and the different software packages needed to set up an OAIR. Participants in the two-day workshop included staff from the various universities and research institutions across the country, such as librarians, faculty and ICT personnel. Most of the participants shared their willingness to use the Dspace programme to set up their OAIR. CARLIGH and International Network organised a second workshop in July 2008 for the Availability of Scientific Publications (INASP), and the third workshop for faculty members from different universities was organised in February 2009. The KNUST Library soon organised itself after these workshops to set up the country's first effective institutional repository. The DOAR (2018) identified the vital issues of the only five operational OAIR in Ghana. Their repository policies are not described and

evaluated (metadata reuse specifically undefined policy, explicitly undefined full data item policy, explicitly undefined content policy, explicitly undefined submission policy and explicitly undefined preservation policy).

Technology Acceptance Model

Technology Acceptance Model (TAM) is a theory of information systems that models how technology is accepted and used. The model suggests that many factors influence their decision about how and when they will use it when users are presented with new technology. Davis's TAM (Davis et al 1989) is the most commonly used framework for the adoption and use of technology (Abbasi, Tarhini, Elyas and Shah 2015). According to Bagozzi, Davis and Warshaw (1992), because new technologies, such as personal computers, are complex and there is an element of uncertainty in the minds of decision-makers about the successful use of them, people are forming attitudes and intentions to try to learn how to use new technology before starting the user-oriented effort (Abbasi et al 2015).

Although it has proved to be an effective tool for determining behavioural intentions to use IS, the classical TAM model has several limitations (Legris, Ingham and Collerette 2003). Nonetheless, several researchers modified and expanded Davis' TAM design due to these limitations (Sullivan 2012). Past research has shown that classical TAM is a useful theoretical model that can help explain the behaviour of users when implementing information systems (Gefen, Karahanna and Straub 2003). Indeed, past empirical testing on TAM has shown that the tools used in these tests are statistically reliable (Sullivan 2012;). Overall, many researchers claim that TAM remains an effective robust model and theoretical framework for predicting the use of information systems (Venkatesh, Morris, Davis and Davis 2003).

Several researchers repeated the original study by Davis (1989) to provide empirical evidence of the relationships between usefulness, ease of use and use of the method (Szajna 1994). A great deal of attention has been given to testing the robustness and validity of the questionnaire used by Davis. Adams, Nelson and Todd (1992) replicated the work of Davis et al (1989) to demonstrate the validity and reliability of his instrument and its measurement scales. They also extended it to different settings and showed the internal consistency and reliability of the two scales by

Figure 1. Conceptual Framework for OAIR Usage Model (Kodua-Ntim, 2019).

using two different samples. Hendrickson, Massey and Cronan (1993) found high reliability and test re-test reliability. Szajna (1994) found the instrument to have predictive validity for purpose of use, self-reported use, and attitude to use. The sum of this work supports the reliability of the Davis instrument and promotes its use with different user groups and different software choices. Segars and Grover (1993) re-examined the replication of the Davis study by Adams et al (1992). They criticized the measuring method used and postulated a different model based on three constructs; usefulness, effectiveness and ease of use. Workman (2007) tested and supported some aspects of these findings, however, by separating the dependent variable into information use and technology use. In most technical and geographical contexts, TAM has been used; one of these contexts is the rapidly growing information systems (Rahimi, Nadri, Afshar and Timpka 2018).

Conceptual framework

The conceptual framework, according to Kumar (2019), is an aspect that is derived from the concepts and theories and becomes the basis for a research problem. Conceptual framework is the argument about why the topic one wants to study matters and why the proposed means of studying it are appropriate and rigorous (Wong, Teo and Russo 2012). This study opted to use a conceptual framework to identify and indicate the various aspects that influence OAIR's use in creating an OAIR Usability Model (see Figure 1). Usability is a multidimensional structure that can be looked at from different perspectives (Kim 2008).

The International Organisation for Standardisation defines usability as the extent to which specific users can use a product to achieve specific objectives in a specific user context with efficiency, effectiveness and satisfaction. Other studies share similar perspectives. Brink, Gergle and Wood (2002) describe usability as functionally correct, user friendly, easy to learn and remember, error tolerant and subjectively pleasing, whereas Oulanov and Pajarillo (2002) proposed five attributes, including efficiency, helpfulness and adaptability. The Massachusetts Institute of Technology (MIT) Information Services and Technology Department (2004) also provided the usability guidelines of ten attributes, including navigation language and content, architectural and visual clarity and functionality.

The following issues hinder the usability of OAIR, namely mandate, interoperability, copyright issues, content recruitment, promotion and preservation strategies. The independent variables of availability, accessibility and visibility of OAIR are influenced by the intention to reuse and user satisfaction. Additionally, the intention to reuse and user satisfaction have an impact on usage benefits of OAIR, such as the efficient and effective dissemination of scholarly information.

