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Influence of Spatial Layout on Wayfinding Behaviour in Hospital Environment in Nigeria

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Abstract

Many studies have shown that wayfinding is affected by the familiarity of subjects with the environment. Wayfinding difficulties are caused due to the complexities of building configuration and evolving spaces that emerge over time in response to operational needs and change which results in disorientation, uncertainty, anxiety, frustration, and stress. A large hospital environment greatly influences the wayfinding behaviour of newcomers, which could be stressful and intimidating for them. This study explores the wayfinding behaviour of unfamiliar users in the acquisition of knowledge of the environment with the aim to improve wayfinding competence in hospitals. The study was carried out at Jos University Teaching Hospital (JUTH), situated in the Plateau State of Nigeria. The methods used for data collection were walking-with observation, verbal protocol and a semi-structured interview. These methods indicated the participants' level of wayfinding performance during the navigation aimed to find the desired destination. The respondents, n 16 (8 male and 8 female), were purposively sampled and observed through behavioural mapping. Additionally, 24 respondents were separately interviewed in order to triangulate the findings of behavioural mapping. The findings revealed that the majority (62.5%) of respondents found the building layout complex to navigate due to their spatial similarities. Additionally, the wayfinding experience of the majority (95.8%) of respondents in the hospital was established to be difficult and stressful. Also, the result proved that 60% of female wayfinders were more prone to wayfinding errors than male wayfinders in finding their way to the desired destination due to the complexity of the building layout. The study recommends that building configuration design in hospitals should be organised in a simple way and it should be constantly reviewed as new spaces evolve. The implication calls for an improved design which remains distinctive and a well-linked layout that facilitates effective and efficient wayfinding for unfamiliar users in a safe and satisfactory manner.

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Keywords: building layout, Nigerian hospital layout, unfamiliar users, wayfinding behaviour

Introduction

Wayfinding is the task of moving from an origin to an unknown destination in a new environment for a given purpose and it is quite challenging to first-time users in a large hospital environment (Anacta et al., 2017). Wayfinding difficulties are caused due to the complexities of building configuration and evolving spaces that emerge over time in response to operational needs and change which results in disorientation, uncertainty, anxiety, frustration, and stress (Hughes et al., 2015). The process of wayfinding constitutes a dynamic relationship between the individual's navigational ability and the setting in which navigation takes place (Brunye et al., 2018). Indeed, navigation takes place in a space where spatial configuration and the flow of people results in human wayfinding behaviour, consequential in decision-making, decision-execution, and information processing (Martins & Melo, 2014). This suggests that building layout affects the choices individuals make in an environment.

Human behaviour is the external demonstration of the processes of perception and cognition based on skills, obtainable information in the environment, and the individual experience of interpreting and taking decisions (Anacta et al., 2017). Several studies affirmed that wayfinding is affected by the familiarity of subjects with the environment (Martins & Melo, 2014; Peponis, 2012; Hölscher et al., 2013). Weisman (1981) recognised four environmental variables that affect the wayfinding behaviour which include visual access, architectural differentiation, floor plan configuration and signage.

Most preceding studies in wayfinding focused on the process rather than the setting in which it takes place (Bakr & Elgendy, 2017). Several studies examined the cues of the environment and the varied strategies that improved the wayfinding process through the environmental setting (Ekstrom et al., 2018). It was asserted that people's movements are affected to a notable degree by spatial configuration and spatial cognition (Mandel & LeMeu, 2018). Teaching hospitals have a diversity of services and movement of people which at times require a certain urgency in the flow of patients and staff (Sevinc & Bozkurt, 2015). Therefore, the qualities of the built environment and the efficient integration of spaces that improve human interaction are significant for effective wayfinding in hospitals (Martins & Melo, 2014). The purpose of this study is to examine the users' behaviour in spatial layout towards improving wayfinding efficiency in hospitals.

Spatial Layout and Wayfinding Behaviour

Several studies stated that spatial layout significantly affects wayfinding behaviour which is based on people's movement, cognition and their social behaviour in the environment (Brunye et al., 2018; Dalton et al., 2019). However, there is a limited understanding of the degree of relationship between spatial configuration in hospital design and users' behaviour during wayfinding (Peponis, 2012). The study of Slone et al. (2014) on the influence of floor connectivity on wayfinding performance showed that participants committed more errors and the time to perform navigation task was affected in more multifaceted environments. It further revealed that performance was more efficient while navigating previously learned routes than novel routes. Still, there is a limited understanding of users' behaviour and choices made in reading and navigating the environment (Mustafa & Rafeeq, 2019).

