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**CONTEMPORARY ISSUES
AND SUSTAINABLE PRACTICES
IN THE BUILT ENVIRONMENT**

EDITORS:

Asimiyu M. JUNAID
Olatunde F. ADEDAYO
Richard A. JIMOH
Luqman O. OYEWOBI

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**Asimiyu M. JUNAID,
Olatunde F. ADEDAYO,
Richard A. JIMOH,
Luqman O. OYEWOLI,**

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Editors

Asimiyu M. JUNAID,	Federal University of Technology, Minna, Nigeria
Olatunde F. ADEDAYO,	Federal University of Technology, Minna, Nigeria
Richard A. JIMOH,	Federal University of Technology, Minna, Nigeria
Luqman O. OYEWABI,	Federal University of Technology, Minna, Nigeria

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Correspondence:

All correspondence pertaining to the SETIC 2018 should be sent to:
Chairman SETIC 2018 LOC
School of Environmental Technology
Federal University of Technology, Minna
Main Campus,
P.M.B. 65
Minna, Niger State, Nigeria.
setconference@futminna.edu.ng: www.futminna.edu.ng

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TABLE OF CONTENTS

Table of Contents	iv
Foreword	v
Acknowledgement	vi
Copyright Statement	viii
Declaration of peer review and scientific publishing policy	ix
Review Panel	x
Local Organising Committee	xv
Scientific Committee	xvi
Profile of Keynote Speakers	xviii
Programme for SETIC 2018	xix
List of papers in SETIC 2018 Conference Proceedings	xlii
Keynote Addresses	1
Conference Papers	1

FOREWORD

The organising committee of the 2nd School of Environmental Technology International Conference is pleased to welcome you to Federal University of Technology Minna, Niger State Nigeria.

The conference provides an international forum for researchers and professionals in the built and allied professions to address fundamental problems, challenges and prospects that affect the Built Environment as it relates to Contemporary Issues and Sustainable Practices in the Built Environment. The conference is a platform where recognised best practices, theories and concepts are shared and discussed amongst academics, practitioners and researchers. The scope and papers are quite broad but have been organised around the sub-themes listed below:

- Architectural Education and ICT
- Building Information Modeling
- Construction Ethics
- Energy efficiency and Conservation
- Environmental Conservation
- Facility Management
- Green Construction and Efficiency
- Health and Safety Issues
- Information Technology and Building Maintenance
- Information Technology and Construction
- Information Technology and Design
- Innovative Infrastructure Development
- Resilient Housing Development
- Smart Cities Development
- Social Integration in Cities
- Sustainable Building Materials Development
- Sustainable City Growth
- Sustainable Cost Management
- Sustainable Property Taxation
- Sustainable Architectural Design
- Sustainable Urban Transportation Systems
- Theory and Practices for Cost Effectiveness in Construction Industry
- Urban Ecology Management
- Urban Land Access
- Disasters, Resilient Cities and Business Continuity

We hope you enjoy your time at our conference, and that you have the opportunities to exchange ideas and share knowledge, as well as participate in productive discussions with the like-minded researchers and practitioners in the built environment and academia.

Local Organising Committee
School of Environmental Technology International Conference (SETIC) 2018
APRIL 2018

REVIEW PANEL

We wish to express our deepest and sincere gratitude to the following people in no particular order who provided comprehensive scientific reviews and made commendable suggestions towards improving the over 258 abstracts and 182 full papers submitted to SETIC 2018. They provided constructive comments to authors regarding their papers, it is necessary to state that there was no reported case of conflict of interest by any of the reviewers or the authors.