The constructs used in the conceptual framework are accessibility, availability, visibility, user satisfaction, intention to reuse and usage benefits. Therefore, the descriptions of the constructs are as follows:

Accessibility

Accessibility in the study is the number of clicks that a user needs to navigate from those results to the full text of the paper itself; thus, accessibility refers to the amount of work that a user needs to obtain the item after determining that it is available. In the study, accessibility refers to the support provided to promote the use of OAIR within university libraries by library

staff and OAIR managers. The interactive and participatory nature of OAIR can influence lecturers, researchers and students to use it for their research work. On the one hand, library staff play an important role in providing support to OAIR users by delivering planned services efficiently and accurately (reliability), providing timely assistance (responsiveness), fostering confidence and trust (assurance), and providing programme users with individual attention (empathy) (Chua and Goh 2010). Accessibility measures in the study included responsiveness, content and timeliness, reliable Internet access, system use guidelines, assurance, availability of technical support and reliability. Accessibility was found to affect both user satisfaction and perceived net benefits (Wang 2008). The study investigated how accessibility affects both user satisfaction and intention to reuse OAIR. Therefore, the following hypotheses were proposed:

> H1: Accessibility has a positive effect on satisfaction in OAIR context.
>
> H4: Accessibility has a positive effect on intention to reuse OAIR.

Availability

The availability in the study refers to the ability of search engines to obtain clear links to an individual paper within the first two pages of results. Availability refers to the simple presence of an item in a search results set, an indication that the item exists. According to Jennex and Olfman (2006), availability ensures that the correct information is captured at the right time and available to the right users. Availability in the study means that the right information is generated and shared for the benefit of the university libraries and their parent institutions. According to Jennex and Olfman (2006), the availability process looks at organisational processes, such as identifying OAIR users and collecting and reusing OAIR items. Formalities of these processes include planning and formatting and context of information to be stored in OAIR. Furthermore, accuracy and timeliness construct could be used to measure availability and information wealth, and links between components of information to ensure availability (Jennex and Olfman 2006).

Examples of availability constructs are personalisation, completeness, relevance, ease of comprehension, currency, timeliness, and usability (Petter,

DeLone and McLean 2008). Availability was found to have a strong influence on user satisfaction in the context of university libraries (Masrek, Jamaludin and Mukhtar 2010). Previous studies have shown that availability has positive effects on perceived value and user satisfaction, which in turn has a significant impact on reuse intention (Dwivedi, Kapoor, Williams and Williams 2013). Academic staff perceive the quality of information provided by OAIR in their libraries to be better than others; therefore, they are more likely to continue to use the system. Consequently, when investigating the satisfaction and intention to use OAIR, availability is important. Reliable information, accurate information, relevant information, understandable information, completeness, feasible and significant information and up-to-date information are accessible constructs used in this analysis. Therefore, the following hypotheses were developed in the study:

> H2: Availability has a positive effect on satisfaction in OAIR context.
>
> H5: Availability has a positive effect on intention to reuse OAIR.

Visibility

Visibility in the study refers to how well the framework performs knowledge creation, storage, and retrieval, transfer, and application functions. In the context of the study, visibility measures the desired characteristics of OAIR and how universities could use it. In the context of OAIR, visibility was found to be a strong indicator of user satisfaction (Petter and McLean 2009) and is moderately influenced by perceived net benefits (Petter et al 2008). Therefore, due to visibility, academics are more likely to continue to reuse the OAIR. Visibility thus increases user satisfaction with the use of OAIR in university libraries. Because of better interaction with the system, lecturers, researchers and students are more likely to continue to reuse OAIR services. Jennex and Olfman (2006) provide the following constructs used to measure visibility: the amount or number of experiences already gained in the development and maintenance of the system; the amount or number of experiences used to develop and maintain the system; and the software and hardware used. The constructs employed in the study to measure OAIR visibility include usability, adaptability, availability, flexibility, stability, reliability and accessibility of the system.

Therefore, the following hypotheses were proposed in the study:

> H3: Visibility has a positive effect on satisfaction in OAIR context.
>
> H6: Visibility has a positive effect on intention to reuse OAIR.

Satisfaction

Satisfaction in the study refers to the level of satisfaction that users feel they have with a system relative to what the user expects when the system is first used (Serumaga-Zake 2017). Jennex and Olfman (2006) add that, when system usage is required, satisfaction is the most applicable measure of success. The efficiency of use, on the other hand, depends on users being satisfied with the system in use (Jennex and Olfman 2006). Satisfaction in the OAIR setting refers to the feeling of pleasure or displeasure that results from combining all the benefits that a person hopes to receive from the interaction with the OAIR system (Masrek et al 2010). Satisfaction can be measured using factors such as adequacy, effectiveness, efficiency, enjoyment, satisfaction with information and satisfaction with the system (Urbach and Muller 2012). Factors of satisfaction measured in the study include efficiency, effectiveness, knowledge needs satisfaction, enjoyment and adequacy. Significant satisfaction factors are net benefits and intention to reuse the system (Dwivedi et al 2013). Therefore, the following hypotheses were tested:

> H7: Satisfaction has a positive effect on intention to use in OAIR context.
>
> H8: Satisfaction has a positive effect on usage benefits in OAIR context.

Intention to reuse

In the study, the intention to reuse the system refers to the favourable attitude of the user towards the OAIR, which results in the repeated use of content gathering and sharing behaviour (Wang 2008). In the study, the intention to reuse the system was explained as a repetition of OAIR application and use after being satisfied with the benefits it affords the user. Previous studies have consistently shown that reuse of the system is a very important factor in determining user acceptance of the information system in the field (Wang 2008). The measures used in the study to measure the intention to reuse OAIR include making the right decision, recording information, communicating information with colleagues, creating specific information and sharing such information. Thus, the following hypothesis was proposed:

> H9: Intention to reuse has a positive effect on usage benefits in OAIR context.

