

Changes in reading behavior of periodicals on mobile devices: a comparative study

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Abstract

Mobile devices not only bring convenience to aspects of life but also change people's behavior in their daily lives, in particular reading. While most of the studies focus on reading books, there are scant systematic publications primarily focusing on electronic periodicals, especially comparing the different needs of patrons from different faculties. We explored whether and how university patrons of the University of Hong Kong changed their reading behavior of e-periodicals in the context of mobile devices through an online questionnaire. Six reading patterns were investigated, including reading frequency, types of periodicals, preference of mobile devices, reading time spent, reading timeslot, and reading location. We purposefully compare subjects selected from three faculties (Education, Engineering, and Science) to examine whether research and learning requirements affect their behaviors. Our analysis found that the reading patterns have indeed changed after patrons adopted mobile devices to read periodicals. There are also some statistically significant differences among the faculties investigated, reflecting their different information needs. The findings can help academic libraries review their periodical subscription policies and reading promotion schemes to satisfy various patrons' needs.

Keywords:

e-periodicals; e-journals; user preferences; academic libraries; learning needs; quantitative study

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Introduction

With the development of mobile device applications, people's life has changed dramatically in many aspects, especially when smartphones have become popular in modern society. Currently, people's life is filled with an enormous amount of information from various mobile applications from laptops, tablets, smartphones, and e-readers. Hayles (2007) indicates current students are "hyper-attentive," meaning that they can multitask on several projects, technologies, and devices at the same time. This is different from "deep attention" or giving long periods to a specific task like reading a book, or something with which traditional libraries and scholars are more familiar.

Newsletters, newspapers, magazines are important in Hong Kong with its advanced printing industry, and reading them has been essential in Hongkonger's life before the prevalence of mobile technologies (Lo *et al.*, 2019). Gossip magazines, local newspapers are filled in the newsstands or convenience stores, and free newspapers are distributed in the railway and subway stations in the weekdays morning, even nowadays. However, a cruel fact is that continually, some publishing companies shut their business down due to decreasing profits and shrinking markets. Because fewer people are willing to pay for printed publications, consumers prefer to visit websites, social media, and mobile apps to access information without any limitations or costs. As for journals, researchers used to spend their time and efforts to visit the library to access the academic journals for their studies previously, but digital technology has changed this situation, they can access the electronic journals instantly regardless of time and location.

The transition to electronic format for periodicals brings many advantages to academia. Firstly, as electronic collections require much less space than the physical collections, librarians can, therefore, save more space and re-purpose library space for other services and activities (Lo *et al.*, 2017). Secondly, e-journals and digitalized newspapers decrease the cost and shorten the long period before publishing than printed formats and reduce the delivery expense (Smith, 2003; Neijens & Voorveld, 2018). Thirdly, the usage of physical journals is less used than e-journals, which demonstrated format is crucial for researchers accessing information (Vaughan, 2003). Fourthly, Borrego, Anglada, Barrios, & Comellas (2007) found most young science scholars, compared with other academic disciplines, especially willing to use e-journals, which means the behavior of using e-journals is highly dependent on discipline or age. Last but not least, patrons can save a lot of time and effort by using e-periodicals due to efficient search and multiple access (Ollé & Borrego, 2010; Adeyinka, 2011). As such, electronic access has much increased various academic resources (Brennan, Hurd, Blečić, & Weller, 2002; Ollé & Borrego, 2010).

Publishers and libraries both put lots of resources on developing electronic journals and collection services in the digital era, as well as other innovative services (Wójcik, 2019). Digital publishing products consist of e-books, digital newspapers, electronic periodicals, original literature network publications, network maps, digital music, animations, online games, etc. (Chang, 2012). In China, the development of the digital publishing industry increased rapidly from only 21.3 billion in 2006 of the annual output value but reaching to 440.4 billion in 2015 (Xu & Chen, 2017). Publishers keep the development of mobile apps and are also experimenting with new business models. As for libraries, they provide more access to e-contents and are dealing with the learning curves associated with device usage, content economics, and copyright compliance as patrons adopt e-contents at a fast and relentless pace (Bosch *et al.*, 2011). According to EBSCO surveys conducted during February 2010 and 2011, more than 80% of librarian respondents indicate that they are likely to move print plus online subscriptions to online-only under budget goals (Bosch, Henderson & Klusendorf, 2011). If libraries have to prioritize services, it made sense to support growing demands like digital collections and services (Little, 2014).

