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Improving wayfinding in a UK higher education institution library

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Abstract: This paper provides an analysis of ShelfMap, an online wayfinding tool which was the centrepiece of a mixed methods case study which aimed to improve understanding of the information practice of students interacting with classification schemas in order to find material in the stacks. It measured changes in wayfinding skill levels resulting from the introduction of ShelfMap to a UK Higher Education Institution (HEI) library.

There was a 39% time saving to find the correct stack which held the item sought and a 33% time saving to find the item itself. Locating the stack was found to be more difficult than finding the item itself, so this time saving is encouraging. A reduction in anxiety levels was also detected suggesting a more positive relationship between the students and their environment had been fostered.

There are recommendations on how libraries can improve their wayfinding and boost students' information literacy.

Keywords: Wayfinding, self-efficacy, impact.

1 Introduction

The research which led to the creation of ShelfMap emerged as a result of the researcher's observation as a member of a university library's helpdesk team that students had difficulty finding items on the shelf. A prototype wayfinding system was deployed to try to assist such users. It was well-received by students and staff alike and it was felt that research into this area would be beneficial.

ShelfMap, a wayfinding app, was developed to reduce the barriers to access that students were experiencing by providing three-dimensional images of the location of a stack in the space which contained the item which was being sought. It was developed by one of the authors of this paper, who had previous programming experience. It was installed at the academic library of Goldsmiths, University of London, a UK Higher Education Institution which specialises in creative arts subjects. A hypothesis was made that the impact of introducing an online wayfinding App would positively change the experiences and ability of students to find items on the shelf following its introduction. A further aspect of the research concentrated on identifying study level differences which may persist in this area.

The objectives of the research were to review and critically assess the literature in order to understand wayfinding issues and approaches to resolve them; to assess the impact of students' experience and study level on their ability to find material located in the online catalogue; to explore the impact of introducing a wayfinding App with physical signage on the ability and perceived experience of locating such material; and to indicate the study's contribution to the field, making recommendations for future research.

2 Literature Review

Wayfinding is the specific area of information behaviour which was being examined. Mandel [1, p.116] describes wayfinding as:

‘The ability of users of the built environment (i.e., a facility) to navigate through that environment to find specific destinations.’

More specifically, it relates to the information gap or Anomalous State of Knowledge [2] which can appear when someone seeks information. It also touches upon information use [3] in respect of the many paths that may be taken to retrieve information. With respect to information literacy, how users become information literate and the impact of context (for example being a student at a university) [4] is of relevance. Digital literacy is also relevant and the use of wayfinding tools is an example of the changing nature of this term over time [5].

Both Mandel [1] and Hahn and Morales [6] observed that humans can find wayfinding stressful or frustrating. Schmidt [7] found that it can lead to heightened anxiety for library users. Levels of self-efficacy could also be harmed, a situation in which individuals’ thoughts and feelings can potentially affect their actions (Bandura [8, p.543]). A link between low self-efficacy and an avoidance of challenging activities correlating with less inclination to develop information literacy competencies [9] is also of relevance in wayfinding.

Evidence of user confusion in finding physical items was discovered, ranging from it being a popular help desk question [10] to the frequency with which shelving assistants are asked for help in this area [11]. Kress [12] has noted that confusion starts early on, with a lack of understanding of what a classmark is for and a desire for that information to be a clickable link in the library catalogue, leading to further help. Murphy [13] has found that students find it difficult to decode classmarks and Bowker & Star [14] noted that confusion arose from lack of collocation between related items (e.g. a book and its accompanying CD)

Building navigation difficulty has long been recognised as an issue [15] and has led to techniques being created for identifying pinch points in the library’s navigation using the technique of spatial syntax [16]. This allows a library’s space to be better configured for easier connectivity by identifying areas of higher and lower visibility.

On the theme of improving navigation, various suggestions have been made ranging from removing the Dewey Decimal system altogether [17] to improvements in signage [18-20]. Schmidt’s research [21] adopted a user-experience focus and described using “touch points” - the places on their journey where customers get assistance, such as a Service Desk.

