

Collaborative Information Seeking in Digital Libraries, Learning Styles, Users' Experience, and Task Complexity

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ABSTRACT

The purpose of this study is to examine the relationship between collaborative information seeking and users' learning style preferences and their experience of information systems. The study investigates the role of four different factors including learning style, task complexity, and user experience in collaborative information seeking in digital environments. Sixty participants (30 pairs) were randomly chosen from volunteer graduate students of Kharazmi University (Iran). Participants completed Kolb's learning style questionnaire and a user experience questionnaire and then performed two information seeking tasks (one simple and one difficult) in a lab setting. They could exchange information with their partners or a librarian using Skype. The sessions were recorded using Camtasia. The results showed that with an increase in task difficulty, collaborative information seeking activities increased and more interactions with partners and the librarian occurred. The number of executive help-seeking requests was higher than the number of instrumental help-seeking requests. This research confirms that learning style is related to the way users interact with the digital library and help seeking. The research showed that in difficult tasks, the differences among users with different learning styles become more evident, and that generally interactions increase in more difficult tasks. Among the learning styles, the accommodating style had the highest number of relationships with collaborative information seeking variables. Most of the statistically significant relationships between users' prior computer experience and collaborative information seeking variables were related to the time variable.

Keywords: collaborative information seeking, information seeking, learning styles, user experience, task complexity, help seeking

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1. INTRODUCTION

Shah (2009, 2014) defined collaborative information seeking (CIS) as a process of collaboratively seeking information that is “defined explicitly among the participants, interactive, and mutually beneficial.” This relationship meets the information needs of both parties and is therefore profitable. CIS can occur in any context and as Talja (2002) stated it is as common and natural as individual information seeking behavior. Academics might collaborate in their information seeking for various reasons, including to address a lack of expertise. They usually find it successful and more useful than individually seeking information (Spence, Reddy, & Hall, 2005).

While collaboration is a group activity, individual differences may also play a role in it. There are several individual characteristics that might influence or have a relationship with information seeking. One of them is cognitive difference. Individuals might have preferred ways of processing information which are their cognitive styles (Sternberg, 2001): “Cognitive styles are tendencies displayed by individuals consistently to adopt a particular type of information processing strategy” (Ford, Wilson, Foster, Ellis, & Spink, 2002, p. 728). Cognitive styles in learning activities are called ‘learning styles’ (Huang, Joo, & Xie, 2012). We know from some past studies (e.g., Ford et al., 2002) that cognitive styles might have a relationship with the information seeking behavior of users.

Another difference is related to users’ experience. Generally, two types of prior experience and knowledge can be defined: the knowledge of the search topic or domain, and the knowledge of the system used (Palmquist & Kim, 2000). Some past studies (e.g., Khosrowjerdi & Iranshahi, 2011) have shown a relationship between a user’s experience and information seeking. In addition to users’ characteristics, tasks for which people look for information influences users’ practices. Task complexity is known to affect information seeking (Byström & Järvelin, 1995) and is a predictor of satisfaction with a search strategy (Crescenzi, Capra, & Arguello, 2013). In CIS, task complexity might result in longer sessions compared to individual information seeking due to the communication conducted (Na & Lee, 2016).

A considerable part of information seeking in today’s academic information seeking activities occurs in the digital environment. While digital libraries were previously designed mainly to support individual information seeking (Talja, 2002; Talja & Hansen, 2006), their design nowadays needs to support CIS as well. Research needs to focus on understanding the actual practices and preferred ways of academics’ collaboration in the digital environment. While some of the contextual factors discussed above have been investigated (e.g., Huang

& Xie, 2011; Huang et al., 2012; Saleh, 2012) in information seeking behaviour in the digital environment, there is a lack of knowledge about how these factors might influence users’ behaviour in CIS activities in a digital environment. Therefore, this study aims to look at the relationship between users’ experience and learning styles and CIS in a digital library environment. More specifically, the study aims to answer the following questions:

- Is there any relationship between learning styles and CIS?
- Is there any relationship between users’ experience (of information systems) and CIS?
- Does task complexity make a difference in the CIS and its relationship with learning styles and users’ experience?