However, spatial complexity of a hospital layout is characterised by the presence of numerous buildings (size), as well as asymmetry and an unclear visual access that makes cognitive and perceptual sense of finding a destination difficult (Hölscher et al., 2013). Spatial intricacy can be measured by looking at the number of perceptible objects in the scene and a simple route with a minimum number of decision points (junctions) that ease identifying route direction (Schwering et al., 2017; Emo et al., 2012). Similarly, the work of Bakr and Elgendy (2017) examined the influence of spatial complexity on wayfinding behaviour in Egyptian underground stations. The study established that spatial configuration has precedence above signage in the presence of illiteracy and due to an inadequate understanding of signage meaning. Still, there is a gap in most hospital design processes in perceiving and predicting the design outcomes in terms of spatial configuration and cognition which strongly affects wayfinding behaviours (Dalton et al., 2019). Moreover, a legible hospital building layout improves human interaction, physical comfort, safety and accessibility of users to destinations (Brunye et al., 2018). Spatial legibility is the extent to which the settings are clear, simple, coherent, understandable and organisable that enables the visitors to perceive the buildings and their links in the scenery (Koseoglu & Onder, 2011). In the context of this study, spatial legibility is measured based on the extent of size, visual access, simple connectivity, and the ability to recognise with ease an important landmark for orientation (Anacta et al., 2017).

The spatial connectivity of hospital circulation spaces and the changes of direction required to move from one location to another in the layout influence navigation (Peponis, 2012). Similarly, new users in a large hospital environment

move and direct their paths to spaces with more direct connections in a layout during wayfinding (Haq & Zimring, 2003). Also, the misalignment of corridors impairs wayfinding (Werner & Schinder, 2004). However, not much is understood about how users respond to such layouts in hospitals which this study seeks to explore.

Research Methods

This is a descriptive research and the qualitative research method was employed. Case study was used to gain a rich understanding of the context in order to elucidate information about the wayfinding behaviour of patients. The tools used for data collection were observation and interview. A semi-structured interview was used to elicit information about users' wayfinding behaviour in hospital setting. The semi-structured interview was considered suitable as there were pre-determined themes the research explored in order to further deepen the understanding of the subject under study. This paradigm of research is built upon Braun's (2013) guide to exploratory qualitative studies.

Data Collection Procedure

Data collection involved the observation of the spatial features of the physical setting in terms of functional links, observation of the patients' wayfinding task and their interviews. The users of Outpatient Department (OPD) were sampled as the participants of the study, with a sample size of 16 (8 male and 8 female) and 24 for observation and interview, respectively. Purposive sampling technique was used to select participants who visited the hospital once or twice during the last 12 months. The sampled participants were unfamiliar about the phenomenon as described by Rahi (2017). All the patients who entered the OPD were invited to participate in the study. An informed consent from patients was obtained by the principal researcher before their interview, photographing and observation of their wayfinding task.

Interview

A sample size of 10 -15 has been established as adequate for data collection through interviews (Mason, 2010). Hence, a saturation point was attained after 16 respondents were interviewed. The saturation point was reached when the responses did not seem to give any additional information (Creswell, 2014). A semi-structured interview form was given out to the respondents to fill and probing questions were asked for further clarification. All interviews were recorded with the consent of the interviewees. The minimum time reserved for the interview

session and audio recording was 30 minutes and a maximum of 40 minutes were allocated for each interview.

Observation of the Participants

The observation of the wayfinding behaviour was such that only the sampled participants were observed without the researchers partaking in the wayfinding task. This was done in a way that observation was carried out from an apt position and the researchers followed the participants during the wayfinding task as described by Creswell (2014). During observation, the principle researcher minimised biasness and ensured the reliability of observations by recruiting two assistants to work with him. The observers followed the participants at a distance during the observation, while recording and coding data for the wayfinding task, such that the three researchers agreed on the recording and coding of data. Furthermore, subject reactivity was reduced to minimise biasness, where participants' behaviour may change due to the presence of observers. As such, the researchers avoided interaction with the participants during the task ensuring that the researchers were unobtrusive in the observation. The observation was supported by verbal protocol about participants' experiences.