Basic forms of virtual wayfinding have also been considered or in use for some time. Li and Deng [22] used maps in a library catalogue, something which has become more common over the last decade. More sophisticated solutions using technologies such as Wi-Fi, Geographic Information Systems (GIS), Global Positioning Systems (GPS), Radio Frequency Identification (RFID), Optical Character Recognition (OCR) and QR code technology have all been considered but have not perhaps developed as far as one might expect. One of the common issues in wayfinding for items is a lack of granularity. Xia [23] proposed a paper-based blueprint for a wayfinding App recognising that the level of granularity achievable (for example identification of the exact item via GPS) is linked to both the maintenance overhead and the accuracy of the result. The latter may be compromised due to shelf-level classmark boundaries shifting over time. In terms of hand-held devices, Hahn and Morales [6] carried out research on using a mobile website for wayfinding and found that it was positively received and the participants supported further development of it.

There was a dearth of information in the literature about differences between undergraduate and postgraduate student level issues relating to wayfinding, but more about the benefits of experience of using libraries. Zaug et al [24] compared novices and experts drawn from the undergraduate group and found that it did not take much experience for the skills gap between novices and experts to dramatically reduce.

3 Research Methods

A mixed methods case study approach was taken using the format of a specifically designed case study incorporating an ethnographic element. This allowed for a more detailed focus on the practical application’s use in the field and was felt to be the most effective way to achieve the objectives of the research. Reassurance that

this decision was correct was gained from similar approaches taken by other researchers in the field [19, 25]. Indeed Mandel's investigation of wayfinding in a library used a case study approach because it helped to 'understand a particular setting in its entirety'. [26, p.65]. The main components of the current study [27] are as follows:

A short online survey was delivered via the Qualtrics web software system in order to establish a base line understanding of our target audience's characteristics and an indicative view of their broad perceptions about finding material on the shelf.

The main technique used was semi-structured interviews which Galletta and Cross have described as 'lived experiences as narrated in the interview in relation to theoretical variables of interest' [28, p.9]. Convenience sampling of six subjects representing the 8,525 FTE students at Goldsmiths was used. These were recruited via university noticeboards with a small gift voucher incentive. Efforts were made to recruit an even number of undergraduate versus postgraduate students and at differing stages of their courses. There were four female and two male volunteers. Three were undergraduates and three postgraduates.

The sessions incorporated a field exercise in which the participant was asked to find four items in the library – only two of which allowed for the use of the App. This was a technique successfully used by Lanclos [29], who recommends that librarians adopt this technique to help us think about how we use technology to engage users. The use of concurrent think-aloud (CTA) protocol where the user verbalizes what they are doing during a task was adopted, in part because it had been successful in one of the key wayfinding studies [19].

The embedding of the field exercise within the semi-structured interview was deliberate in order to allow comparison of levels of self-efficacy before and after the exercise. A scale to measure self-efficacy which had been used before for information literacy work [30] was used. In particular, in Kurbanoglu et al.'s 28 point scale, C8 "locate information sources in the library" was the one most closely matching this study.

The interviews, which were recorded on audio with consent of the users, were later codified into themes for analysis via an iterative process as described by Tracy [31]. The main themes chosen included wayfinding barriers, study level and familiarity, specific information literacy skills, ability, experience, seeking assistance and self efficacy.

The ShelfMap app itself was installed for use by all Goldsmiths' library users over a four month period and the log files examined for overall usage. Finally, library staff feedback was elicited in order to provide an alternate perspective and see if the results were confirmed by their experiences as providers of the library service.

In terms of external validity, immediate generalisation was sacrificed for depth. Mandel [1] recognised that there is a potential for the obtrusiveness of the researcher to inhibit the user. In order to mitigate this during the field exercise, this was sequenced to run after the first part of the semi-structured interview in the hope that trust would have been developed between the researcher and subject. Wolff [32] has found that levels of dyslexia amongst art students are significantly higher than average, and as Goldsmiths is an institution which specializes in art, it was therefore relatively more likely that the sample would include such students. Whilst it was not within the scope of this study to investigate the ways that dyslexia may affect wayfinding, participants could opt to share this information should they wish to.