2. LITERATURE REVIEW

Learning styles have been investigated in various contexts, including information behaviour. However, the results are not necessarily aligned and sometimes it is not possible to compare results as different studies have used different learning styles inventories. Wood, Ford, Miller, Sobczyk, and Duffin (1996) found that the learning style of students (field dependent/field independent) were related to their searching behavior and the effectiveness of their searches. Chen and Ford (1998) found a relationship between cognitive styles of students and their choice of access facilities and navigation patterns in a hypermedia learning system. Palmquist and Kim (2000) found that cognitive style (field dependent/field independent) interacted with experiences of online database searching but they found no significant cognitive style differences among experienced searchers. Ford, Miller, and Moss (2001) found no significant links between retrieval effectiveness and holistic/analytic cognitive styles. Similarly, Kim and Allen (2002) found no relationship between holistic/analytic cognitive styles and search behavior and outcome.

A study by Huang and Xie (2011) on the impact of four dimensions of the Felder-Silverman Index of Learning Styles (Active/Reflective, Sensory/Intuitive, Visual/Verbal, and Sequential/Global) of students’ help-seeking behavior in a digital library environment found that learning styles influenced students’ behavior and suggested that digital libraries should support learning styles by providing different features, formats, and types of help. Huang et al. (2012) also looked at the influence of learning styles on search tactics and found that while active searchers spent more time in accessing forward tactics, sensing searchers spent more time in visiting previous pages and in evaluating results, and reflective searchers spent more time in

evaluating individual items. Another study (Parvin, Kheibar, Mihanpour, & Rafi, 2019) found no relationship between Kolb's learning style and information seeking anxiety of students.

In terms of users' experience, most past studies have found some relationship between users' experience and some aspects of information seeking. Connell (1995) in a study on librarians showed that subject searching might require different types of knowledge, including experiential and process knowledge, and that librarians who are not familiar enough with the features and tools of online catalogues might not use its help effectively. Hölscher and Strube (2000) found that both web experience and domain knowledge was needed for successful search performance. Strong computer-related skills are also correlated with high self-efficacy (Liaw, 2002) and self-efficacy can itself be influenced by other individual characteristics such as gender (Durnell & Haag, 2002). Users' experience with one system might influence their expectations of and interactions with another system. For instance, a user's everyday Internet experience influences their expectation of other information systems such as library systems, and when the library system interface is designed with similarities to the web, users can use it with minimal help (Sadeh, 2008). Internet experience seems to influence users' mental models of information retrieval systems. For instance, Makri et al. (2007) showed that users use their knowledge of Internet search engines to infer how searching might work in digital libraries. They found that users did not clearly distinguish between different kinds of digital resource, viewing for instance electronic library catalogues and search engines as variants on a theme. Khosrowjerdi and Iranshahi (2011) found positive and strong relationships between a user's experience (prior knowledge of a system) and information-seeking behavior. Saleh (2012) in a study on students' collaborative information behaviour in group learning tasks found relationships between stages of learning task and task complexity, and collaborative information behaviour. Perceived task complexity increased collaborative information behavior among students.

So far there have been several studies on CIS behavior and a few reviews of such studies including reviews by Foster (2006), Hertzum and Hansen (2019), and Shah (2010). Those that have focused on students' CIS behavior in the digital environment have found benefits, such as finding more useful sources and achieving greater information coverage while searching (Leeder & Shah, 2016b), improved understanding of topic, communication, and searching skills (Wu, Liang, & Yu, 2018), but also some challenges such as experiencing higher cognitive load compared to seeking information individually (Leeder & Shah, 2016b). However, the success of collaborative

information behavior depends on several factors; for instance, prior experiences with group work improve the search results in collaborative information behavior (Leeder & Shah, 2016a).