Usage benefits

According to DeLone and McLean's (2004) model, usage benefits in the study refer to both positive and negative impacts of the system on the user; however, the researcher needs to define the stakeholders clearly and carefully, as well as the context in which usage benefits are to be measured. Serumaga-Zake (2017) described usage benefits as an individualised comprehensive measure of the amount of all past and expected future benefits due to the use of an IT system. Any use of resources (including time) in the building, learning how to use and using the system is costly. Therefore, in order to measure usage benefits, one must adopt the point of view of some stakeholders on what is valuable and what is not. The expected usage benefits in the sense of the study relate to the positive impact that OAIR use will bring to the client. Constructs used to measure perceived usage benefits in the study, therefore, include new knowledge and innovation, ideas for acquisition, management and storage of information, task performance, job improvement and quality of work improvement.

Research methodology

Positivist paradigm, quantitative research approach and survey design were used for the study. Simple random sampling and stratified random sampling were the sampling procedures and methods employed. The questionnaire was used as a research instrument to gather relevant data for the study. Five university libraries in Ghana were selected because they were the only universities listed in the DOAR (DOAR 2018), they are the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), University of Cape Coast (UCC), University for Development Studies (UDS) and Ashesi University (AU). Therefore, they are obligated to meet certain operational criteria, such as infrastructure and resources, the number of qualified and permanent staff, the notion of well-equipped libraries and the operational status of their OAIR.

The target population of the study was the 3439 academics at the five selected universities. The population was deemed to be uniform, because the researcher believed the participants were stakeholders who sought to enhance the learning environment through instruction, applied research, scholarly activity and service, all of which support the mission of a university. Academic staff have various ranks, therefore the study participants were stratified prior to being randomly selected, so that each rank would be fairly represented. The sample size of the study was the 1085 academic staff working in the five selected universities. The study used a statistical power analysis software package known as Sample Size Calculator of Creative Research System to calculate the sample size (Creative Research Systems 2003). A total of 998 respondents completed the questionnaire distributed face to face, giving a response rate of 91.98%. Colleagues helped with the collection of the questionnaire as the respondents were instructed to leave the questionnaire with them or the University Librarian. Descriptive statistics (frequencies, percentages, means and standard deviation) and inferential statistics (multinomial logistic regression and CFA using SEM) were used as statistical tools to analyse the data, assisted by SPSS.

Analysis and findings

Several factors could be integrated to facilitate the usage of OAIR within university libraries. For the study to identify those factors, a conceptual framework was employed. The conceptual framework was made up of six variables, which was consistent with the literature. Variable one has five items representing accessibility. Variable two is composed of seven items representing availability. Variable three is composed of seven items representing visibility. Variable four is composed of five items representing an intention to reuse the system. Variable five is composed of five items representing satisfaction. Variable six is composed of five items representing usage benefits.

Therefore, the six variables with 34 items were considered for confirmatory factor analysis (CFA). Structural Equation Model (SEM) was employed in the study to explain relationships among the factors that affect the usage of OAIR. SEM is a confirmatory method providing comprehensive means for validating the measurement model of latent variables. The validating procedure is called CFA. The researcher performed CFA for all the latent variables involved

in the article before modelling their inter-relationship in the structural model. In the context of SEM, the CFA is often called 'the measurement model', while the relationship between the latent variables (with directed arrows) is called 'the structural model'.

Measurement model

CFA is a special form of factor analysis. It was employed to test whether the measures of a construct are consistent with the researcher's understanding of the nature of that construct. Every measurement model of a latent construct needs to undergo CFA before modelling in SEM. The conceptual framework has three (3) exogenous variables, namely accessibility (2 items), availability (4 items) and visibility (2 items) as well as three (3) endogenous variables, namely intention to reuse (2 items), satisfaction (4 items) and usage benefit (2 items). The measurement model was employed to represent how measured items come together to represent variables. The findings are presented in the Figure 2.

The first-order CFA was conducted using AMOS version 23 to test the measurement model. Researchers use more than a dozen different fit statistics to assess their measurement models and structural models. Kline (2015) and Cornell University Statistical Consulting Unit (2017) suggest that the minimum set of fit statistics that should be reported are X2/df, RMSEA, CFI, RMR, AGFI and NFI. These six fits statistics were used for the study. This is presented in the Table 1.

The measurement model was further assessed for convergent validity of scale items by using reliability, CR and AVE. Reliability of factors was estimated by assessing the Cronbach's alpha and factor loadings from the CFA. Thus, the Cronbach's alpha coefficients of all six constructs were 0.8 to 0.9, which indicates that the measurement model used for the study was highly reliable. Convergent validity was further evaluated by examining the factor loadings from the CFA. In the study, all the factor loadings of the items in the CFA for the measurement model were between 0.98 and 0.75. Thus, all the factors in the measurement model had good reliability and convergent validity.