4 Findings and Discussion

4.1 Survey

The online survey was answered by 69 students (roughly divided between undergraduate and postgraduate). 58% stated that they were in the first year of their course at Goldsmiths' and 52% used the library once a week or more. 74% felt confident about finding books on the shelf.

26% had received information literacy training at university relating to the finding of items on the shelf but slightly more than that had never received any such training. Larsen and Tatarkas's study [20] has noted that only 30% of students attended induction sessions which showed how to read a classmark, suggesting that these figures were likely to be correct.

Training that was provided was perceived to be either too quick ('[the induction] was so fast I couldn't remember what we did afterwards and you probably needed to do it three times') or unnecessary, for example, where a postgraduate may already have received such training before at another institution and felt that attending would be an unproductive use of their time. One user stated that they felt training on finding books 'could not be taught' and that he had learnt to do this 'by osmosis'.

No interviewees stated that they had received formal instruction on how to use libraries before reaching university in relation to finding books or using a classification system. This echoes the findings of Murphy et al. [13] who found that training on finding materials in libraries was often lacking.

In terms of seeking help, the majority of users (over 50%) stated that they do so if unable to find an item.

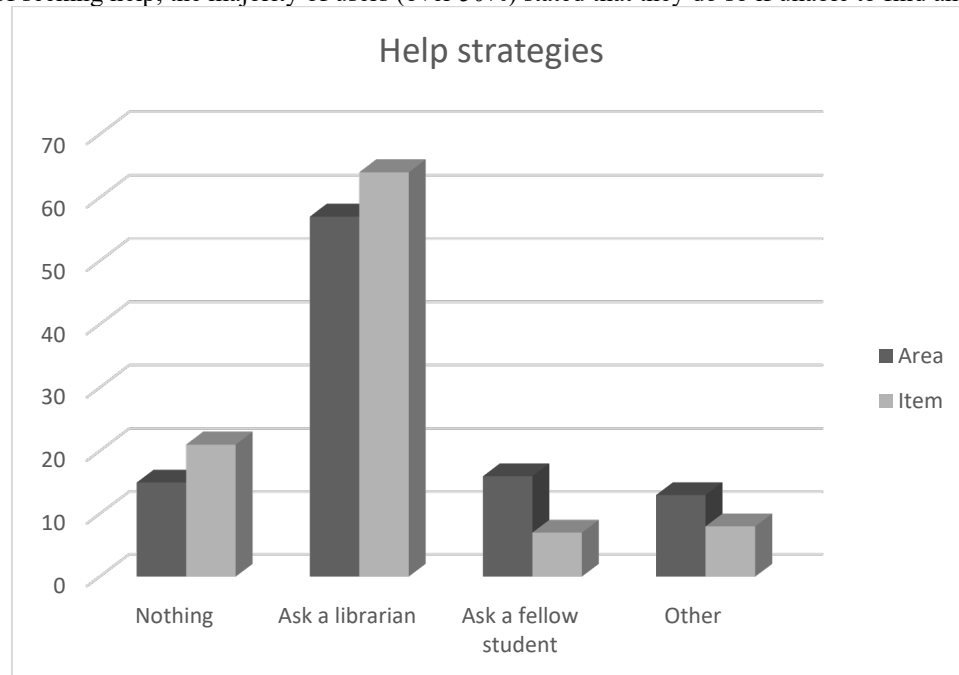


Fig 1. Help strategies used by students looking for items on the shelf

4.2 Experience and Study Level

The transition from using public or school libraries to using higher education libraries was described as challenging by the participants. For example:

'...when I first came to an academic library, I really couldn't make head or tail about how it worked'. (Participant B)

Some postgraduate participants reported avoiding the library stacks in all but their final year of a course, whereas others felt comfortable sooner. The wide and contrasting range of views given make it difficult to say much more than that there seems to be a relationship between studying at a higher level and experiencing reduced anxiety.