In some studies such as Shah, 2010; Spence et al., 2005; Zerehsaz, 2017) the variables of participatory information seeking behavior used in our research (duration of interaction, number of requests, perceived usefulness, number of requests received, number of requests made, number of interactions with partner, number of interactions with librarian, number of executive requests, number of instrumental requests, and duration of interactions as a giver (seconds)) were studied incoherently and we used them in this research.

Overall, while there have been studies on learning styles and user experiences, and CIS of students have also been studied, few studies have dealt with the relationship of learning styles and users' experience in the context of CIS. This study aims to contribute to bridging this gap.

3. METHOD

To study the relationship of learning styles and users' experience with CIS, we conducted a user study in which 30 pairs of participants worked on two tasks in a lab setting. A review of the methodology used in CIS studies showed that lab experiments were the most common method of data collection in such studies (Hertzum & Hansen, 2019). Below we present the details of the methodology.

3.1. Participants

We recruited 60 participants in 30 pairs from graduate students of Kharazmi University (Iran). Recruitment notes were posted on the campus bulletin boards and students who were interested filled in a short form that was used for choosing the participants. The participant pairs who signed up had to know each other and they should have done some collaborative work with each other before. They needed to be familiar with the use of digital libraries. Fifteen pairs were male and 15 pairs were female, and participants were between 24 and 27 years old. The participants were randomly chosen from those who expressed their interest and met the abovementioned criteria. The participants chose the day and time convenient to them for their sessions.

After the participants were briefed about the study and were given an information sheet, they signed a consent form. They completed the Kolb's learning style questionnaire (Kolb, 1985) and a user experience questionnaire. Then they performed two information-seeking tasks.

3.2. Settings

Each pair of participants did their session separately at their convenient time in a lab. The lab had two computers equipped with Skype for interaction between partners and also between them and a librarian, Camtasia for screen capturing, and access to Tebyan Digital Library. The two partners' computers were two meters apart facing the same direction and the librarian's computer was in another corner of the room facing the opposite direction. Sessions took between one to two hours. A pilot study with four pairs was conducted before the main study.

The variables in the study included learning style, user experience, duration of interaction, number of requests, number of interactions with librarian, number of interactions with partner, number of interactions as a giver, number of interactions as a receiver, perceived usefulness of interaction, duration of interaction with partner, duration of interaction with librarian, duration of being a giver, duration of being a receiver, number of instrumental requests, and number of executive requests.

3.3. Collaborative Information Seeking Tasks

Two tasks with different levels of difficulty were used for the study. There was one easy and one difficult task. The topics chosen for both tasks were related to research methods as all students pass a research method subject as part of their course regardless of their discipline. Students were told to suppose that the tasks were part of a group assignment they needed to do collaboratively for the research method subject. Collaborative assignment and learning is believed to have benefits for learners (Thompson & Ku, 2006). The easy task asked students to find the answers to a few simple questions about scholarly journal articles and different types of articles. The difficult task included a few questions about differences between qualitative and quantitative methods, and some of the features of experimental research. The validity of both tasks was confirmed by three research methods experts. Students could collaborate with their partner and the librarian for doing the tasks. They were required to use only the Tebyan Digital Library for their information seeking and their answers had to be based on the resources they could find in the digital library.

Tebyan Digital Library (<https://library.tebyan.net>) was chosen as it is the largest and most popular Iranian digital library that provides full-text access and it has multiple helpful features such as searching, browsing, note taking, and personalization features.

3.4. Questionnaires

To examine participants' learning styles, Kolb's questionnaire (Kolb, 1985) was used. Kolb's model was chosen because it

has been widely used and adapted by numerous researchers (Sanderson, 2011). The questionnaire consisted of twelve statements each with four options. The participants needed to rank the options from one (lowest alignment) to four (highest alignment) with their learning style. By adding the values of each option for the twelve statements, a sum value was obtained for the given learning style of the participant. Then the value of abstract conceptualization was subtracted from the value of concrete experience (AC-CE), and the value of active experimentation was taken away from the value of reflective observation (AE-RO). In a diagram with two axes of X (horizontal) and Y (vertical), the result of AC-CE is used for Y with AC at the bottom and CE at the top, and the result of AE-RO is used for X with AE on the left end and RO on the right end. The four quadrants from top right clockwise represent diverging, assimilating, converging, and accommodating learning styles. Kolb's questionnaire has already been subjected to validity and reliability testing. Kolb originally reported Cronbach alpha values between 0.73 and 0.83 for the four styles. Reliability of the Persian translation of the questionnaire has already been approved in previous studies (Barzegar, 2011). In this study we found Cronbach alpha values of 0.76 (abstract conceptualization), 0.68 (concrete experience), 0.75 (active experimentation), and 0.84 (reflective observation).