At the selected hospital's entrance is a fountain, reception with Automated Teller Machine (ATM) stand, Outpatient Department (OPD), and the family clinic (See Figure 1). The buildings in the hospital were observed in terms of their spatial legibility, such as clear visual access, simplicity of decision points (number of junctions in a straight path), architectural features and their functional relationship that forms the wayfinding cues.

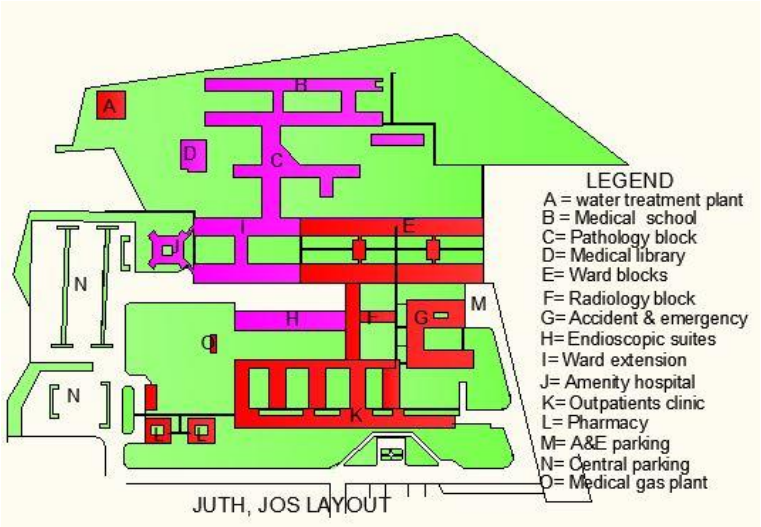
Each participant observed was tracked from the OPD (K) to execute a wayfinding task to the required destinations without instruction and interference from the observer. The selected destinations for observation from OPD were Accident and Emergency (A & E), laboratory complex, radiology and pharmacy which are all closely related in terms of medical procedure.

To evade idleness among participants, the researchers identified the destination areas prior to the execution of the wayfinding task. Moreover, the participants were not given any hints about the location of the various destinations. Therefore, the participants' navigational recital was experiential through walking-with watching technique, where two to three researchers escorted the participants' during their walk. The observers noted down the navigation pathways and reported participants' events, such as cues searched and looked at during the trip with a video camera. The essence of the video camera was to capture all the events and choices made in

the ecological milieu in which they happened and to report actions, events and choices without forgetting or leaving out any data. Furthermore, photographs were taken to support the wayfinding task.

Figure 1

Hospital Site Layout (Source: Works Dept. of JUTH)



Analysis

The collected interview data was anlaysed using content analysis. The unit of analysis was the interview text concerning the users' wayfinding behaviour. The analysis drew attention to the manifested meaning, while noting the latent meaning as supportive evidence in the interpretation. The tape recorded interview and data were transcribed in verbatim and read several times to familiarise the researchers with the text. The transcript was condensed into sense parts, summarised and labelled using ciphers. Diverse ciphers were contrasted in terms of their disparities and similarities and further arranged into sub-groups and groups that constituted the obvious content. The analysis used the framework approach in the form of a matrix that included familiarisation, recognising a thematic structure, indexing, charting, mapping and interpretation as described by Li (2016). The emerging themes from the data were identified, counted for their frequency and were interpreted while seeking to draw an explanatory conclusion grouped in the area of the subjects, as stated by Gale et al. (2013). Furthermore, descriptive analysis of the observation data was employed using percentages and average counts of attributes used.

Results and Discussion

Spatial Legibility of Hospital Buildings

The researchers' observation showed that hospital buildings have features which are supposed to make them spatially legible in terms of their functional layout, visual access, circulation routes and the similarity of building layout found in the same zone. Furthermore, all buildings of the selected hospital including its OPDs are 1-3 storey buildings (See Figure 1 and Figure 3). For instance, A & E, radiology department and endoscopy suites (F, G & H respectively) are one storey buildings zoned together which should have aided wayfinding. However, the majority (62.5%) of respondents found it difficult to navigate. This corroborates the result of Bakr and Elgendy (2017), that a user's ability to judge the complexity of a setting in wayfinding depends on the user's culture, cognition level, and literacy level.