Prof. Lekan Sanni,	Department of Urban and Regional Planning, University of Ibadan, Ibadan
Dr. Taibat Lawanson,	Department of Urban and Regional Planning, University of Lagos, Lagos
Dr. Joy Maina,	Department of Architecture, Ahmadu Bello University Zaria
Dr. Yemi Adewoyin,	Department of Geography, University of Nigeria, Nsukka
Dr. Micheal A. Olukolajo,	Department of Estate Management, Federal University of Technology, Akure
Dr. Naomi I. Popoola,	Department of Estate Management, Federal University of Technology, Minna
Dr. O.K. Akande,	Institute of Public Health and Environmental Engineering, University of Leeds, UK
Dr. Philip Ayuba,	Department of Architecture, Federal University of Technology, Minna
Arc. Stephen Oyetola,	Department of Architecture, Federal University of Technology, Minna
Dr. Joel A. Ojekunle,	Department of Transport Technology, Federal University of Technology, Minna
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Arc. O. A. Adebayo,	Department of Architecture, Bells University of Technology, Ota
Dr. Anita Adamu,	Quantity Surveying, Federal University of Technology, Minna
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Dr. Abdulkarim Saka,	Department of Chemical Engineering, Federal University of Technology, Minna
Dr. M.T.A. Ajayi,	Department of Estate Management, Federal University of Technology, Minna
Dr. O.A. Kemiki,	Department of Estate Management, Federal University of Technology, Minna
Dr. Samsideen Ojoye,	Department of Geography, Federal University of Technology, Minna
Dr. Isa Babtunde,	Department of Building, Federal University of Technology, Minna
Mr. Abdulganiyu Oke,	Department of Quantity Surveying, Federal University of Technology, Minna

THE ROLE OF ARCHITECTURE IN WAYFINDING PERFORMANCE IN HOSPITAL BUILDINGS IN NIGERIA

S. Ahmed, R.E. Olagunju, S.N. Zubairu and O.K. Akande
Department of Architecture, Federal University of Technology, Minna, Nigeria

Tertiary hospitals are large scale, complicated healthcare facilities due to their purposeful organisations' complexity and architectural configuration. As such, these buildings are not able to support the psychological needs of first time patients and visitors who are unfamiliar with the hospital environment. In hospitals, people do not have time and energy to waste in looking for destinations. Accordingly, architectural design of the hospital environment should be efficient in wayfinding performance in order to ensure users' psychological satisfaction, comfort, and safety in order to improve staff productivity in the hospital. This research focuses on the roles of architectural features in providing information for spatial legibility in the hospital wayfinding process. The architectural features examined in the study are floor plan, pathways (circulation), landmark and signage. The case study was carried out at the University of Abuja Teaching Hospital (UATH), Gwagwalada, Abuja-FCT. The unit of analysis are buildings of General Outpatients Departments, Laboratory unit, Radiology and Pharmacy departments. The findings have shown the role of the architectural features in the legibility of the hospital environment as it affects wayfinding performance.

Keywords: Architectural features, wayfinding performance, users' perception, legibility

INTRODUCTION

Wayfinding is the ability to know where you are (origin), how to get to the place (path) and recognising the destination on getting there (Lin, *et al.* 2014). In complex teaching hospital, wayfinding performance could be quite a challenging task in terms orientation for unfamiliar users of the environment that have to search for destinations (Samah, *et al.*, 2013). This impact negatively on the patients in form of disorientation, being lost and stress (Mustikawati *et al.*, 2017). In spite of these difficulties, wayfinding is a need of life as people must move from one place to another for a purpose, in the right direction and path, at the right time and target (Vilar, *et al.*, 2014). Furthermore, wayfinding is significant in hospital design as a vital consideration in the quality of spatial disposition and the usability of the space that affect the quality of care in the hospitals (Samah *et al.*, 2013).

A lot of research has investigated the issues of wayfinding in unfamiliar environments, such as shopping malls, complex teaching hospitals, airports, urban environment and had been extensively discussed (Ullas & Aju, 2014). However, there is a paucity of research on the roles of architectural features has played in providing information for spatial legibility in the hospital wayfinding process. The architectural attributes are environmental features designed by the architects. Thus, architectural legibility is the extent to which the designed features of the environment help people in creating an effective mental image of the spatial relationships within a building, and the subsequent ease of wayfinding within the environment (Dehghan *et al.*, 2012). Data was elicited from observational studies conducted in the hospital. The aim of the study is to describe the process of wayfinding by identifying the role of architectural features used to guide wayfinding performance. The objective is to gain understanding of the most important of the architectural attributes that influences the psychological needs and the social behaviour of the users in order to prioritise capital investment in wayfinding designs.

salawu.ahmed@futminna.edu.ng

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The users' experience of the hospital environment is a functional relationship between the user and the environment (Hashim & Said, 2013). Thus, the success of wayfinding performance depends on the environmental cues which architectural attributes have a role in its identification and the spatial legibility.