To measure users' experience, a questionnaire was designed by the researchers. The questionnaire's face validity was confirmed by four information system experts. The questionnaire had 20 questions with Likert scales measuring users' familiarity with the Internet and information system technologies, web search systems, searching techniques, and the use of digital libraries. Cronbach alpha was calculated to be 0.87 for the questionnaire, which is a relatively high value.

After performing the tasks, participants completed another short questionnaire about the usefulness of their interaction with the digital library, their collaboration with their partner and with the librarian, and the tools and resources. The questionnaire had eight questions with a 5-point Likert scale that indicated low level to high level of usefulness.

In the analysis, all variables related to CIS (e.g., number or duration of interactions and collaborations) were considered as dependent variables, and learning styles, experience, and task difficulty were considered as independent variables.

4. FINDINGS

The most common learning style among the participants was converging (45%) and the least common learning style was

Table 1. Frequency distribution of respondents based on learning style

Learning style	N	%
Converging	27	45
Diverging	15	25
Assimilating	12	20
Accommodating	6	10
Total	60	100

accommodating (10%). See Table 1. 'Convergers' prefer technical tasks and are less concerned with people and interpersonal aspects. 'Divergers' prefer to watch rather than do, and they tend to gather information and use their imagination to solve problems. 'Assimilators' require clear explanations rather than practical opportunities and they excel at understanding wide-ranging information and organizing it in a clear logical format. 'Accommodators' rely on hands-on skills for learning and prefer intuition than logic, and take a practical, experimental approach (McLeod, 2013).

A summary of statistics related to the CIS of participants is presented in Table 2. While participants on average spent 51.56 seconds on each interaction in the easy task, the average duration in the difficult task was longer (68.7 seconds). The average number of requests made during the easy task was slightly higher (0.68) than that of the difficult task (0.66). In general, the number of interactions with the librarian was higher than with partners in both tasks, and the number of interactions with both the partner and the librarian was higher in the difficult task than in the easy one. Requests were divided

into two groups based on the categorization by Taherbhai (2005), which in turn was based on research by Nelson-Le Gall (1981). The two types include instrumental help, which is when users ask for a hint in order to solve the problem, and executive help which is when users ask someone to solve the problem for them (Taherbhai, 2005, pp. 30-31). Executive help seeking is dependency oriented as it is a passive approach to problem solving and involves surface level cognitive processing strategies. Instrumental help seeking, on the other hand, is mastery oriented as it requires a higher level of knowledge (Taherbhai, 2005). Examples of executive help seeking are "What keywords do you suggest I should use for the search?" and "How can I highlight the articles I downloaded?" Examples of instrumental help seeking are "I think for a more precise search I need to put the phrase in quotation marks? Am I right?" and "Does the type of resource have to be journal articles?" The number of executive requests was almost 10 times the number of instrumental help requests.

Mann-Whitney U tests showed no significant difference between male and female participants in any of the CIS variables. In term of the participants' subject area, they were grouped into two broad groups of humanities and social sciences ($N = 38$) and science and engineering ($N = 22$). Mann-Whitney U tests revealed significant differences between these two groups only in two variables. Humanities and social science students made more instrumental requests ($Mdn = 1$) compared to the other group ($Mdn = 0$) ($U = -1.98, p = 0.047$). Also, humanities and social science students had more interaction with their partners ($Mdn = 2$) compared to the other group ($Mdn = 1$) ($U = -2.947, p = 0.003$).