As there was only one novice user in the sample, the following inference should be treated with some caution, but the fact that they demonstrated competence in Dewey class number decoding suggests that even a modest amount of academic library experience aids finding ability and that this increasing experience (regardless of study level) may be just as significant if not more so than course level alone. This would fit with the findings of Zaug et al. [24] who discovered that it does not take much for the skills gap between novices and experts to be reduced. In general, the study did not elicit as much detail about study level differences in wayfinding as had been hoped.

4.3 Field Exercise

Of the 24 tasks tested, 87% were completed successfully and without seeking assistance. This correlates well with other studies such as Eaton [33] who reported a 97% success rate and Carr [18] who reported 92%. Library stack navigation was the top fail point in this study. Hahn and Zitron [19] reported this as one of their top two fail points too.

As shown in Table 1, the overall time saving benefit from using the App to find items (as opposed to without) was 39%. The calculation in respect of determining average time is described in Scaife [27, Appendix H].

Scenario	Average completion time - all	A and B (lowest ability)	C and E (highest ability)
With shelfmap	01:12	02:04	00:58
Without shelfmap	01:59	03:11	00:42
Saving (secs) per item	47	67	16
% time saving	39%	35%	27%

Table 1: Average time taken in minutes and seconds per task by participants in the field exercise to successfully find the stack in which an item is located

In respect of finding the item once an area had been successfully identified, 73% of survey respondents claimed to be confident about their understanding of how to decode Dewey decimal class numbers and find an item on the shelf. A high level of aptitude was demonstrated. For finding the area (i.e. the stack), there was less confidence and this was borne out by the research in which there were more “area” failures than “item” level failures. Additionally, time saved at item level was slightly less than at area level.

Participants were asked to report their feelings of self-efficacy both before the field exercise and then afterwards on a scale of 1 to 10. More experienced users of the library stated that the availability of the app was of more marginal assistance than those with less. However, although the time saved was of slightly less consequence for the highest achievers, it appeared to show that their perception of there being only marginal benefits of the App may be somewhat exaggerated.

4.4 Other Themes that Emerged

First, if the directional flow of shelves was broken interrupting the sequence, then this could cause problems:

005.3 – 006.68	006.68 – 070	GAP	133 - 150	150 – 150.19
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Fig. 2: Gap in shelf stack sequence

Also, the shelving of material in different areas (for example oversized books) caused some anxiety as did either the lack of, or incorrectly labelled, signage. This was also found by McKay and Conyers [11].

End stack classmark range signage which described two sides of a book stack via a single range was found to be unhelpful due to confusion about which side the sequence started at. For this research, end stack aisle numbers were added and made prominent in the App which matched the branding. There was a very positive reaction to this. For example, Participant A said

‘Oh hold on a minute, I’ve just seen the aisle number, 46 so thank you’.

Xia [23] found a similar technique helped with shelf range navigation. A particularly interesting element that was noticed was the blurring of the physical with the digital environment. Users were observed looking at the App and then looking up - making connections between the aisle numbers depicted on the App with the signage they were spotting on the stacks themselves.