LITERATURE REVIEW

Lynch (1960) first officially defined wayfinding as the consistent use and organisation of sensory cues from the external environment. This definition influenced the concept of spatial orientation and cognitive mapping being used to express wayfinding (Arthur & Passini, 1992). Pati, *et al.*, (2015) defined wayfinding as one's ability to find his way without getting lost. This definition has evolved over the years, depending on the perspective of the research field. Wayfinding is defined in the context of architecture as human response to the environmental cues that ease navigation to the desired destination in the built environment (Hashim & Said, 2013). This implies that it is an environmental learning process that includes perception, cognition and cognitive mapping by the use of the environmental information.

Basically, wayfinding is the process of recognising the current location and understanding how to get to the desired destination with ease (Farr, *et al.*, 2012). In this process framework are decision making (plan of action), decision execution (putting the plan into appropriate behaviour correctly) and information processing (which involves the use of environmental perception, cognition and cognitive mapping) to accomplish the wayfinding task that flows in psychological pattern based on visual perception (Mustikawati *et al.*, 2017; Ullas & Aju, 2014). The focus of this study is on the role of architecture in the information processing in hospital wayfinding.

Development of Wayfinding

The foundation of human wayfinding started with the works of Kelvin Lynch (1960) the 'image of the city', where he divided the contents of the city into five elements used in environmental information to make cognitive map and make sense of the city. The elements identified were paths, edges, districts, nodes and landmarks which are connected with the perception of space and wayfinding in the urban environment (Karimi & Emami, 2015). Lynch's (1960) research findings are usually referred to as an architectural wayfinding approach.

Afterwards, Down and Stea (1973) studied human wayfinding problem from the cognitive science perspective and explained wayfinding on the basis of process – oriented approach. Their findings focused on environmental perception, cognition and individual decision-making process for successful wayfinding. Subsequently, Weisman (1982) identified four classes of environmental variables that influence the ease of wayfinding performance within the built environments, namely, (1) Visual access, (2) the degree of architectural differentiation, (3) plan configuration, and (4) the use of signs and room numbers to provide identification or directional information.

In addition, Arthur & Passini (1992) assessed the component of architecture and wayfinding in the circulation pattern with a view to construe environmental cues. Thus, this study is anchored on the theories of Lynch, (1960) which described environmental legibility as the ease to form a clear mental image that allows its users to find their way within it in the context of architecture.

Wayfinding in Hospitals Buildings

The first wayfinding research in hospital facilities was on the 'Design that Cares' by Carpman, Grant & Simmons (1986) in which it was contended that a harmonized wayfinding arrangement is required in healthcare facilities in order to ease wayfinding challenges that causes stress experienced by users (Mustikawati *et al.*, 2017). In addition, the capabilities of manifest cues (such as the effectiveness of the signage posted in the environment) and environmental affordance (such as what the building communicates to the users) to communicate wayfinding were discussed in the studies.

Beyond this early healthcare research was the work of Baskaya *et al.*, (2004) which identified some environmental attributes that influence navigation. The study showed that floor plan, building layout and environmental cues (such as visual configuration of space,

landmark, signage, architectural differentiation and symmetry) should be properly considered in the initial plan of hospitals. The findings reveal that plan configuration correlates with wayfinding performance. In addition, the study showed that symmetry and repetition of elements could pose a challenge to wayfinding in hospitals. Other studies confirmed these findings and identified the deficiencies in environmental attributes to affect wayfinding performance (Marquardt, 2011; Pati *et. al.*, 2015).

Furthermore, studies have placed environmental affordance (such as corridor width and brightness) in straight rivalry with manifest cues (such as signage) as a result of the roles played by these factors in different circumstance, such as location tasks and emergency situations, (Vilar *et. al.*, 2014). These disparities relating to the role of the floor plan and of manifest cues were demonstrated in the studies on people with dementia (Marquardt, 2011). The study indicated the architectural features that impede or aid wayfinding performance, such as long undifferentiated corridors, colour, lighting, repetitive elements, deviations of directional information within the circulation systems and information disorder negatively affects the spatial orientation in the design of environmental features.