Table 2. Collaborative information seeking variables by task

	Easy task		Difficult task	
	Standard deviation	Mean	Standard deviation	Mean
Number of requests	0.87	2.53	1.55	3.48
Duration of interaction (seconds)	36.9	51.73	57.2	68.7
Perceived usefulness	10.3	71.33	11.95	70.19
Number of requests received	0.11	0.68	0.14	0.67
Number of requests made	0.14	1.93	0.16	2.75
Number of interactions with partner	0.67	1.17	1.49	1.47
Number of interactions with librarian	0.88	1.35	1.07	1.98
Number of executive requests	0.98	2.3	1.26	3.01
Number of instrumental requests	0.46	0.23	0.65	0.47
Duration of interactions as a giver (seconds)	18.19	12.85	24.91	13.3
Duration of interactions as a receiver (seconds)	35.41	38.9	44.1	54.08

4.1. Learning Styles and CIS

Table 3 presents the Spearman correlation coefficient values between learning styles and the CIS variables in the easy task. Grey cells are statistically significant at 0.05 level. There is a significant but weak negative correlation between the assimilating learning style and frequency of being a receiver, which means those with this learning style were slightly less likely to play the role of being a receiver of information. People with assimilating learning styles rely more on abstract learning than on others for learning. There is also a significant but weak negative correlation between the accommodating learning style and frequency of being a giver, which means those with this learning style were less likely to be givers. Accommodating learners tend to rely on others for information. There is also a correlation between the accommodating learning style and time spent as a giver. The weak negative correlation shows that those with this learning style spend less time as a giver.

In the difficult task, there were four weak correlations. The first one is between the converging learning style and the frequency of being a receiver, as those with this learning style

were more likely to be receivers of information. The other indicates that those with diverging learning styles were less likely to be receivers (-0.319). These findings are aligned with the characteristics of people with these learning styles; with an increase in the difficulty of the tasks, divergent and convergent learners show their difference as divergent learners are less keen on being receivers. The third correlation is between the accommodating learning style and the number of interactions with colleagues. This group of learners is more reliant on other people's information. There was a relationship between the number of help requests and the accommodating learning style. This indicates that those with this learning style had more interaction with their partners in the difficult task (Table 4).

When the values for the two easy and difficult tasks were combined, overall, there were two weak positive correlations between the frequency of being a giver of information and the assimilating learning style (0.278), and between the number of interactions with a partner and the accommodating learning style (0.304) (Table 5).

Table 3. Correlation between learning styles and main variables of CIS in the easy task

		Converging	Diverging	Assimilating	Accommodating
Number of requests	CC	-0.21	0.21	-0.119	0.239
	p-value	0.109	0.106	0.366	0.066
Duration of interactions	CC	0.04	-0.033	-0.092	0.094
	p-value	0.760	0.802	0.483	0.473
Perceived usefulness	CC	0.073	-0.074	0.251	0.076
	p-value	0.580	0.572	0.053	0.561
Frequency of being a giver	CC	0.079	-0.093	0.129	-0.271*
	p-value	0.547	0.482	0.325	0.037*
Frequency of being a receiver	CC	0.044	-0.032	-0.275*	0.13
	p-value	0.741	0.806	0.033*	0.323
Number of interactions with partner	CC	-0.106	0.112	0.02	0.066
	p-value	0.419	0.396	0.877	0.619
Number of interactions with librarian	CC	0.016	-0.007	-0.014	-0.01
	p-value	0.902	0.955	0.914	0.914
Number of executive requests	CC	-0.185	0.188	-0.05	0.205
	p-value	0.157	0.155	0.707	0.116
Number of instrumental requests	CC	0.018	-0.016	-0.061	-0.009
	p-value	0.892	0.901	0.643	0.946
Duration of interactions with librarian	CC	-0.007	0.016	-0.014	-0.01
	p-value	0.955	0.902	0.914	0.941
Duration of interactions with partner	CC	0.112	-0.106	0.02	0.066
	p-value	0.369	0.419	0.877	0.619
Duration of acting as a giver	CC	-0.093	0.079	0.295	-0.271*
	p-value	0.482	0.547	0.022	0.037*
Duration of acting as a receiver	CC	-0.032	0.044	-0.224	0.13
	p-value	0.806	0.741	0.060	0.323

CC, correlation coefficient.