While various literature has focused on digital reading habits, there is scant related research solely on digital periodical reading (Wang *et al.*, 2016). Only a few studies pay attention to digital approaches to periodicals and digitalized newspapers (Smits, 2014; Cordell *et al.*, 2016). Therefore, this study attempts to fill this research gap focusing on studying changes in the behavior of periodicals on mobile devices. This study adopts the framework of Wang's research, which investigated the general periodical reading habits in Hong Kong (Wang *et al.*, 2016). Further, we purposefully compare subjects selected from three faculties (Education, Engineering, and Science) to examine whether discipline and learning requirements affect their reading behavior. As our finding gives an overview of current library users' perception of the periodical collections, it could provide significant insights for academic libraries for reviewing periodical renewals and subscription policies and mechanisms of managing electronic resources. To sum up, we would like to probe into four research questions (RQs):

RQ1: What are the factors affecting the reading patterns of the patrons?

RQ2: What are the statistically significant differences in the reading patterns among three faculties?

RQ3: Have the patrons' periodical reading patterns changed when mobile devices are involved in people's reading process?

RQ4: What are the features of printed periodicals that still attract patrons to read?

The rest of the paper is developed as follows. First, we review the related literature on the profile of digital reading in Asia and reading on different mobile device contexts. Next, we present our research methodology and the results of data analysis. Finally, we conclude our paper by a discussion

of our findings, as well as future contributions and limitations of this study.

Literature review

Digital reading profile in Asia

Although people's reading behavior has changed gradually because of technology advancement, studies on people's preference in the format of reading materials between print and electronic have been examined over a decade. At the beginning of the digital reading era around 2003, a study conducted at the University of Hong Kong (HKU) Library explored this issue among its patrons. The result showed that an overwhelming majority (77%) of the respondents preferred print to digital materials (Bodomo, Lam, & Lee, 2003). However, the trend of using digital media for reading has become increasingly prevalent for both educational and recreational reading. An experimental study conducted at the Chinese University of Hong Kong about students' usability and usefulness of eBooks demonstrates that technology has the potential to enhance teaching and learning in the university context (Lam, Lam, Lam & McNaught, 2009). But, there are still a lot of challenges that need to be addressed, such as computer skills, reading processes, comprehension of digital text, etc. Besides, a study shows respondents from Hong Kong with the highest frequency of reading e-books and academic papers, reaching 43% and 35% respectively, among Australia, Portugal, Sweden, UK Leeds, and UK Open University (Kukulka-Hulme *et al.*, 2011). Wang *et al.* (2016) investigated the impact of digital media on the magazine reading habits at the HKU. They pointed out that HKU students read more types of magazines after using mobile devices.

In recent years, a study that investigated university students' academic reading behavior and preferences in 21 countries with over 10,000 participants (Mizrachi *et al.*, 2018). Nearly 80% of respondents preferred the printed format of academic course materials. Similar findings were found in other studies. For example, Kurata *et al.* (2017) revealed that approximately 70% of the majority of Japanese respondents favored print media over digital media. However, at the same time, about 70% of their total reading time was spent on digital media. Liu and Huang (2016) also found that undergraduate students in China still prefer to read on printed materials while they have increased the reliance on mobile phones for reading. These findings show a mismatch between digital reading time and preference of reading format. While people may still prefer to read on paper, the trend of using digital media for reading has been increasing.

Reading on different mobile devices

While most studies focus on people's preference in the format of reading materials between

print and electronic, comparatively fewer studies have identified different types of mobile devices for reading. Notably, different types of devices provide unique features for reading (Sage *et al.*, 2019). While people usually do more browsing and scanning on smartphones, they preferred reading on desktop or laptop computers. It is because of bigger screens, faster network speeds, and ease of editing, searching, navigating, downloading, and storing materials of these devices compared with the handheld counterparts (Liu and Huang, 2016, Ko *et al.*, 2015; Lau *et al.*, 2017; Wai *et al.*, 2018).

The invention of the iPad also brought a dramatic push in the digital publishing market as it has raised the profile for e-publishing generally. Unlike the design of e-readers, the iPad and other similar tablets provide more functions and applications, such as email, Web browsing, and all the main features of the iPhone (except the voice phone only available in limited models). It also has a color screen and includes interactive magazines and tailored news contents that mix text and multimedia (Anderson, 2011). The visually appealing feature can enhance the user experience, and studies have found that the multimedia capabilities of tablets facilitate student engagement in classrooms (Fischer *et al.*, 2013; Soffer & Yaron, 2017).