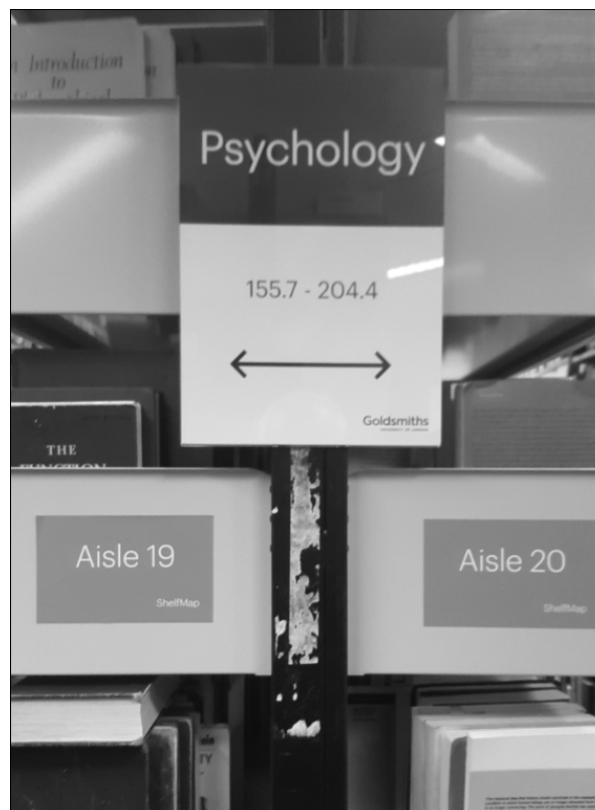


Fig 3: One-sided granularity (aisle numbers) versus two-sided

Lobby signage was underused or simply unnoticed, possibly due to its small size as found by Hahn and Zitron [19]. These issues led to two reactions as described by Folkman [34]. First, “problem focussed coping” in which participants simply persevered, and second, emotionally focussed coping in which pent up emotions were released such as those exhibited by one participant during the third task of the field exercise:

‘I feel like I’m sitting with like stress of definitely the mislabelled [shelf stack]’. (Participant C)

The lack of a floor number in the library catalogue was also seen to be problematic and points to shortcomings in respect of the online catalogue information provided. It matches the findings of Calhoun et al [35] whose respondents said they would like more detailed and explicit location information in the catalogue.

One participant’s comments about encountering two doors on a stair landing which looked similar and not being sure which to use chime with the findings of Li and Klippel’s study of wayfinding in a library where spatial syntax methodology was used to identify areas of navigational confusion in a building [16].

Help strategies employed when a user became stuck only once led to a member of staff being asked to assist. The reluctance to ask for help is nothing new [Ruppel and Fagan 36]. More popular were self-help strategies including walking the aisles or opting to use an alternative but subject related item. Hahn et al [37] found the same when they used handheld devices as part of their wayfinding study. Coupled with this was a strong element of resilience and determination not to give up in the face of perceived adversity. For example, one participant said if she couldn't find the item, she would simply "look harder".

There were a wide range of emotions and feelings exhibited regarding the finding of materials, some expressed via cognitive maps drawn by the participants. Claustrophobia, apprehension that there might be an unsuccessful outcome, frustration and stress were the negative ones. This also reflects the findings of Kuhlthau [38] in relation to anxiety being embedded in the information seeking process. On a more positive note, the result of successfully finding a book led to feelings of relief and joy. This matches Hahn and Morales who stated that 'some responded with joy when they found the desired book' [6, p.419].

Unexpected themes were gleaned from two users with self-declared specific learning disabilities (SpLD). One who suffered from dyspraxia found that the three dimensional map of ShelfMap had helped her to place herself in the space more easily. Together, these two users made average time savings of 35% when using the App, indicating that the relationship between negative effects of SpLD and less opportunity to benefit from the App is not strong. Similar but slightly lower time savings are found here in relation to time to find the actual item.

There were 13,582 requests to the App from the library catalogue which would have resulted in a map being displayed over the four month period. The requests made to the App during the four month trial when compared to the loan statistics showed that there is substantial demand for such a service.