Further, the CR and AVE, which were indicators of the convergent validity, were conducted. CR was measured by assessing the internal consistency of the measurement model. Discriminant validity was used to assess the extent to which a concept and its
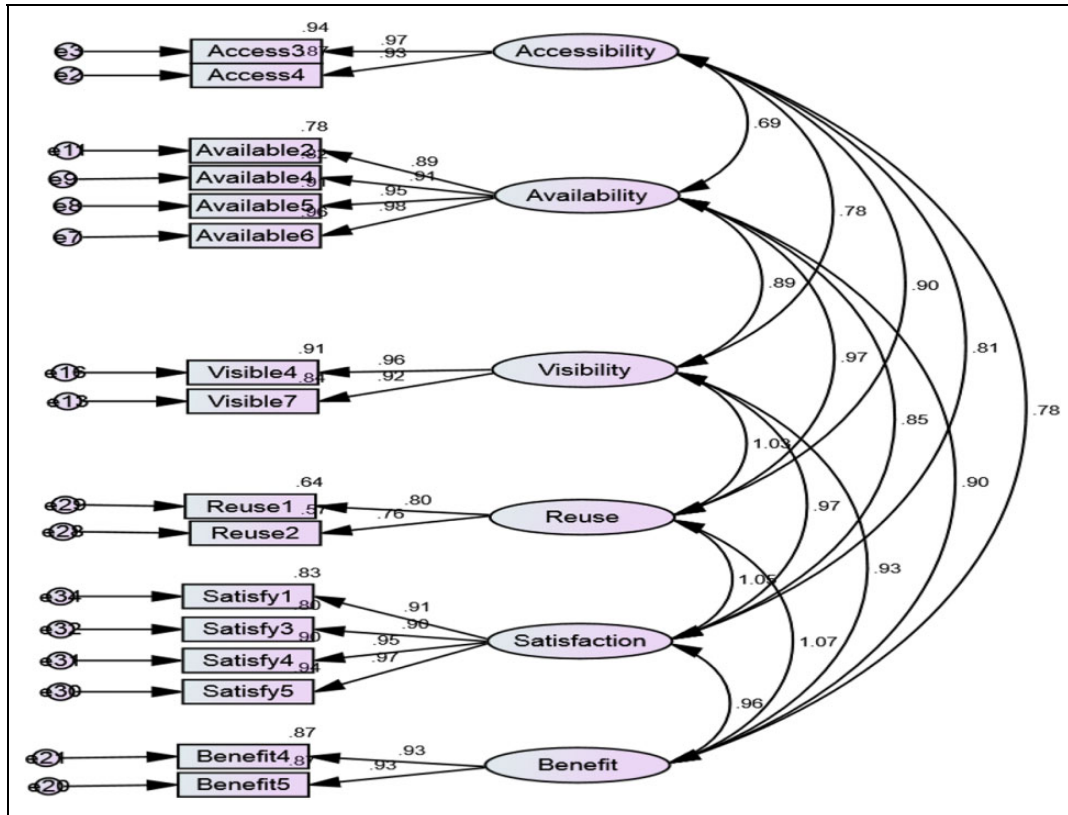
Figure 2. Measurement model.

Table 1. Fit statistics for the measurement model.

Fit Statistics	Measurement Model	Cut-Off for Good Fit
X^2/df	0.678	≤ 3.0
RMSEA	0.023	≤ 0.06
CFI	1.000	≥ 0.90
RMR	0.021	≤ 0.08
AGFI	0.997	≥ 0.90
NFI	0.998	≥ 0.95

Source: Field data, Kodua-Ntim (2019).

indicators differ from another concept and its indicators. The study findings indicated that the square root of the AVE was greater than its correlations with all other constructs. Therefore, discriminant validity was established. The findings also showed that the CR ranged between 0.6 and 0.9, which indicates that the research model can be considered and that it had acceptable convergent validity. On the other hand, all six constructs indicated an AVE of 0.6 and 0.9; therefore, the measurement model in the study had an acceptable AVE. All diagonal values exceeded the inter-construct corrections, and thus, the results

confirm that the research instrument had satisfactory construct validity. In addition, the CFA measurement model had adequate reliability, convergent validity and discriminant validity. Table 2 presents CR, AVE and discriminant validity of constructs.

When the structural model was (Figure 3) compared to the measurement model, the results showed no significant difference between the two. This means that the structural model had an excellent statistical fit as compared to the measurement model. Therefore, the researcher decided to continue with the structural model. This is presented in Table 3.

SEM results showed standardised path coefficients, their significance for the structural model and the coefficients of determinants for each endogenous construct. The standardised path coefficient indicated the strengths of the relationships between the independent and dependent variables. Therefore, in the study, out of twelve hypotheses, nine of them were found significant.

Firstly, accessibility had no significant effect on satisfaction. Therefore, hypothesis H1 was rejected (P>0.099). Further, the study showed that accessibility had a significant effect on intention to reuse OAIR

Table 2. CFA results for the measurement model.

Factors		M	SD	Factor Loadings	α
Accessibility	IRs are easy to use (usability)	4.15	.703	.969	.893
	IRs are easy to learn and adapt (adaptability)	4.09	.570	.933	
Availability	IRs provide reliable information for research work (reliable)	4.03	.834	.886	.962
	IRs provide accurate information for research work (accuracy)	4.15	.820	.905	
	IRs provide relevant information for research work (relevance)	4.00	.920	.952	
	IRs provide detailed information	3.91	.792	.980	
Visibility	Users within IRs can easily access their information needs (content or scope and timeliness).	4.06	.693	.956	.813
	Library provides reliable technical support and personnel.	3.82	.868	.919	
Intention to reuse	I will use IRs to communicate research output with colleagues	4.24	.552	.799	.852
	I will use IRs to share my research output	4.30	.522	.755	
User satisfaction	I am satisfied with IRs' efficiency	3.67	.841	.913	.827
	I am satisfied that IRs meet my research processing needs	3.79	.807	.896	
	I am enjoying using IRs (enjoyment)	3.70	.836	.951	
	I am satisfied with IRs' adequacy	3.36	.851	.970	
Usage benefits	IRs help me to acquire new knowledge and innovative ideas	4.09	.793	.934	.891
	IRs help me to effectively manage and store information I need	4.03	.759	.935	

Source: Field data, Kodua-Ntim (2019).