E-readers (e.g., Kindle) have some features that products like iPad or other devices miss. Firstly, in contrast to tablets with the liquid crystal display (LCD), e-readers use sharp e-ink screens to prevent eye-fatigue and allow reading in a wide range of environments (Anderson, 2011; Benedetto *et al.*, 2013). This feature makes reading on the e-reader comparable with reading the printed text (Siegenthaler *et al.*, 2010; Benedetto *et al.*, 2013), and in 2011 e-books sales on Amazon surpassed printed books for the first time. Secondly, the battery life of e-readers is generally longer than other mobile devices, which may make it more accessible for long trips (Anderson, 2011). However, e-readers are not suitable for academic readings due to content availability and licensing issues, graphic display capabilities, organizational issues, and high costs (Clark, Goodwin, Samuelson, & Coker, 2008).

There are other factors affecting people's choice of devices as a reading tool. One significant human factor influencing personal reading ability is working memory capacity (Linderholm & van den Broek, 2002; Margolin, Driscoll, Toland, & Kegler, 2013; McVay & Kane, 2012). Working memory capacity will decrease with age, overload tasks demanded, and distraction (De Beni, Borella, & Carretti, 2007; McVay & Kane, 2012; Waters & Caplan, 2001). Distraction often happens in the digital reading context because online reading is easily interrupted by other events, including pop-up advertisements or messages, colorful pictures, email alerts, and so on (Fisher, Lapp, & Wood, 2011). Other factors may be related to physical needs; for example, tablets become popular among older people with arthritis and people with visual impairment due to its lightweight and adjustable font size

for reading (Quan-Haase *et al.*, 2014; Balling *et al.*, 2019).

Methodology and data collection

We conducted a quantitative research approach to study the changes in reading behaviors of periodicals on mobile devices at the University of Hong Kong (HKU). This was a follow-up study of Wang *et al.* (2016), which had indicated that most participants had changed their reading patterns on the magazine reading, in terms of reading frequency, magazine types, time spent, time slot, and reading location. Besides, we added one new reading pattern about reading devices preference, referring to which mobile devices do participants prefer to read e-periodicals. We anticipated that using mobile devices might benefit from increasing and promoting the reading of periodicals, as mobile devices are very efficient tools to access information. Therefore, we measured the patrons' periodical reading patterns in terms of their (1) reading frequency, (2) types of periodicals, (3) preference of mobile devices, (4) reading time spent, (5) reading timeslot, and (6) reading location.

This study adopted the main questionnaire framework of Wang's research to investigate further in the general reading of periodicals. The raw data is collected via an online self-administered questionnaire on Google Form with six main parts correspondingly, plus one part for demographic information. We sent the link of the questionnaire purposefully to members of three faculties, including the Faculty of Education, Faculty of Engineering, and Faculty of Science, to compare whether discipline and learning requirements affect their reading behavior. After collecting the data, the dataset was analyzed using SPSS (Statistical Package for the Social Sciences) for comparing the three groups.

Table 1. Demographic backgrounds of participants

	Education (N=59)	Engineering (N=51)	Science (N=45)
Male	13 (22%)	34 (67%)	33 (73%)
Female	46 (78%)	17 (33%)	12 (27%)
Age			
18 to 22	6 (10%)	27 (53%)	10 (22%)
23 to 27	22 (37%)	13 (25%)	26 (58%)
28 to 32	15 (25%)	7 (14%)	8 (18%)
33 or above	16 (27%)	4 (8%)	1 (2%)
Student	55 (93%)	45 (88%)	41 (91%)
Staff/Faculty	1 (2%)	3 (6%)	2 (4%)
Both	3 (5%)	3 (6%)	2 (4%)
Mobile devices used to read e-periodicals (multiple choice)			
Laptop	44 (75%)	30 (59%)	34 (76%)
Tablet	20 (34%)	15 (29%)	16 (36%)
Smartphone	50 (85%)	46 (90%)	37 (82%)
E-reader	13 (22%)	6 (12%)	4 (9%)
Average number of devices owned	2.15	1.90	2.02

Table 1 shows the demographic information of the 155 participants recruited. Among the three

faculties, the primary respondents are mainly students with 35.5% (N = 55) from Education, 29.0% (N = 45) from Engineering, and 26.5% (N = 41) from Science, with the remaining 9.0% (N = 14) respondents are faculty and staff (see Table 1). On average, each participant owns nearly 2 mobile devices to read e-periodicals.

Results and Analysis

Reading patterns of participants

For the data collection regarding the reading patterns of our participants, we decided to adapt Wang's questionnaire and add two periodical types "Academic journals" and "Cartoons and comics" (see Table 3), so a total of 14 types of periodicals were included in the study. The p -value of each periodical type from each faculty was tested with the Chi-Square test to compare BEFORE and AFTER figures referring to their adoption of mobile devices to read. Most of them are statistically insignificant differences except "Health & Well-being" type from Education with $p < 0.01$, "Business & Investing" type from Engineering with $p < 0.05$, and academic journals with $p < 0.10$. The average reading on periodical types was calculated (see Table 2), and we found that only in Education exhibited statistically significant difference after using mobile devices to read periodicals with $p < 0.01$. But all three faculties read more periodicals after adopting mobile devices on average, though the difference is statistically insignificant.