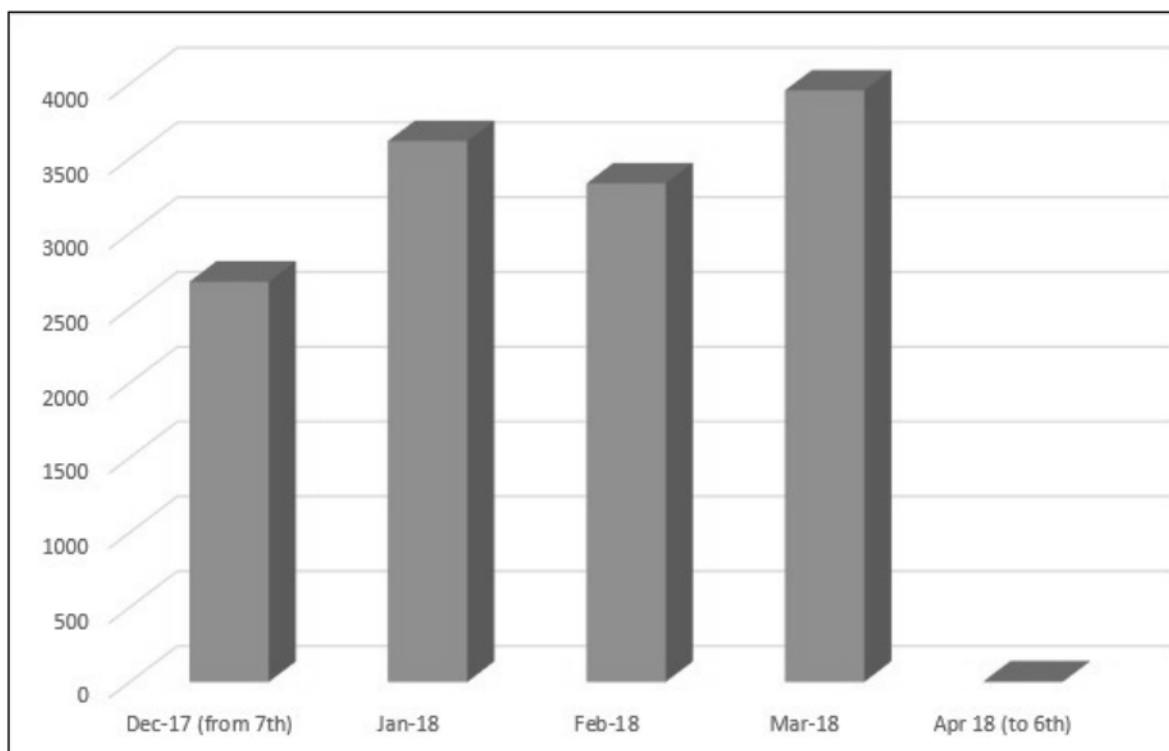


Fig 4: Requests per month to the App

In summary, the introduction of a wayfinding App had a positive impact, in particular on ability to locate the area of the library in which an item is to be found in a timely manner. The effect on ability was more significant for users with less familiarity with a library than expert users, but expertise does not necessarily align with a user being an undergraduate (inexperienced) as opposed to a post-graduate (experienced). Use of the App appears to reduce perceived stress associated with finding items and increase self-efficacy. In terms of perceived stress, the majority of participants (66%) used more positive language to describe the process of finding materials afterwards, compared with before the field exercise. In respect of increased self-efficacy, Participant A's comments illustrate this well:

‘We saw it there. I was zoomed to finding that shelf. And I have been in that area before [using the App] and I was there 20 minutes.’

5 Conclusions and Recommendations

5.1 Conclusions

In terms of ability to locate material on the shelf, this study concluded that students find it rather more difficult to find the stack than to find the item when they get there. Experience is a more significant factor than study level in regard to predicting ability of students to find items. The lack of study level differentiation in the sample has led to little new information being elicited in the area of study level as was originally anticipated, which may go some way to explaining the lack of literature in this area.

Regarding the impact of introducing the App on ability and perceived experience, the conclusion was that doing so allows students to find a book more quickly than they would otherwise do, although it has only a modest impact on changing the eventual outcomes themselves. A unique contribution of this research was that it compares times without and with the App in order to give a more quantifiable idea of difference between the two scenarios. A time saving of 32% to find the book and 39% to find the stack was observed when using the App. Benefits were also observed for both low and high ability users. It is also clear from the log file analysis that there is a healthy demand for a service of this type.

Using a wayfinding App improves self-efficacy, reduces anxiety and improves the perceived student experience. There is some evidence that the three-dimensional layout of the maps, with prominent landmarks judiciously added, can help a user to more easily place themselves within the space. Additionally, there is evidence that those with a SpLD benefit from the technology almost as much as those without. Aisle numbers used in conjunction with the App reduce barriers to wayfinding more effectively than simply using the App in isolation.