Table 3. Fit statistics for the structural model.

Fit Statistics	Structural Model	Cut-Off for Good Fit
X^2/df	0.679	≤ 3.0
RMSEA	0.023	≤ 0.06
CFI	1.000	≥ 0.90
RMR	0.021	≤ 0.08
AGFI	0.997	≥ 0.90
NFI	0.998	≥ 0.95

Source: Field data, Kodua-Ntim (2019).

and usage benefit. Therefore, the hypotheses H4 and H10 were accepted (p<0.000 and p<0.000).

Secondly, availability had a significant effect on satisfaction and intention to reuse OAIR. Therefore, hypotheses H2 and H5 were accepted with the significant value of (p>0.005 and p>0.000). Further, availability had a significant effect on usage benefit. Therefore, hypothesis H11 was accepted (p<0.000).

Thirdly, visibility had no significant effect on satisfaction. Thus, hypothesis H3 was rejected (p>0.790). Further, the study findings showed that visibility showed a significant effect on intention to reuse OAIR and usage benefit. Therefore, hypotheses H6 and H12 were accepted (p<0.000 and p<0.000).

Fourthly, satisfaction had no significant effect on intention to reuse OAIR. Therefore, hypothesis

H7 was rejected (p<0.030). Satisfaction had a significant effect on usage benefit. Thus, hypothesis H8 was accepted (p<0.000).

Lastly, intention to reuse OAIR had a significant effect on usage benefit. Therefore, hypothesis H9 was accepted (p<0.000). The findings are presented in Table 4.

Discussions

Several factors could be integrated to facilitate the usage of OAIR in university libraries. Factors used in this study were accessibility, availability, visibility, intention to reuse satisfaction and usage benefits. The study adopted the Technology Acceptance Model (TAM), which was then modified to fit the study. A prerequisite for validating the structural model was the estimation of the measurement model through confirmatory factor analysis (CFA) (Hair, Black, Babin, Anderson and Tatham 2010). After submitting the measurement items to CFA, the initial results suggested that all fit statistics showed good fit for the measurement model; thus, the measurement model, as proposed by Hair et al (2010), was adopted for SEM. By using three criteria, namely reliability (R), composite reliability (CR) and average variance extracted (AVE), the measurement model was further evaluated for convergent validity of scale items. According to Hair et al (2010), reliability is an

Table 4. Result testing of hypotheses.

Hypotheses	Path	P-value	Decision
H1	Accessibility → Satisfaction	.099	REJECTED
H2	Availability → Satisfaction	.005	ACCEPTED
H3	Visibility → Satisfaction	.790	REJECTED
H4	Accessibility → Intention to reuse	.000	ACCEPTED
H5	Availability → Intention to reuse	.000	ACCEPTED
H6	Visibility → Intention to reuse	.000	ACCEPTED
H7	Satisfaction → Intention to reuse	.030	REJECTED
H8	Satisfaction → Usage Benefit	.000	ACCEPTED
H9	Intention to reuse → Usage Benefit	.000	ACCEPTED
H10	Accessibility → Usage Benefit	.000	ACCEPTED
H11	Availability → Usage Benefit	.000	ACCEPTED
H12	Visibility → Usage Benefit	.000	ACCEPTED

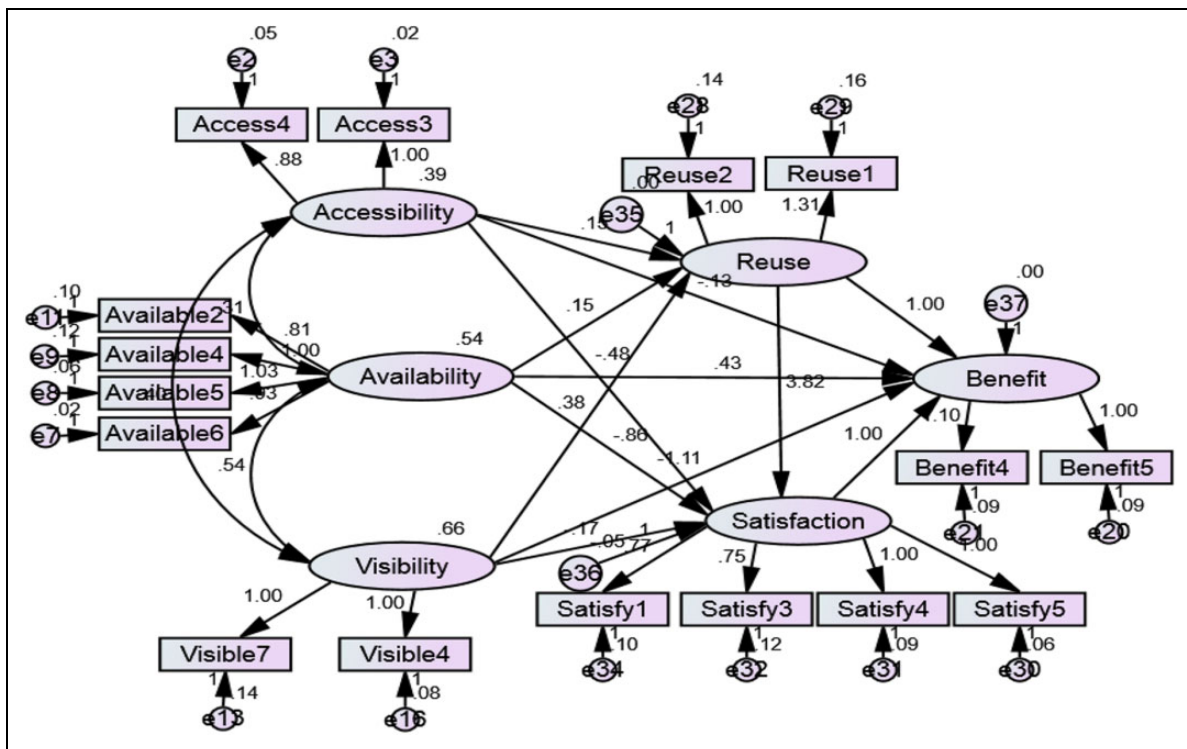Source: Field data, Kodua-Ntim (2019).