Table 2. Average reading on periodical types

	Education (N=59)	Engineering (N=51)	Science (N=45)
Before	3.92	4	3.18
After	4.83	4.63	3.93
Difference	0.91	0.63	0.75
<i>p-value</i>	0.006 **	0.082	0.063

Note: ** $p < 0.01$ $p < 0.05$

Table 3. Total number of reading each type of periodical (N = 155)

	BEFORE	AFTER	Difference (After – Before)
Automobile	9	10	1
Business & Investing	24	38	14 **
Electronics & Audio	17	25	8
Entertainment	71	80	9
Fashion & Style	38	51	13
Health & Well-being	30	58	28 ***
Literary Magazines & Journals	23	28	5
Music & Movie	43	55	12
News & Politics	91	87	-4
Science Magazines	55	57	2
Sports Magazines	26	31	5
Travel Magazines	42	52	10
Academic Journals	70	87	17 *
Cartoons and comics	39	40	2

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ for Chi-Square Test on the change of the proportion.

We further investigated the three types of periodicals in which the migration of mobile devices would affect their reading selection. We asked the participants what mobile devices (including laptop, tablet, smartphone, e-reader) they preferred to use when reading these three categories of e-periodical. In general, the most popular device was the smartphone, followed by laptops and tablets. Very few participants used e-readers for reading these periodicals. We also noted that our participants still liked to read print periodicals. Besides, even though most users liked to use the smartphone to read business and health periodicals, they would prefer to access academic journals using laptops and reading the printed version (see Table 4).

Table 4. Reading medium preference (multiple choice)

	Business & Investment	Health & Well-being	Academic Journals
Laptop			
➤ Total	30	21	61
➤ Education	12	6	27
➤ Engineering	10	6	12
➤ Science	8	9	22
Tablet			
➤ Total	17	19	9
➤ Education	3	6	2
➤ Engineering	8	8	6
➤ Science	6	5	1
Smartphone			
➤ Total	74	93	22
➤ Education	31	37	6
➤ Engineering	22	31	12

➤ Science	21	25	4
E-Reader			
➤ Total	3	2	4
➤ Education	2	1	0
➤ Engineering	0	0	3
➤ Science	1	1	1
Printed Version			
➤ Total	31	20	59
➤ Education	11	9	24
➤ Engineering	11	6	18
➤ Science	9	5	17

Table 5. Reasons for choosing these types to read

	Education (N=59)	Engineering (N=51)	Science (N=45)	<i>p-value</i>
Academic needs	43 (73%)	20 (39%)	30 (67%)	0.001
Work needs	15 (25%)	9 (18%)	12 (27%)	0.512
Personal interest	53 (90%)	45 (88%)	38 (84%)	0.704
Hobbies	30 (51%)	29 (57%)	17 (38%)	0.166
To acquire knowledge	30 (51%)	31 (61%)	25 (56%)	0.581
Recommended by other people	10 (17%)	2 (4%)	5 (11%) ^u	0.094
To kill time	18 (31%)	17 (33%)	14 (31%)	0.948

Table 5.1. Post hoc test of “Academic needs”

Education vs. Engineering	<i>p</i> = 0.001
Engineering vs. Science	<i>p</i> = 0.008
Education vs. Science	<i>p</i> = 0.495

Besides, in terms of the above 14 periodical types, why the participants chose these periodical types to read is one of the key research issues (i.e., RQ1). Results in Table 5 show that the top two reasons for both Education and Science were for “Academic needs” and “Personal interest,” while the situation in Engineering was very different. The top two were “Personal interest” and “To acquire knowledge,” and “Academic needs” only took fourth place. Notably, the difference referring to “Academic needs” between three faculties had a statistically significant difference with $p < 0.01$. The main difference was because of the various opinions of “Academic needs” of the Engineering participants (see Table 5). Furthermore, two participants indicated that they read these types because of diversion from work and discount when purchased with friends.

To what extent reading periodicals help the participants’ learning is also an interesting topic to explore. As shown in Table 6, the reasons “Enhancing writing skill,” “Getting extra knowledge outside class,” “Getting the latest information in the related field,” “Required by teachers,” and “Need contents for doing course assignments” have statistically significant differences in three faculties.