Table 1

Observation Schedule on Spatial Legibility of Hospitals

Assess-ment Method	Building Layout	Visual Access from the Entrance	Signs:	Horiz-ontal Circul-ation	Vertical Circulation (stairs / elevators)	Open Core Circul-ation System	Floor Plan Configu-ration	Symmetry of the Building Layout
Legible	*	*		*		*	*	*
Not Legible			*		*			
Not Available								

Observation of Spatial Attributes of Patients' Travel Route

Subjectivity in the assessment of spatial legibility of wayfinding in hospitals was addressed by involving two research assistants when results were compared and triangulated. Also, the data was validated with the verbal protocol from the participants who were interviewed. The number of directional turns were mostly two during wayfinding from the main entrance to the OPD and other marked destinations in the hospital (See Table 2). Brunye et al. (2018) affirmed that paths with fewer decision points such as junctions (nodes) and landmarks elicit an efficient choice behaviour (for example, - look around, - turn) during wayfinding.

Table 2

Spatial Attributes of Patients' Travel Route

S/No.	Spatial Attributes	OPD	(A & E)	Laboratory	Radiology	Pharmacy
1	Number of Directional Turns (maximum turn expected = 2)	2	1	2	1	2
2	Distance from Entrance to Destination	12m	3m	120m	50m	25m
3	Number of Signages on Walls from Origin to Destination	1	1	3	2	1
4	Number and Types of Landmarks Used	3 types: Sculpture 1, Fountain 1, Many Trees	Pictograph Signage	Pictograph Signage	Pictograph Signage	Signage

Note. *Accident and Emergency (A & E)

There is a clear visual access from the entrance to various target locations due to their proximity with an average distance of 25m except for the laboratory unit. A & E has the minimum travel distance of 3m, while the laboratories are the farthest away with a maximum distance of 120m but had a straight trip. This suggests that short and straight trips of travel within the setting could facilitate wayfinding successfully, as described by Brunye et al. (2018). Also, the signage on the walls is clear, consistent and legible (See Figure 2). However, there are no directional signs where paths intersected (nodes) and at the staircases, which are the positions where the wayfinders made decisions on what path to follow. As such, patients had to ask for directions from other patients and staff. The following excerpt from the

interview responses explains further: *"Asking for directions from staff" …(R08),* "*I read signs and symbols on the wall and door posts to find my way"…. (R11).*

Figure 2

Signage of Radiology Department (participants' consent obtained in the field)

Similarly, landscape elements such as trees were used as landmarks by the participants to identify their desired destination (See Figure 3). The following excerpt from the respondents clarifies further: "*I used the tree to locate my destination" (R22).* This implies that trees and signs in the hospital constitute the main landmarks during wayfinding.

Figure 3

Landscape Tree at the Laboratory (participants' consent obtained in the field)

Observation of Patients' Wayfinding Behaviour

The wayfinding behaviour observed was based on the movement pattern from the origin (main entrance) to the desired destination. It included the number of stops made before reaching the destination, the number of times the participant looked around, the number of times the participant asked for direction, and the number of backtrackings made by the participant prior to reaching the desired destination (See Table 3). These attributes were counted and recorded as average values. The number of stops made by the female participants was on average two times in three units (60%), while male participants generally made one stop during wayfinding before reaching their various destinations. This implies that female wayfinders were more prone to wayfinding errors than male wayfinders, such as missing the way, which corroborates the findings of Lawton (2010). The places where the participants stopped were identified as decision points. These were the places where cues and information (junction) were perceived by the wayfinder and decision was taken for execution. This suggests that decision points had no sufficient cues and information to effectively direct the wayfinders to their destinations.

Table 3

Average Spatial Attributes of Patients' Wayfinding Behaviour

S/No.	Wayfinding Behaviour	OPD		A & E		Laboratory		Radiology		Pharmacy	
		M	F	M	F	M	F	M	F	M	F
1	Number of Stops Before Destination	1	1	1	1	1	2	1	2	1	2
2	Number of looking around to find destination	2	1	1	1	2	2	1	2	1	1
3	Number of Times of Asking for Direction	1	1	1	1	2	2	1	2	1	1
4	Number of Times Patients Backtracked	0	0	0	0	1	2	0	1	0	0

It was observed that the participants looked around to scrutinise information provided by the visual content of the cues to confirm being on the right path that could potentially direct them to their desired destination (See Figure 4). There were no directional signs in the OPD building.