Figure 3. Structural model.

assessment of the degree of consistency between several factor measurements. R was calculated by evaluating CFA loadings of Cronbach's alpha and factor analysis. Therefore, the coefficient of Cronbach was examined for each aspect. Hair et al (2010) provide that good reliability is suggested by the thumb rule for a reliability estimate of 0.7 or higher. The reliability between 0.6 and 0.7 can also be accepted, however, provided that other indicators of the construct validity

of the model are good (Hair et al 2010). In the analysis, the alpha coefficients for Cronbach of all six variables ranged from 0.8 to 0.9, suggesting that the instrument adopted for the research was highly reliable.

Convergent and discriminant validity have been established accordingly. Evaluating the CFA factor loadings tested convergent reliability. Composite reliability was measured by testing the internal

consistency of the measurement model. Therefore, the reliability and convergent validity of all variables in the measurement model was adequate. Using CR and AVE, convergent validity was also evaluated. The CR tested the internal consistency of the measurement model. Recommended CR thresholds are 0.70 or higher and an AVE of more than 0.50, followed by internal consistency construct (Hair et al 2010). The findings showed that CR ranged from 0.6 to 0.9, suggesting that the study model could be viewed as having acceptable convergent validity. The discriminant validity, on the other hand, measured the degree to which a concept and its indicators vary from another concept and its indicators (Phillips, Bagozzi and Yi 1991). When the square root of the extracted average variance is greater than its correlations with all other variables, it means that it has established discriminant validity. The findings of the study showed that all of the AVE square roots are greater than the correlations in the model between a variable and any other variable. This meets the criteria of discriminant validity of Fornell and Larcker (1981) (Phillips et al 1991). Therefore, the AVE should be 0.5 or higher to indicate the correct convergent validity. All six variables showed an AVE of 0.5 and 0.6 in the analysis, which indicates that the study's measurement model can also be assumed to have acceptable convergent validity. In other words, both the measuring model and the structural model had adequate reliability, convergent validity and discriminant validity in the study.

SEM was conducted to verify whether the variables specified in the study were supported. Hair et al (2010) add that SEM is a family of statistical models that seeks to explain the multi-variable relationships. To observe the structural model, the same sets of fit statistics used for the measurement model were also used. The findings revealed no significant difference between CFA and SEM models fit statistics. As this means that SEM has an excellent model fit, the researcher decided to continue with it. Twelve relationships have been proposed by the study. Usage benefits were considered as a dependent variable in the analysis, while the rest of the variables were considered as independent variables, namely accessibility, availability, visibility, intention to reuse and satisfaction. The standardised path coefficient indicates the strength of the relationship between the independent and the dependent variables. The results suggested significant support for the conceptual framework (OAIR Use Model) to enhance the use of OAIR in university libraries in Ghana. In the

analysis, nine of the twelve hypotheses were accepted, as explained below:

Accessibility

First, there was no significant effect of accessibility on satisfaction. However, the study showed that accessibility had a significant effect on the intention to reuse OAIR and usage benefit. The results of the study showed that accessibility had the strongest direct effect on user satisfaction compared to any other variable within the model. The study findings provide that university libraries, as well as library staff, need to ensure accessibility to improve the use of OAIR in order to meet the needs of users. Accessibility, on the other hand, had the strongest positive effect on the intention to reuse the OAIR. Therefore, the study has indicated that, should OAIR be accessible, it will increase the intention to reuse the system among academic staff. The findings of the study revealed that accessibility played a key role in driving user intention (H1 and H4). The university should, therefore, work to improve the overall accessibility of OAIR in order to increase the user's intention to use it. Academic staff are supposed to be the key readers and contributors to the OAIR website. Increasing their intention to use helps enrich the OAIR platform content. Furthermore, university libraries should provide open OAIR, respond timely to user queries and demands, maintain trust and confidence, and give academic staff individual attention to use the platform. University libraries should also identify IT library staff to manage OAIR. Therefore, academic staff should also take advantage of a wide range of OAIR functions to strengthen the intention of the user. The findings of the study have also shown that accessibility has no significant effect on usage benefits. The study finding was inconsistent with the results of other TAM studies Thus, it is confirmed that while the study results did not indicate a direct relationship between accessibility and usage benefits, university libraries need to enhance their accessibility in the context of OAIR, as accessibility improves the use of OAIR which, in turn, benefits the university.