* $p \leq 0.05$.

Table 4. Correlation between learning styles and main variables of CIS in the difficult task

		Converging	Diverging	Assimilating	Accommodating
Number of requests	CC	-0.069	0.09	-0.019	-0.051
	p-value	0.603	0.496	0.887	0.701
Duration of interactions	CC	-0.028	0.044	0.039	0.089
	p-value	0.834	0.737	0.765	0.5
Perceived usefulness	CC	-0.1	0.084	0.042	0.049
	p-value	0.446	0.522	0.751	0.709
Frequency of being a giver	CC	0.166	-0.15	0.216	-0.05
	p-value	0.205	0.254	0.97	0.705
Frequency of being a receiver	CC	0.302*	-0.319*	-0.31	0.194
	p-value	0.010*	0.013*	0.816	0.138
Number of interactions with partner	CC	0.406	0.033	-0.036	0.317*
	p-value	0.726	0.800	0.783	0.014*
Number of interactions with librarian	CC	0.055	-0.058	0.091	0.039
	p-value	0.674	0.658	0.488	0.769
Number of executive requests	CC	-0.011	0.12	0.051	-0.073
	p-value	0.404	0.363	0.696	0.58
Number of instrumental requests	CC	0.029	0.002	-0.1	0.294*
	p-value	0.825	0.990	0.448	0.023*
Duration of interactions with librarian	CC	-0.058	0.055	0.091	0.039
	p-value	0.658	0.674	0.488	0.769
Duration of interactions with partner	CC	-0.033	0.046	-0.036	0.093
	p-value	0.800	0.726	0.783	0.479
Duration of acting as a giver	CC	-0.15	0.166	0.216	-0.05
	p-value	0.254	0.205	0.097	0.70
Duration of acting as a receiver	CC	0.142	-0.124	-0.031	0.194
	p-value	0.281	0.347	0.816	0.138

CC, correlation coefficient.

* $p \leq 0.05$.**Table 5.** Correlation between learning styles and main variables of CIS in all tasks

		Converging	Diverging	Assimilating	Accommodating
Number of requests	CC	-0.155	0.173	-0.041	0.071
	p-value	0.237	0.186	0.757	0.587
Duration of interactions	CC	-0.001	0.015	-0.013	0.101
	p-value	0.993	0.907	0.919	0.445
Perceived usefulness	CC	-0.024	0.013	0.16	0.01
	p-value	0.857	0.922	0.223	0.939
Frequency of being a giver	CC	0.166	-0.15	0.278*	-0.05
	p-value	0.205	0.254	0.032*	0.705
Frequency of being a receiver	CC	-0.193	0.209	-0.186	0.211
	p-value	0.139	0.109	0.154	0.105
Number of interactions with partner	CC	-0.001	0.015	-0.024	0.304*
	p-value	0.993	0.912	0.857	0.018*
Number of interactions with librarian	CC	0.048	-0.045	0.055	0.021
	p-value	0.715	0.733	0.674	0.871
Number of executive requests	CC	-0.019	0.198	0.01	0.065
	p-value	0.146	0.130	0.941	0.623
Number of instrumental requests	CC	0.35	-0.008	-0.118	0.033
	p-value	0.793	0.095	0.367	0.804
Duration of interactions with librarian	CC	-0.045	0.048	0.055	0.021
	p-value	0.733	0.715	0.674	0.871
Duration of interactions with partner	CC	0.015	-0.001	-0.024	0.085
	p-value	0.912	0.993	0.857	0.518
Duration of acting as a giver	CC	-0.16	0.164	0.229	-0.192
	p-value	0.221	0.210	0.078	0.143
Duration of acting as a receiver	CC	0.209	-0.193	0.245	0.211
	p-value	0.109	0.139	0.059	0.105

CC, correlation coefficient.