Figure 4

National Health Insurance Scheme (NHIS) OPD (participants' consent obtained in the field)

The following quote from the respondents interviewed further buttresses the point: *"I observed where people entered and asked for the confirmation of my destination'' (R7).* This suggests that all participants asked for direction at least once before reaching their various destinations. Also, the male participants backtracked only once while the female participants turned back twice on their way to the laboratories and the radiology unit (See Figure 5).

Figure 5

Surgical Outpatient Department (participants' consent obtained in the field)

The following expressions from the interviews implied turning back: *"It looks like I took a wrong path, so, I asked for direction from people around''... (R16), "I said let's go back; this is not the right way... I asked the staff for direction''... (R13).* In sum, the male participants performed better in the navigational task than female participants. It can be explained that females exhibited higher spatial anxiety than males with a resultant negative effect on their navigational capability and spatial performance in accordance with the findings of Lawton (2010).

Figure 6

OPD Cosultation Waiting Area (participants' consent obtained in the field)

Building Layout in Wayfinding

The respondents were asked how well they understood the building configuration during wayfinding in the hospital (See Table 4). The alphabets in capital letters indicate the coding of themes, while the numbers indicate the count of themes recurring in all responses.

The main trend of opinion depicted in Table 4 shows that the majority (62.5%) considered that the building layout was difficult to understand during wayfinding. This was buttressed further in the following interview quotes: *"The building arrangement was complex to understand'' (R2),* "*Hospital buildings were complex'' (R9).* This shows that most of the respondents had trouble in wayfinding due to their unfamiliarity with the hospital environment. As such, the conceptual composition of hospital design needs to be made simple to navigate for effective wayfinding.

Table 4

Opinion on Building Arrangement

Identifying Themes	Indexing: Coding and Merging of Similar Issues	Charting: Data Abstraction and Summary	Mapping and Interpretation
Theme: Building Layout Satisfactory / good layout and simple to understand (2)* A bit complex layout for old and illiterate people (1)* Building arrangement is okay and easy to locate (2)* A bit scattered and disorganised layout (3)* Big layout and complex to understand (5)* Well laid out building for easy direction finding (3)* Okay but confusing arrangement of buildings (4)* Efficient / functional building arrangement for direction finding (2)* Building layout is complex for direction finding (2)*	(A) Simple building layout to understand (2)* B) Building arrangement is okay and easy to locate (2)* (C) Well laid out building for easy direction finding (3)* (D) Efficient / functional building arrangement for direction finding (2)* (E) A bit complex layout for old and illiterate people (1)* (F) A bit scattered and disorganised layout (3)* (G) Big layout and complex to understand (5)* (H) Okay but confusing arrangement of buildings (I) Building layout is complex for direction finding (2)*	Layout was simple to understand (A to D) = (9)* (R1, R10) Layout was complex to understand and confusing (E to I) = (15)* (R2, R9)	More than half of the respondents agreed that building layout was complex to understand and confusing to unfamiliar users Core Concept: Complexity

Note. *Frequency of concepts in bracket and bold; alphabets in capitals indicate coding (A, B, C ...I)

Wayfinding Experience in the Hospital

The respondents were asked about their wayfinding experience to their desired destination. The analysis revealed the core concepts shown in Table 5.

Table 5

Wayfinding Experience

Identifying Themes	Indexing: Coding and Merging of Similar Issues	Charting: Data Abstraction and Summary	Mapping and Interpretation
Theme: Wayfinding experience, asking for directions from people (14)* Someone followed / aided me to my destination (4)* Difficult to locate my destination (1)* Asked for direction but still did not understand, got confused, had to use door signs (2)* Finding the desired location was stressful and confusing, had to ask for direction (2)* Unconscious movement to my destination (1)*	(A) Asking for directions from people (14)* (B) Someone followed / aided me to my destination (4)* (C) Finding the desired location was difficult, stressful and confusing, had to ask for direction (5)* (D) Unconscious movement to my destination (1)*	Asking for direction and assisted to destination (18)* (A & B) = (R1, 9) Difficult, stressful and confusing wayfinding (5)*(C) = (R4, 14) Unconscious movement to my destination (1)* D	Difficult and stressful wayfinding experience due to complexity Core Concept: Complex and stressful wayfinding

Note. *The bold numbers indicate the frequency of concepts

The result shows that the vast majority (95.8%) of respondents stated that wayfinding experience in the hospital was difficult and stressful, such that the patients had to ask for directions to their various destinations. This was buttressed further in the following interview excerpts: *"Finding the desired location was stressful because of moving up and down when I was confused in locating my destination'' (R14), "For the first time, it was a little difficult and stressful to locate my destination, I had to ask for directions to and fro the journey'' (R19).* This implies that wayfinding experience was difficult and stressful for users which was exacerbated by spatial layout complexity. This result substantiates the findings of Sevinc and Bozkurt (2015) and Hughes et al. (2015), which state that multifaceted buildings are difficult to navigate and negatively influence wayfinding.