Availability

Availability had a significant effect on satisfaction and intention to reuse OAIR. Further, availability had a significant effect on usage benefit. The study findings showed that availability had a significant effect on satisfaction. Therefore, the study finding was

inconsistent with the findings obtained in other TAM studies. Accordingly, university libraries must improve the quality of the accumulated information to allow more library clients to use it. Further, the study findings have indicated that availability had a significant effect on the intention to reuse the system. Therefore, university libraries need to ensure availability before information is uploaded onto OAIR, to attract more users to the OAIR. In addition, academic staff and library staff need to create and share knowledge to ensure availability to enhance the intention to reuse the OAIR. However, since the study did not indicate a direct relationship between availability and intention to reuse the system (H5), library staff should focus on enhancing knowledge availability to raise satisfaction with OAIR. Relevance, accuracy, timeliness and completeness are the main factors leading to the success of OAIR. Library staff should also develop means to monitor online content to ensure availability of information, including user-generated content. The intention to continue using OAIR can increase due to a high level of satisfaction, which will justify the high investment costs involved in developing and maintaining the OAIR. Lastly, the usage of OAIR can also improve when availability measures are put in place to enhance satisfaction and intention to reuse OAIR. In addition, OAIR managers should also ensure that OAIR are reliable, available and user friendly to encourage academic staff to reuse the system. The study findings have indicated that availability had the strongest direct effect on usage benefits. Therefore, the study asserts that increased availability could be associated with usage benefits. In the study, the usage benefit is the outcome the system brings to both an individual and organisation after the full implementation and usage of model. Researchers, students, staff and institutions will require ongoing availability of content within the OAIR (Okumu 2015). Therefore, there is a need to ensure availability, which will have a positive impact on both the staff and the university.

Visibility

Although visibility had no significant effect on satisfaction, study findings showed that it had a significant effect on intention to reuse OAIR and usage benefit. Therefore, there is a need for university libraries to improve visibility to enhance satisfaction

in the use of OAIR. However, the study did not indicate a direct relationship between visibility and intention to reuse the system. There is a need for university libraries to increase the effectiveness of OAIR to increase the intention to reuse the system. The study provides the need to employ system administrators to improve visibility in the platform through customisation and updating processes. The study findings also indicate that visibility had the strongest direct effect on usage benefits. It is, therefore, important for accurate and correct knowledge to be used by the right person at the right time and in the right context.

Satisfaction

Satisfaction had no significant effect on intention to reuse OAIR, but had a significant effect on usage benefit. Satisfaction is critical to the use of the model within the institution. This is because a user needs to be satisfied with the system that they are going to use, as well as the value and benefit that such a system could bring to the institution. After being satisfied, users might increase their intention to reuse the system for the benefit of their institutions and to increase their job performance to provide better services to users. Therefore, satisfaction plays a major role in the usage of OAIR. The study has also revealed that satisfaction affects availability. On the other hand, the study findings have indicated that satisfaction had the strongest direct effect on usage benefits.