Table 6. How reading periodicals help your learning

	Education (N=59)	Engineering (N=51)	Science (N=45)	Weighted average	<i>p-value</i>
Enriching vocabularies	3.66	3.18	3.51	3.45	0.055
Enhancing writing skill	3.54	3.1	3.2	3.28	0.031
Enhancing reading skill	3.61	3.41	3.71	3.58	0.372
Getting extra knowledge outside class	4.34	3.82	4.07	4.08	0.028
Getting latest information in related field	4.36	3.86	4.18	4.13	0.039
Required / recommended by teachers	3.29	2.51	2.71	2.84	0.001
Need contents for doing course assignments/projects	3.76	2.78	3.07	3.20	< 0.001

Note: 5=Strong agree; 1=Strong disagree.

Table 6.1 Post hoc test for the options with a statistically significant difference in Table 5

<i>Enhancing writing skill</i>	<i>p-value</i>
Education vs. Engineering	0.010
Engineering vs. Science	0.629
Education vs. Science	0.080
<i>Getting extra knowledge outside class</i>	
Education vs. Engineering	0.008
Engineering vs. Science	0.229
Education vs. Science	0.177
<i>Getting latest information in related field</i>	
Education vs. Engineering	0.012
Engineering vs. Science	0.095
Education vs. Science	0.584
<i>Required / recommended by teachers</i>	
Education vs. Engineering	0.001
Engineering vs. Science	0.401
Education vs. Science	0.014
<i>Need contents for doing course assignments/projects</i>	
Education vs. Engineering	< 0.001
Engineering vs. Science	0.299
Education vs. Science	0.012

For print periodicals in the last question in the survey, we examined a deeper level of the participants' behavior about whether they printed out electronic periodicals by themselves. The result in Table 7 shows a statistically significant difference to this point with $p < 0.001$ among the three faculties, with 69% (N = 41) of Education and 80% (N = 36) of Science participants would like to use print format. However, in the primary analysis, it was found that the participants from Engineering were relatively different from the other two faculties, 57% (N = 29) of them would like to use electronic format (see Table 7.1).

Table 7. Print e-periodicals

	Education (N=59)	Engineering (N=51)	Science (N=45)	<i>p-value</i>
Yes	41 (69%)	22 (43%)	36 (80%)	< 0.001
No	18 (31%)	29 (57%)	9 (20%)	

Table 7.1. Post hoc test for Table 7

	<i>p-value</i>
Education vs. Engineering	0.006
Engineering vs. Science	< 0.001
Education vs. Science	0.228

Table 8 summarizes the underlying reasons why participants preferred to read physical periodicals.

“Convenient to take notes” was the primary reason for the majority of participants from both Education and Science, while “Easier to concentrate” was the main reason for the Engineering participants. Some participants left the messages to indicate their reasons as well in response to this open-ended question (see Table 8.1).

Table 8. The reasons you prefer to read the physical periodicals

	Education (N = 59)	Engineering (N = 51)	Science (N = 45)
Convenient to take notes	43 (73%)	26 (51%)	34 (76%)
Get used to read on paper	25 (42%)	25 (49%)	28 (62%)
Easier to concentrate	37 (63%)	41 (80%)	29 (64%)
Unfamiliar with using digital equipment	1 (2%)	2 (4%)	0

Table 8.1. Other comments for Table 8

Education	Engineering	Science
I did not use paper versions anymore after I got my iPad.	Screen size may not be suitable for reading.	Only for academic journals and only if laptops available.
Sometimes it's difficult to sit in front of a computer for long. Print outs help the flexibility of movement.	You can compare the front and back paragraphs.	More comfortable for eyes.
Help to memorize.	Feels better on hand.	
Physical periodicals allow for a broader view, especially when you want to go back and forth for particular sections.	It is easier to read on paper for long paragraphs.	
Reduce eye strain.	Not easy to be distracted.	
I don't get tired easily when reading printed materials or using a Kindle.		
I prefer a digital version.		
Protect the eyes.		

As for the attractiveness of the features provided by mobile devices, Table 9 shows that the overall result from three faculties is similar, with *p*-values all above the 0.05 level. In general, the most attractive feature is “Be able to read anytime, anywhere,” followed by “Higher accessibility,” “Convenient to retrieve relevant information through online search engines,” and “More updated articles.”

Table 9. Attractiveness of the features from mobile devices

	Education (N=59)	Engineering (N=51)	Science (N=45)	Weighted average	<i>p</i> -value
Be able to read anytime, anywhere	4.42	4.55	4.47	4.48	0.838
More updated articles	4.41	4.25	3.98	4.21	0.098
Higher accessibility	4.44	4.39	4.33	4.39	0.636
Be able to share on the social media	3.46	3.31	3.31	3.36	0.714
Convenient to retrieve relevant information through online search engines	4.32	4.04	4.31	4.22	0.153
Built-in tools, such as dictionary	3.41	3.39	3.44	3.41	0.934
Bookmark function	3.05	3.08	3.22	3.12	0.653
Flexibly change font style and size	3.49	3.22	3.18	3.30	0.331
Highlighting function	3.53	3.18	3.04	3.25	0.113

Note: 5=Very attractive; 1=Not at all attractive.