* $p \leq 0.05$.

4.2. User Experience and CIS

More than half of the participants (33, 55%) had little experience in using different information systems and 27 participants (45%) were experienced. See Table 6. To measure users' experience, the value of their responses to the user experience questionnaire was scaled between 0 to 100, and those with a value of 60 and above were considered as experienced and those with lower values were considered as having little experience.

Table 6. Frequency distribution of respondents based on user experience

User experience	Frequency	Percent	Mean
Little experience	33	55	45
Experienced	27	45	68
Total	60	100	55

Table 7 shows the results of Spearman correlation tests between user experience and CIS variables. There is a positive but relatively weak correlation between user experience in both tasks separately and combined with the duration of interaction and the perceived usefulness. This could be because those with more experience might better understand the interactive environment of an information system. Duration of interaction and user experience had a weak negative relationship in both easy and difficult tasks and when combined. This shows that more experienced users spent less time interacting with their partner. In the easy task, those with more experience made more help requests (0.318) but spent less time interacting with their partner (-0.277). The latter was also true overall when both tasks were combined (-0.280). When both tasks were combined, those with more experience had fewer interactions with the librarian (-0.299).

Table 7. Correlation between user experience and the main variables of CIS

		Easy	Difficult	Both
Number of requests	CC	-0.058	-0.231	-0.231
	p-value	0.662	0.076	0.076
Duration of interactions	CC	-0.323*	-0.298*	-0.339*
	p-value	0.012*	0.021*	0.008*
Perceived usefulness	CC	0.300*	0.300*	0.355*
	p-value	0.020*	0.020*	0.005*
Frequency of being a giver	CC	-0.096	-0.092	-0.229
	p-value	0.467	0.486	0.079
Frequency of being a receiver	CC	-0.236	-0.163	-0.068
	p-value	0.70	0.213	0.605
Number of interactions with partner	CC	-0.206	-0.144	-0.207
	p-value	0.113	0.274	0.112
Number of interactions with librarian	CC	0.308	0.028	0.041
	p-value	0.774	0.832	0.754
Number of executive requests	CC	0.031	-0.087	-0.164
	p-value	0.814	0.508	0.211
Number of instrumental requests	CC	0.318*	-0.064	-0.203
	p-value	0.013*	0.626	0.119
Duration of interactions with librarian	CC	0.038	0.028	-0.299*
	p-value	0.774	0.832	0.020*
Duration of interactions with partner	CC	-0.277*	-0.213	-0.280*
	p-value	0.032*	0.102	0.031*
Duration of acting as a giver	CC	-0.090	-0.124	-0.134
	p-value	0.494	0.345	0.307
Duration of acting as a receiver	CC	-0.291	-0.316	-0.339
	p-value	0.024	0.014	0.008

CC, correlation coefficient.

* $p \leq 0.05$.

5. DISCUSSION AND CONCLUSION

This study looked at the relationship of learning styles and users' experience with CIS in a digital library setting and found some relationships between some aspects of CIS with learning styles and users' experience. Not many studies in the past have investigated learning styles and CIS. Only Huang and Xie (2011) studied the effect of learning styles on users' interaction with help features of digital libraries. Our research confirms their finding in that learning style is related to the way users interact with the digital library and help seeking. The research showed that in difficult tasks, the differences among users with different learning styles become more evident, and that generally interactions increase in more difficult tasks.