Intention to reuse

Intention to reuse OAIR had a significant effect on usage benefit. The study findings have indicated the relationship between intention to reuse the system and usage benefits. The study, therefore, proposes that intention to reuse the system could lead to usage benefits in terms of good services, and thus attract more users to use the OAIR available in the library. OAIR can maximise the availability, accessibility, discoverability and functionality of scholarly research outputs at no cost to the user (Dlamini and Snyman 2017). Accessibility, availability, visibility, intention to reuse, satisfaction and usage benefits were the factors used in the study. The study adopted the Technology Acceptance Model (TAM), which was then modified to fit the study. Usage benefits were regarded as a dependent variable, while the rest of the variables, namely accessibility, availability, visibility, intention
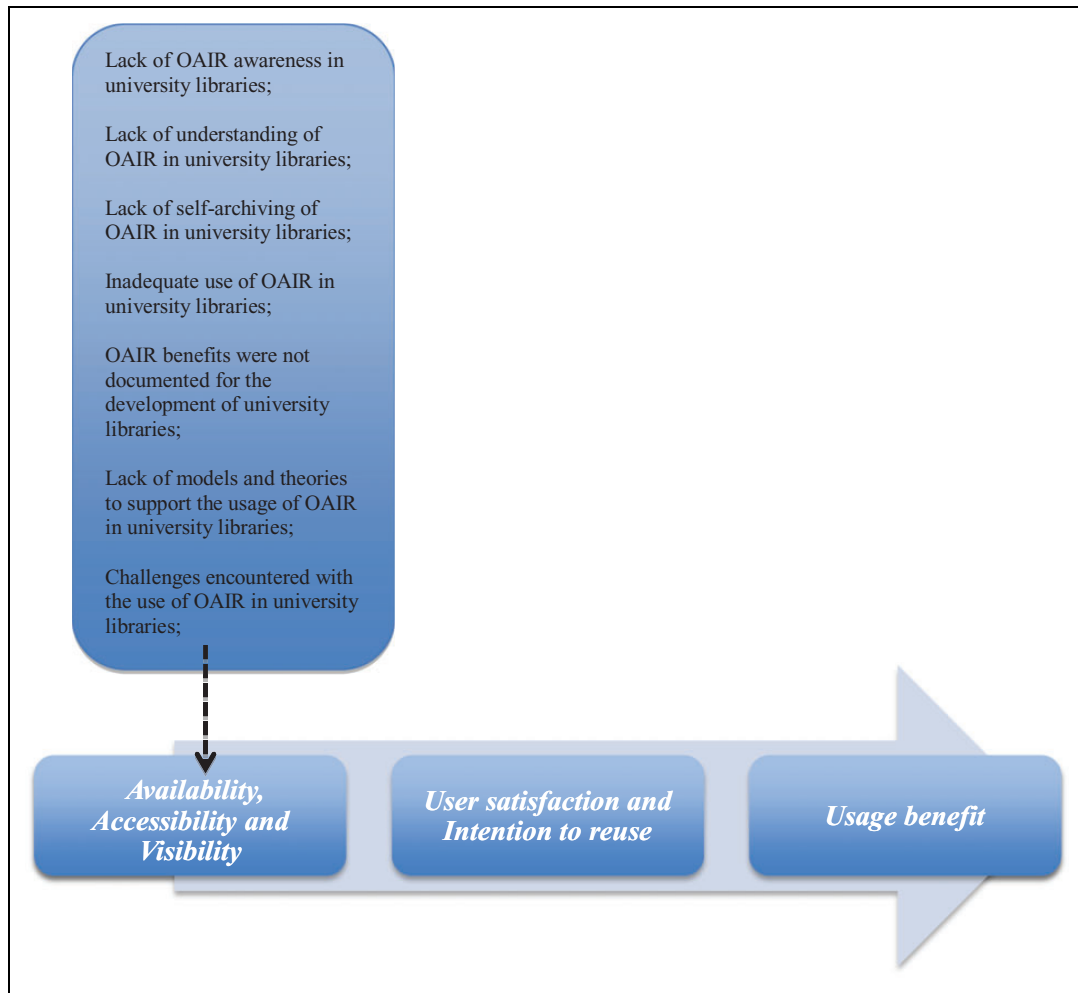
Figure 4. OAIR Usage Model (Kodua-Ntim, 2019).

to reuse and satisfaction, were regarded as independent variables. The findings supported the conceptual framework (OAIR Usage Model) to enhance OAIR use in the university libraries in Ghana, since nine out of the twelve hypotheses were supported.

Proposed OAIR usage model for university libraries in Ghana

Drawing from the findings presented in the preceding discussion, the proposed model for OAIR usage at university libraries in Ghana is presented in Figure 4.

Figure 4 shows that many factors need to be considered for the efficient and effective usage of OAIR in university libraries. Accessibility, availability, visibility, intention to reuse, satisfaction and usage benefits were the factors used in the study. Usage benefit was regarded as a dependent variable, while the rest of the variables – accessibility, availability, visibility, intention to reuse and satisfaction – were regarded as independent variables.

A model shows the relationship between the independent and dependent variables. The application of TAM (TAM1, TAM2, TAM3 and UTAUT) in the study provided the factors that support the usage of OAIR in university libraries. The article employed TAM (TAM1, TAM2, TAM3 and UTAUT) to explain the usage of OAIR in university libraries in Ghana. Again, TAM was used to link various activities as identified under TAM1, TAM2, TAM3 and UTAUT and OAIR usage. Furthermore, the article developed a conceptual framework that was adapted, validated and modified to fit the study. The conceptual framework used in the article combined all the factors of the objectives and linked all other factors as explained in TAM (TAM1, TAM2, TAM3 and UTAUT).

Justification of the model

The model is justifiable based on the following facts:

1. Lack of OAIR awareness in university libraries;
2. Lack of understanding of OAIR in university libraries;
3. Lack of self-archiving of OAIR in university libraries;
4. Inadequate use of OAIR in university libraries;
5. OAIR benefits were not documented for the development of university libraries;
6. Lack of models and theories to support the usage of OAIR in university libraries; and
7. Challenges encountered with the use of OAIR in university libraries.

Conclusion

The proposed model aims at assisting universities to enhance the usage of OAIR. The model attempts to establish the link between the problem and the proposed solution, therefore justifying the need for this comprehensive and open model for the usage of OAIR in university libraries. The model attempts to show and link factors that could lead to the efficient and effective usage of OAIR in university libraries. The model will guide university libraries in the development and usage of OAIR in university libraries. It was based on information gathered from literature reviews and the findings of the study. One needs to consider several factors for the efficient and effective usage of OAIR in university libraries. Accessibility, availability, visibility, intention to reuse, satisfaction and usage benefits were the factors used in this study. Usage benefit was regarded as a dependent variable, while the rest of the variables – accessibility; availability, visibility, intention to reuse and satisfaction – were regarded as independent variables.

Institutionally mandated deposits are required if universities in Ghana would like to move beyond the slow and time-consuming self-driven and voluntary process of collecting content and increase the accessibility, availability and visibility of scholarly information produced in the universities to enhance development in the country. However, accessibility, availability and visibility continue to be big challenges. The feasibility of a model to address all of these elements is seen by many as the next step to enhance the usage of OAIR.

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