In addition to these negative affordances, several studies underscore the importance of user's characteristics such as the aging population, the visually impaired and people with dementia and their limited abilities (Rousek & Hallbeck, 2011; Marquardt, 2011). Consequently, they identified some design attributes that produced wayfinding issues which include signage, path, lighting and flooring. As such, they argued that these issues impacted negatively on the participants, which involve tripping off to getting lost in the environment. As such, there is high awareness on the part of the contemporary hospital designers to implement multiple design strategies to improve wayfinding (Devlin, 2014).

However, there are limited researches that clarify which of the design strategies to prioritise and compromise due to project cost limit in terms of the way environmental cues are processed and used (Pati *et. al.*, 2015). This implies that it is significant to understand the different roles played by these environmental cues in terms of their importance and frequency of use. It is on this premise that this study is anchored in order to achieve project prioritisation and project cost budgeting in the design of wayfinding system. The identified architectural features and constructs for measurements are subsequently drawn.

Constructs for Measurement: The constructs used in the context of this study are spatial legibility, influences and usefulness of the attributes in wayfinding in the hospital studied. These were derived from literature.

Spatial Legibility: This is the extent to which the designed features of the environment is clear, simple, coherent, understandable and organisable that assist people in generating an effective picture-like perception of the spatial relationships within a building, and the subsequent ease of wayfinding within the environment (Koseoglu & Onder, 2011). However, these concepts used in describing spatial legibility are characteristics of space which are easier and faster to acquire spatial knowledge, but cannot be used to measure legibility (Dehghan, Moradi & Memariyan, 2012). In order to measure spatial legibility some parameters have been identified which can be used to measure the variables such as the extent of spatial layout complexity and the ability to recognise the variable as an important landmark (Pati *et. al.*, 2015).

Influences

The influence of a designed space in wayfinding is the extent to which the built environment inspires, stimulate, effect and encourage movement of hospital users to find with ease their destinations within the facility (Marquardt, 2011). The parameters that can used to measure these concepts are distinctiveness, complexity, affordance, accuracy and visibility of the environmental cues (Paul, 2013). However, for each of this dimension, specific design elements are measured with the factors that influence the ease of wayfinding in order to determine the quality of space in wayfinding (Marquardt, 2011).

Usefulness

The usefulness of any place legibility system is the extent to which patients and visitors see the information in the environmental cues, which may positively or negatively affect the ease of wayfinding (Ullas & Aju, 2014). For instance, architectural cues such as signs may be difficult to read if they are mounted too high, located behind another sign, and poor colour

combination (Paul, 2013). Moreover, finding a particular destination in a hospital can be difficult if the typeface, colour, letter, size, and terminology printed on the signs is poor.

However, it should be noted that no matter how good, legible or clearly worded the cue or sign is, if the information is not available where it is needed, the cue's or sign's usefulness is considerably reduced (Ullas & Aju, 2014).

Finally, for the effective usefulness of cues, signs and numbering, they should be made simple, consistent, flexible and visible (Pual, 2013). These are the constructs used in measuring the variables listed in the observation schedule for assessing the effectiveness of wayfinding performance design indicators.

METHODOLOGY

The study assessed the role of architecture in wayfinding performance at the University of Abuja Teaching Hospital, Abuja – Nigeria in the General Out-Patient Department (GOPD). Case study was done to understand this role in wayfinding processes undergone in the hospital. Consequently, wayfinding observation schedule on hospital design indicators was prepared based on previous studies to identify the various attributes as variables to be used for the assessment of the effectiveness of the wayfinding performance in the hospital. The study was based on researcher's participant observation of the physical setting and the social travel behaviour of the patients in the hospital. Also, constructs used for the measurement were identified from literature which was used in structuring the items in the schedule. The observations of the items in conjunction with the floor plan were analysed, inferences and conclusions were drawn.

Research Setting The case study was carried out at the University of Abuja Teaching Hospital, Gwagwalada-Abuja, Nigeria. The hospital was commissioned in 1992 by the Federal Capital Development Authority and in 1993 it was taken over by the Federal Government as a specialist hospital. In 2006, it was approved as a teaching hospital. The hospital has a bed capacity of 338. As a result of the evolution in development of the hospital in phases and the expansion of the hospital, circulation network was affected due to the addition of new buildings which consequently affects wayfinding in the hospital. The hospital layout is shown in figure 1 and the study area in figure 2.