5.2 Effect upon Information Literacy

Low attendance levels at information literacy induction sessions [20] suggest that students' wayfinding problems may not always be effectively addressed through the traditional learning routes. The existence of a wayfinding App such as ShelfMap at the point of use (when they wish to retrieve an item in the catalogue) can mitigate the adverse effects of this. By providing assistance which reduces anxiety and cognitive load, the student is given a better chance of a satisfactory outcome which builds self-efficacy. The same can be said about the reluctance to seek help [36] because an App provides an alternative digital self-help option that was previously not available. Thus, the question becomes to what extent the App can supplement existing information literacy skills.

5.3 Limitations

As a case study, the extent to which this research can be generalised is limited. Nevertheless, it gives a good indication of what can be expected in a small to moderate sized university library setting. In order to be able to make any further generalisation about its applicability in different library sectors, it would be necessary to repeat the research.

It was not possible to recruit PhD students as part of the sample, and therefore these results are limited to postgraduate and undergraduate levels. Had PhD students been included, it is possible that more information would have been elicited relating to varying experience at differing levels. Also, as Library Student Representatives (LSRs) made up the whole sample, there is a possibility that this means they do not fully represent the student population at Goldsmiths in general. However, it was ascertained that LSRs do not receive extra end-user training but only what any standard student is offered.

The researcher had predicted a possible excess of students with a specific learning disability and indeed it transpired that two of the six participants in the sample (33.3%) declared a SpLD. Although it was not within the scope of this study to investigate the reasons this may affect wayfinding, there were some unexpected and interesting findings here which may benefit future researchers.

5.4 Recommendations

This study's key recommendation is that academic libraries introduce an online wayfinding system with companion signage which matches aisles displayed in the system. It should be embedded in the online library discovery system so that it is available at the point of use. The reason for making this recommendation is threefold. First, this research demonstrates that students can save time in finding materials when using an App, thus releasing further study time which may benefit overall student outcomes. Second, an App can reduce information seeking anxiety by providing the student with relevant but distilled wayfinding information. Finally, an overall improvement in the student's perceived experience matches a key objective of many learning institutions which is to increase student satisfaction levels.

Other recommended actions are:

- Ensure that end stack signage is maintained and accurate.
- Place prominent maps within lobbies and areas of key wayfinding decision making where visual distance is restricted and there are multiple direction choices.
- Ensure that a signage policy exists which has been developed, preferably involving users in its creation, building on this study's experience that a student perspective offers a unique insight into the problem of wayfinding.
- Review location information included in the library catalogue to ensure that only relevant locational information is displayed, and only where this contributes to finding the item, as opposed to irrelevant or non-contextualised information which may simply confuse the user. For example, a collection name that is not related to a geographical location might be better excluded.

Relating to the App, it was recommended that the button or link which is embedded in the library discovery system is sufficiently prominent and descriptive for users to understand its purpose. The embedding of links from third party applications in discovery systems is nothing new. Link resolvers have been used in this way for some time. Their objective is to connect users with a full text electronic version. An analogous objective exists with a wayfinding App which aims to connect users with the full text *physical* version. Are there lessons to be learnt from the experience of making link resolver systems intuitive to use that could be applied to wayfinding Apps?

Where possible, it is also recommended that images in the wayfinding App are oriented in such a way as to highlight the position of landmarks within the building such as stairs and lifts, in order to reduce the cognitive load of understanding the relative location of the stack being sought.

Here are several potential areas for future research:

- Noting that there is a trade-off between the maintenance overhead of labelling each shelf and bay within a library and the perceived or actual benefits that a student might gain from this, a study in which the App was used in a shelf-level library setup, comparing the results with this study, might help to calculate this cost-benefit more accurately.
- Exploring the impact of presenting different App views based on the current location of the user in the space so as to afford a more accurate spatial perspective and whether this further reduces wayfinding anxiety.
- The impact of a specific learning disability on the ability to find materials in libraries and the contingent benefit from wayfinding tools would benefit from further research as it appears to be an area in which a positive impact can be made.
- A watching brief on developments in the area of indoor navigation should be maintained. Organisations such as Indoor Atlas (2018) are working on the ability to use satellite navigation and other technologies inside buildings. These may not yet be accurate enough to use in a library shelf mapping setting, but if that changes, there may be benefits in incorporating it into a library wayfinding App.

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