Comparison of Results

Table 6

Comparison of Results

Theme	Interview	Observation	Remarks
Building Layout	Complexity in wayfinding (62.5%).	Simple, legible and user friendly (37.5%)	Observation result (37.5%) contradicts interview result (62.5%).
Wayfinding Experience	Stressfulness; got lost (95.8%).	*More wayfinding errors by female wayfinders than male wayfinders (60%) *Stopping to ask for verbal direction *Looking around more than twice to confirm route selection *Minimal backtracking by wayfinders	Wayfinding was demanding in both observation and interviews

The major findings (62.5%) of the interview revealed that building layout was difficult to navigate by patients (See Table 6). However, findings from the observation of the physical setting by the researchers showed that building layout was legible, simple to understand and user friendly and this observation contradicts

the interview findings. This observation was, however, supported by only 37.5% of the interviewed respondents. The negative case in the observation could be due to the researchers' experience and subjectivity in qualitative research, as stated by Eisner (1991). Reporting the negative case is a valuable strategy for assessing the credibility of qualitative claims (Booth et al., 2013).

Conclusion

This study examined new users' wayfinding behaviour in a multifaceted spatial layout for the sake of improving their wayfinding competence in the hospital. The study revealed that spatial layout of the hospital was complex and stressful to navigate. This suggests that building design in hospitals should be organised in a simple way, following a simple route that minimises the number of decision points to ease wayfinding. Also, the findings revealed that wayfinding behavior caused confusion and frustration, such that the female participants missed their way more than the male participants. As such, the participants asked for verbal directions during wayfinding. This implies that women have greater spatial anxiety than men, which adversely affects their navigational ability and spatial performance in the layout. The anxiety experienced by female folks needs to be considered in hospital designs, keeping in view that they constitute the majority of the visitors to hospitals. Explicitly, a simple route in spatial layout minimises the number of decision positions and maximises less difficult decision points that are simple to recognise, so favoured in itinerary direction for effective wayfinding. Consequently, an improved hospital design could enable wayfinders to reach their destinations in a safe, comfortable, effective, and efficient manner during wayfinding expedition.

References

Anacta, V. J. A., Schwering, A., Li, R. & Muenzer, S. (2017). Orientation information in wayfinding instructions. *Springer Geojournal, 82*, 567–583. https://doi.org/10.1007/s10708-016-9703-5

Bakr, E. A., & Elgendy, N. (2017). Spatial complexity: Identifying critical zones in the Egyptian underground reciprocal stations. *REAL CORP, 2017(*12-14), 527–539. http://www.corp.at

Booth, A. Carroll, C., Ilott, I. Low L. L., Cooper, K. (2013). Desperately seeking dissonance: Identifying the disconfirming case in qualitative evidence synthesis. *Qualitative Health Research, 23*(1), 126–141. https://doi.org/10.1177/1049732312466295

Braun, V. (2013). *Successful qualitative research: A practical guide for beginners*. SAGE.

Brunye, T. T., Gardony, A. L., Holmes, A., & Taylor, H. A. (2018). Spatial decision dynamics during wayfinding: Intersections prompt the decision-making process. *Cognitive Research: Pinciples and Implications*, *3*, 13. https://doi.org/10.11186/s41235.018.0098.3

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage publications. https://www.researchgate.net/file.PostFileLoader.html?...assetKey.

Dalton, R. C., Hölscher, C., & Montello, D. R. (2019). Way finding as a social activity. *Frontier in Psychology*, *10*(142), 1–14. https://doi:10.3389/fpsyg.2019.00142.

Eisner, E. W. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. Macmillan.

Ekstrom, A. D., Spiers, H. J., Bohbot, V. D., & Rosenbaum, R. S. (2018). *Human spatial navigation.* Princeton University Press.