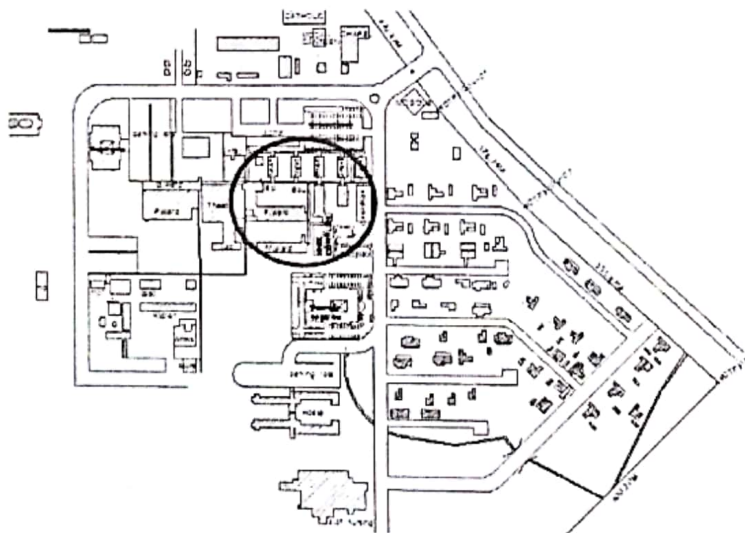


Figure 1: The layout of the hospital

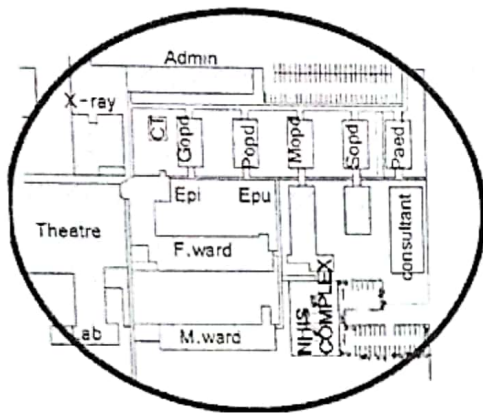


Figure 2: the study area within the hospital

Participants

Fifteen participants were observed, which includes 8 males and 7 females with an age range of between 20 and 55 years. The participants were assumed to be new patients who were unfamiliar with the hospital setting. This is because at the GOPD there was usually health talk to patients in which the researcher participated. It was mentioned by the senior nurse officer who delivered the health talk that the patients at the GOPD were new and was there to collect new record card at a cost which would expire after 7 days of collection.

Data collection procedure

Ethical approval was sought from the University Health Research Ethics Committee which enables the researcher to obtain permission for the study at the various units visited for the research. The study was carried out on 27th December, 2017 to 5th January, 2018. The hospital site plan, floor plan (GOPD) was obtained and photographs of selected departments were taken. An informed consent of all patients who entered the GOPD was taken by the principal investigator before the observation of the patients' behaviour in wayfinding situations. However, some patients declined participation because they were not emotionally stable to participate. Thus, the selection of the patients was purposive sampling. Each patient contacted was observed without instruction as he moves to the next destination after the consultation at the GOPD. The selected destinations for observation from GOPD were Accident and Emergency (A & E), Laboratory complex, Radiology and Pharmacy because they are all on the entry level of the hospital. The variables used for the spatial attributes of hospital users' route were number of directional change, distance from GOPD entrance, Signage on the wall and landmarks used by patients. In addition, patients travel behaviour was based on number of stops, number of looking around, number of asking for direction and the spatial legibility of destination from the GOPD entrance. Furthermore, 27 attributes of the architectural features considered as design indicators of the hospital units based on previous studies were prepared in the observation schedule and assessed on its legibility, influences and usefulness on the effectiveness of wayfinding performance.

Study Limitations

In this study some limitations were noted. They were as follows:

- (i) In spite of the rich data obtained, the process of data collection in the participant observation was tedious and time consuming. Therefore, it is suggested that the method be applied to a small number of participants.
- (ii) Besides, the interpretation of the patient's intention of stopping and looking around could be subjective since participants were not instructed to talk aloud for their intentions for actions. This was not possible for a sick patient that was in a hurry for medications. For future study, the use of camera and talking aloud by the participants should be applied.