Table 10. Time spent in reading periodicals

	Education				Engineering				Science			
	Before	After	Change	<i>p-value</i>	Before	After	Change	<i>p-value</i>	Before	After	Change	<i>p-value</i>
Automobile	1.29	1.41	0.12	0.118	1.53	1.69	0.16	*0.035	1.4	1.51	0.11	0.289
Business & Investing	1.53	1.75	0.22	*0.013	1.63	1.82	0.19	*0.049	1.76	1.93	0.17	0.146
Electronics & Audio	1.58	1.75	0.17	0.057	1.57	1.82	0.25	*0.013	1.51	1.73	0.22	*0.021
Entertainment	2.34	2.44	0.1	0.152	2.1	2.29	0.19	0.359	2.18	2.36	0.18	0.454
Fashion & Style	2.02	2.07	0.05	0.286	1.75	1.92	0.17	*0.035	1.67	1.78	0.11	0.344
Health & Well-being	2.14	2.25	0.11	0.263	1.8	2.04	0.24	**0.007	1.73	1.84	0.11	0.424
Literary Magazines & Journals	2.19	2.31	0.12	0.18	1.82	1.88	0.06	0.791	2.02	2	-0.02	0.804
Music & Movie	2.19	2.37	0.18	0.108	1.82	2	0.18	0.057	2.09	2.33	0.24	0.454
News & Politics	2.46	2.69	0.23	*0.011	2.18	2.2	0.02	1	2.36	2.56	0.2	0.481
Science Magazines	1.93	2.07	0.14	0.189	2.02	2.22	0.2	*0.021	2.73	2.69	-0.04	1
Sports Magazines	1.71	1.69	-0.02	1	1.69	1.88	0.19	*0.013	1.76	1.87	0.11	1
Travel Magazines	2.22	2.24	0.02	0.523	1.69	1.88	0.19	*0.021	1.84	1.87	0.03	1
Academic Journals	3.51	3.83	0.32	**0.008	2.47	2.55	0.08	0.824	3.31	3.67	0.36	0.302
Cartoons and comics	2.17	2.24	0.07	0.332	1.78	1.86	0.08	0.648	1.96	1.96	0	1

Note: 6 = 120-150 minutes; 5 = 90-120 minutes; 4 = 60-90 minutes; 3 = 30-60 minutes; 2 = Less than 30 minutes; 1 = 0 minutes.
**p<0.01, *p<0.05

Generally, as shown in Table 10, the participants spent more time on reading periodicals after using mobile devices to read with statistical significance. Notably, the most statistically significant difference between BEFORE and AFTER occurred in Engineering for over half of the periodical types. The reading duration had increased for all types of periodicals, which was different from the other two faculties. Moreover, both Science and Education had significant growth of reading duration (0.36 and 0.32) on reading “Academic journals” type, while the most significant increase in Engineering was the “Electronics & audio” type.

As for the overall reading frequency, the change was not statistically significant within the three faculties with $p = 0.051$ (see Table 11). Notably, all the three faculties had an increase in the reading frequency, with the Faculty of Engineering having the highest growth of 0.43, while Education remained almost the same.

Table 11. Reading frequency

	Education (N = 59)	Engineering (N = 51)	Science (N = 45)	Weighted Average
Before	3.53	3.37	3.44	3.45
After	3.61	3.8	3.76	3.72
Difference	0.08	0.43	0.32	0.28
<i>p-value</i>	0.441	0.243	0.286	

Note: 5 = Daily; 4 = More than once a week; 3 = Once a week; 2 = Once in two weeks; 1 = Once a month.

Table 12 summarizes the change in reading timeslots after using mobile devices. Participants' reading patterns changed as well, especially Education and Engineering participants switched their reading time from "Morning (6:00 – 12:00) to "No fixed period of time slots," while Science participants did not show a statistically significant difference.

Table 12. Reading timeslot (multiple choice)

	Education (N = 59)		Engineering (N = 51)		Science (N = 45)	
	Before	After	Before	After	Before	After
Morning (6:00 - 12:00)	10	3	9	1	6	3
Afternoon (12:00 - 18:00)	11	8	5	5	7	7
Evening (18:00 - 24:00)	8	8	19	6	9	11
Midnight (24:00 - 6:00)	0	0	0	3	0	2
No fixed period of time slots	30	40	18	36	23	22
<i>p-value</i>	0.027		< 0.001		0.607	

Last but not least, reading locations for all three groups showed a statistically significant difference after pair-wise tests with $p < 0.001$. This shows participants might do their periodicals readings at different and more locations (see Table 13). Notably, the choices of "At home," "In the park," "In the café/restaurant," and "On transportations" have significant changes (see Table 13.1).