Emo, B., Hölscher, C., Weiner, J. M., & Dalton, R. C. (2012). Way findings and spatial configuration: Evidence from street corners. In M. Geene, J. Reyes, & A. Castro (Eds.), *Proceedings: Eight International Space Syntax Symposium*. Santiago de Chile.

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, *13*, 117. https://doi.org/10.1186/1471-2288-13-117

Haq, S., & Zimring, C. (2003). Just down the road a piece: The development of topological knowledge of building layouts. *Environment and Behaviour*, *35*, 132–160. https://doi.org/10.1177/0013916502238868

Hölscher, C., Büchner, S., & Strube, G. **(**2013). Multi-floor buildings and human way findings cognition. *Behavioural Brain Science Journal*, *36*, 551–552. https://doi.org/10.1017/S0140525X1300040X

Hughes, N., Pinchin, J., Brown, M., & Shaw, D. (2015). *Navigating in large hospitals*. Paper presented at the 6th International Conference on Indoor Positioning and Indoor Navigation, Alberta, Canada. https://www.eprints.nottingham.ac.uk/35695/1/Navigating

Koseoglu, E. & Onder, D. E. (2011). Subjective and objective dimensions of spatial legibility. *Procedia - Social and Behavioural Sciences,* 30, 1191–1195. https://core.ac.uk/download/pdf/50613791.pdf

Lawton, C. A. (2010). Gender, spatial abilities, and way findings. In J. C. Chrisler, & D. R. McCreary (Eds.), *Handbook of gender research in psychology* (pp. 317-341). Springer publisher.

Li, N. (2016). *Using framework analysis in qualitative data: A brief guide*. https://nevilleliresearch.weebly.com/uploads/3/1/2/8/31284985/using_framework_analysis_on_qualitative_data_-_a_brief_guide.pdf

Mandel, L. H. & LeMeur, K. A. (2018). User way finding strategies in public library facilities. *Library and Information Science Research, 40* (1), https://doi.org/10.1016/j.lisr.2018.04.001

Martins, L. B., Melo, H. F. V. (2014). *Way finding in hospital: A case study*. Paper presented at the 3rd International Conference, DUXU 2014, held as part of HCI International, (pp. 72-82). https://www.researchgate.net/publication/300321704

Mason, M. (2010). Sample size and saturation in Ph. D. studies using qualitative interviews. *Forum; Qualitative Social Research. FQS 11*(3), Art. 8. http://www.qualitative-research.net/

Mustafa, F.A., & Rafeeq, D. A. (2019). Assessment of elementary school buildings in Erbil city using space syntax analysis and school teachers' feedback. *Alexandria Engineering Journal*, *58*(3), 1–15. https://doi.org/10.1016/j.acj2019.09.007

Peponis, J. (2012). Building layout as cognitive data: purview and purview interface. *Cognitive Critique*, *6*, 11–51. https://cspav.gatech.edu/people/john-peponis

Rahi, S. (2017). Research design and methods: a systemic review of research paradigms, sampling issues and instruments. *International Journal of Economics & Management Science, 6*(2), 1–5. https:/www.omicsonline.org

Schwering, A., Krukar, J., Li, R., Anacta, V. J., & Fuest, S. (2017). Way findings through orientation. *Spatial Cognition & Computation*, *17*(4), 273–303. https://www.tanfonline.com/doi/full/10.1080/13875868.2017.1322597

Sevinc, Z. & Bozkurt, E. (2015). Way finding behaviours in a healthcare environment: A case study analysis of individual differences. *Gazi University Journal of Science (GUJ Sci.) Part: B, 3*(3), 37–45.

Slone, E., Burles, F., Robinson, K., Levy, R.M., & Iaria, G. (2014). Floor plan connectivity influences wayfinding performance in virtual environments. *Environment & Behaviour Journal, 47*(9), 1024–1053. https://doi.org/10.1177/0013916514533189

Weisman, J. (1981). Evaluating architectural legibility way-finding in the built environment. *Environment and Behaviour, 13*(2), 189–204. http://dx.doi.org/10.1177/0013916581132004

Werner, S., & Schindler, L. E. (2004). The role of spatial reference frames in architecture–misalignment impairs way finding performance. *Environment & Behaviour Journal, 36,* 461–482. http://dx.doi.org/10.1177/00139165003254829