Data Analysis

The research assesses the effectiveness of wayfinding performance in the hospital by exploring the role of architectural cues in the ease of wayfinding performance. In the

analysis, the observation of the physical setting, those of patients' route, the patients' behaviour and site plan analysis were done.

Observation of the physical setting

The site plan in conjunction with the physical observation of the buildings was done. The circulation spaces (pathways) in both the horizontal and vertical cues were legible. The GOPD has a central open core circulation system with stair case dividing the courtyard into two, which makes circulation legible. The floor plan configuration is symmetrical, the building plan shape and building layout were legible. However, the building entrance was not conspicuous which makes visual access not to be legible. Furthermore, most of the lighting points in the corridors (circulation space) were not working and consequently not legible. In addition, maps and display boards were not provided at the entrance which would have assisted patients in finding their directional routes.

Furthermore, the GOPD was a storey building adjacent to other out patients departments, such as the paediatric outpatients department (POPD), the medical out patients departments (MOPD), and surgical outpatients department (SOPD), that was bungalow buildings. Consequently, the architectural differentiation significantly influences the effectiveness and ease of wayfinding in the hospital. Besides, trees were used as visible landmarks, edges and different zones were clearly demarcated which influences wayfinding because they could be used as reference points. However, there were no directional cues such as signs at corridor intersections where patients take decisions as to which route to follow. Thus, could cause confusion on which route to take. In addition, rooms were clearly numbered and labelled. The cluster of functions, such as shops, ATMs, Banks and seating arrangements, as well as location signs were useful in the case of wayfinding performance in the hospital.

Spatial attributes of a patients' route

The number of directional change from the entrance to the GOPD and other areas at entry level ranges between 1 and 2. Also, the signages on the walls were clear, consistent and legible. Trees and shrubs were used as landscape elements which constitutes the main landmark in the GOPD. However, there were no directional signs at the decision points.

Patients wayfinding behaviour

In this study, the participants were new patients that were not familiar with the spatial layout of the buildings visited. Besides, there were no instructions for the participants to talk aloud their actions. Thus, the observer just walks along and observes their movement pattern and wayfinding behaviour. This includes the number of stops, the number of looking around, the number of asking for directions and the spatial legibility of destinations from entry.

In addition, number of stops range between 1 and 2 amongst the participants. 5 out of the 7 female participants stopped 2 times while the male stopped 1 time before reaching their various destinations. Also, when the patients stopped, it was observed that they looked around to scrutinise the information by understanding the visual content of the cues that could potentially direct them to their destinations. Again, all the participants asked for direction to their destinations once. This implies that the spatial layout, signage, and architectural cues were legible and clear to the patients.

DISCUSSION

This research is about new patients in an unfamiliar hospital environment. The focus is on the user's perception of some architectural features that help to identify the buildings of their destinations as it affects the legibility of the hospital environment in wayfinding process. The concern of the studies is on the information obtained in the wayfinding process.

The wayfinding process consists of a sequence of steps of understanding where one is, realise the right route direction, follow the route and for one to recognise when the destination is reached (Mustikawati *et. al.*, 2017). The information needs of the patients vary at each stage of the wayfinding process. This study examined the architectural information available in the physical setting, important landmarks, the spatial legibility of the architectural features, those that were useful and influences wayfinding performance. These constructs used in measuring spatial legibility and the findings corroborated previous study (Paul, 2013).

Besides, the findings on wayfinding behaviour revealed that the number of stops was to reassure the patient's orientation and to understand the information presented in the environment while the looking around was to ensure that the right route was followed. Thus, in this process, to avoid backtracking, patients ask for direction and to reinforce that the destination was reached which corroborated previous studies (Tzeng & Huang, 2009; Mustikawati *et al.*, 2017). The findings in this study of patients' behaviour conform to the concept of affordance in the visual quality of perception offered to users in the environment (Gibson, 2015; Marquardt, 2011).

CONCLUSION

The study showed that the spatial layout, circulation pattern, landmark and the design quality of the environment were significant cues in wayfinding process and that users depend more on visual perception than cognition. In addition, the findings of the research corroborated previous studies that gender and familiarity influences wayfinding performance in the hospital complex environment. Finally, the constructs of spatial legibility, influences and usefulness of architectural cues were used to assess the wayfinding performance in the unfamiliar hospital environment.

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