Table 13. Reading location (multiple choice)

	Education (N = 59)	Engineering (N = 51)	Science (N = 45)
Number of locations (BEFORE)	1.85	1.55	1.62
Number of locations (AFTER)	2.86	2.69	2.22
Difference	1.02	1.14	0.60
<i>p</i> -value	< 0.001	< 0.001	< 0.001

Table 13.1. Post hoc test for the options with statistically significant difference

<i>p</i> -value	Education (N = 59)	Engineering (N = 51)	Science (N = 45)
At home	0.454	0.219	1
In the park	< 0.001	0.002	0.125
In the café / restaurant	< 0.001	< 0.001	0.004
On transportations	< 0.001	< 0.001	< 0.001
In libraries	0.727	0.302	0.289

Discussion

RQ1: What are the factors affecting the reading patterns of the patrons?

Firstly, the changes may be brought by each participant's background information. From Tables 1 and 8, our results showed that each participant owned nearly two mobile devices on average to access electronic periodicals, with only a minority of these participants (2%) unfamiliar with digital equipment. Therefore, our participants might be characterized as "digital natives" with a high level of digital literacy. Earlier digital reading challenges mentioned by Lam *et al.* (2009), such as the lack of computer skills and unfamiliar with technologies, have been overcome by the new generation brought up with digital technologies. This is also consistent with the view of Bosch *et al.* (2011) that patrons adopt e-content usage at a fast and relentless pace. Recently, students have also been found completing search tasks faster with mobile apps for searching library catalogs than using the laptop (Chen, 2019).

Secondly, the advantages of mobile devices were crucial to attracting participants from all three faculties ($p > 0.05$). The main reasons for attracting them included the ability to read anytime and anywhere, higher accessibility of up-to-date digital contents, and easy information retrieval for further understanding via search engines (see Table 9). These features may suggest the potential use of digital technologies to enhance teaching and learning (Lam *et al.*, 2009).

Thirdly, the purposes and medium preference of reading e-periodicals may also help understand the reading patterns of patrons. "Personal interest" and "Academic needs" were the two main reasons to push people to read periodicals (see Table 4). The majority of respondents have strongly relied on smartphones for reading leisure magazines such as "Entertainment," "Fashion & Style," "Health & Well-being," "Music & Movie," and "News & Politics." At the same time, they preferred to use a laptop or printed format or to read "Academic journals" (see Table 6). This finding was consistent with previous studies (Ko *et al.*, 2015; Liu & Huang, 2016), which indicated that people

tend to read short texts or do quick browsing on their smartphones and read serious materials on other devices such as laptops or on paper. This may also explain why each participant owns nearly two devices, as switching between devices is a common reading practice in the digital era. Besides, contrary to the finds of Wang *et al.* (2016), our results suggested that tablets were not popular than smartphones for reading. Such a difference is also reasonable as smartphone manufacturers have been producing smartphones with larger screens or so-called “phablets” in recent years. According to the statistics report of smartphone unit shipments, over 1 billion smartphones with a screen size of 5 to 7 inches have been shipped around the world (Statista 2019). It is expected that the difference between smartphones and tablets will become much less significant.

RQ2: What are the statistically significant differences in the reading patterns among three faculties?

Our finding showed that the behavior of reading is dependent on discipline to a certain extent. Participants from different faculties have different curriculum and information requirements. This explains why Engineering participants had distinct opinions in why they choose those types of e-periodicals to read (see Table 4), and whether they printed out e-periodicals for reading (see Table 7). Besides, most Education and Science participants read e-periodicals because of “Academic needs,” but most Engineering participants were for “Personal interest.”

Furthermore, most Education and Science participants preferred the printed format, while Engineering participants were more inclined to use the electronic version. As for Education participants, they emphasized that reading of e-periodicals is required or recommended by teachers or needed for doing course assignments, but Engineering and Science participants seemed not to agree with this (see Table 5). Moreover, Education participants showed the most statistically significant difference in terms of reading locations among the three faculties (see Table 13). One possible explanation is that Engineering and Science articles often contain complex mathematical formulae that are hard to read on the move (Ko et al., 2015; Wai et al., 2018).

RQ3: Have the patrons’ periodical reading patterns changed when mobile devices are involved in people’s reading process?

Firstly, Table 2 shows an increasing trend of participants to read more types of e-periodicals, which is in line with the previous finding by Wang *et al.* (2016). For example, the Education participants were also interested in “Business & Investing” and “News & Politics,” while the Science participants liked “Electronic & Audio.” As for the Engineering participants, they read widely, such as “Automobile,” “Business & Investing,” “Electronic & Audio,” “Fashion & Style,” “Health & Well-

being,” “Science magazines,” “Sports magazines,” and “Travel magazines” (see Table 10).

Secondly, this study indicated an increase in the time spent on reading periodicals after using mobile devices (see Table 10). After adopting mobile devices, Science and Education participants spent more time on reading magazine type “Academic journals,” while Engineering participants spent more time on “Electronics & audio.” Thirdly, the overall reading frequency has been increased while reading timeslots have become irregular. More participants from the Education and Engineering faculties inclined to read in flexible reading timeslots instead of reading in the morning (see Table 12). This phenomenon of irregular reading patterns is common in the digitalization era, as people like to use mobile devices to view messages, emails, and webpages when they are not busy (Anderson, 2011; Wai et al., 2018), and therefore browsing e-periodicals more frequently.

Last but not least, the most apparent change of reading patterns is on the reading location, which has expanded to a wide variety of environments. The convenient accessibility of mobile devices allows people to do digital readings regardless of time and place (Yoo & Kim, 2016; Wai et al., 2018). In general, the reading of periodicals has become increasingly popular after adopting mobile devices in reading.

RQ4: What are the features of printed periodicals that still attract patrons to read?

Finally, the participants’ attitudes toward physical periodicals cannot be ignored. Our results showed that the majority of participants (64%) would print out e-periodicals when necessary (see Table 7) mainly because of “convenient to take notes” and “easier to concentrate” (see Table 8). This aligns with the findings of other studies that people have better focus on printed articles, particularly for serious reading and lengthier texts (Liu & Huang 2016; Mizrachi *et al.*, 2018). Plus, the multiple functions of mobile devices might distract their concentration and affect their working memory, and therefore deterring the reading quality (Linderholm *et al.*, 2002; Margolin *et al.*, 2013; McVay & Kane, 2012; Wai et al., 2018; Fan et al., 2020). We also noticed a participant leave a comment of printed materials with “feels better on hand” (see Table 8.1). It seems some distinctive features of paper such as texture, smell, and weight are essential reading experience (Balling *et al.*, 2019).

Besides, a few participants have raised concerns about the usage of electronic devices on visual health. Previous studies have indicated that e-ink technology could reduce eye fatigue, and e-readers are comparable with printed text (Siegenthaler *et al.*, 2010; Benedetto *et al.*, 2013). However, in line with the finding of Wang *et al.* (2016), only a few Hong Kong participants own e-ink devices (see Table 1). This phenomenon is different from the statistics report in 2019, which indicated that nearly one in two adults own an e-reader in the U.S. (Statista, 2020). One possible reason may be due to the

competition between tablets and e-readers. Tablets provide multi-functional features, while e-readers only provide limited functions. People may choose tablets over e-readers as it is more cost-effective. Nevertheless, not many periodicals (especially e-journals) are available on e-readers (such as Kindle), which was used mainly for reading “News & Politics” by our participants (see Table 6). The promotion of e-readers in the Asian market and technologies related to the areas of eye health for digital reading may need much improvement.

Limitations

This study was conducted on an exploratory level, with the sample size and study scale limited to some extent. We plan to extend our study to other faculties and other universities. On the other hand, as the participants in this research were mainly students, we are planning to extend this study to teaching staff and researchers. Also, it would be useful to understand the proportion and which types of e-periodicals are actually printed out for intensive viewing. Further employment of qualitative research methodology, such as interviewing with participants, can provide a more practical and in-depth understanding of the participants’ rationale. We are also interested in using user-opinion mining to explore their mobile reading needs and preferences (Zhou, Zheng, Li, & Shen, 2019). As e-periodicals on health and well-being are unexpectedly welcome even before the pandemic, we are planning to look into in-depth issues on health information seeking and reading behaviors of the students (Rantala, Enwald, & Zinn, 2019).

Conclusion

As academic libraries should have a deep understanding of the patrons’ reading needs, this research sheds light on future policies for periodical subscriptions. In particular, not only are traditional communications with faculty members crucial, but libraries should also consider the changing needs, preferences, and interests of students. Periodicals cover a wide range of topics and contribute to leisure reading, informal reading, and formal studies, which may not be easily distinguished in contemporary inquiry-based curricula design under the current globalized knowledge-based society. Meanwhile, more people are turning to use electronic resources in libraries, and we are excited to find that the use of mobile devices has resulted in more reading of e-periodicals. Therefore, this exploratory study is valuable to libraries in general, especially with the growing expenditure in electronic resources.

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