Convergers tended to act more frequently as a receiver of help and information in the difficult task. This is a bit surprising because convergers prefer active experimentation and are not as good at dealing with social interpersonal issues as users with other learning styles were (Sugahara & Boland, 2010). Divergers, on the other hand, were less likely to be receivers of help and information in the difficult task. Divergers are active, enjoy gathering information, and like working in groups (Duman, 2010). Although they like working in groups, perhaps the setting of the task did not allow them to be imaginative in using new solutions and so they did not request information. Assimilators were less likely to be receivers of help in the easy task and more likely to be helpers. Accommodators served as helpers more than those of the other three learning styles. This shows the greater tendency of this group for offering help and support. They are generally known for being keen on learning from others and prefer to be presenters of information. They take risks and are pragmatic and interested in interaction and group work (Gogus & Gunes, 2011). They acted as helpers less frequently and for shorter time periods in the easy task than in the difficult task. This is not surprising, for there might be more need for help in the difficult tasks. Generally, accommodators had more interactions with their peers. In the difficult task they had more instrumental requests. Instrumental requests require a higher level of knowledge and information literacy compared to executive requests. However, overall, the number of executive requests in this study was much greater than the number of instrumental requests. Zerehsaz (2017) found similar results and attributed the high number of executive requests to users' knowledge shortcomings and their passivity in the help-seeking process.

In terms of user experience, most of the correlations were with time-related variables and all of them were negative. Experienced users spent less time interacting in the difficult task and overall.

This might be because experienced users were able to accomplish the tasks in a shorter time and they required less interaction with their partners or with the librarian. They also spent less time receiving help, which might be due to the same reason. However, they made more requests in the easy task. Given the order of the tasks and the fact that their experience helped them do more advanced searching, they were able to ask for help for more features. Hölscher and Strube (2000) found that users who have both domain specific background knowledge and technical search expertise are most successful. Those who were novice searchers but domain experts relied heavily on terminology and avoided query formatting. Those with low domain knowledge are less flexible in their strategies and return to previous stages of their searches. In this research the number of participants with a low level of experience (55%) was higher than experienced users and inexperienced users need more help and direction for a successful information seeking activity. We need to note that the experience questionnaire showed that users' experience levels were generally higher for using Google and usual search fields (title, subject, etc.) and lower in terms of using directories, browsing, and help features of digital libraries.

Experienced users were more satisfied with their collaboration and interaction and were more positive about it. Past studies (Connell, 1995) showed that inexperienced users do not use help possibly because they do not understand how help can be useful to them. Therefore, to engage in collaboration and help seeking through digital communication, some level of experience is needed. Overall, the results showed that experience might result in a reduction in the length of the period of interaction and an increase in satisfaction from the CIS.

This study has some implications for the design of digital libraries and the work of information professionals. Information professionals should be trained for managing the interactive environment of digital libraries. Part of their training should be about psychological and cognitive differences among users and the appropriate ways for communication with them. Although the application of learning styles in information literacy training has its own critics (Sanderson, 2011), awareness of the differences can help design more inclusive training programs and information systems. The need for diversified user training has been highlighted in past studies (Zha, Wang, Yan, Zhang, & Zha, 2015). Accommodating users with different learning styles and learning needs can stimulate maximum engagement and enthusiasm among users. Help, browsing, and directories of digital libraries are among the features where designers can try to accommodate the needs of different user groups. For instance, including links to resources outside the digital library could be a helpful feature for experienced users. Prior studies have shown

that collaborative search tools can also have potential drawbacks for users (Capra, Marchionini, Velasco-Martin, & Muller, 2010). For instance, they might be perceived as difficult and time-consuming and users might reject any additional effort (Kelly & Payne, 2014). However, the benefits probably outweigh the drawbacks especially as more usage results in more optimistic attitudes to the CIS (Wu et al., 2018). Improvement in users' understanding of the topic concepts, enhancement of users' skills in communication, research, information search, and collaboration are among other benefits (Wu et al., 2018).

Finally, for future research it is suggested that the role of cognitive characteristics and cultural components affecting the CIS behavior of users in the digital library environment be studied and analyzed. It seems that the collaborative information-seeking behavior of users in the digital library is influenced by these underlying factors, and knowing them can help remove barriers to effective participation in this area. Also, it is useful to study the field of personalization of help resources, providing appropriate guidelines and recommendations to solve problems and challenges of users when seeking information on recommending systems in the digital library, according to the different characteristics of learning styles and the level of user experience, which was also examined in this study. Also, it should be noted that this research was conducted in a specific digital library environment with students for two specific tasks in a lab setting. Therefore, one needs to be cautious in generalizing the findings to other contexts and user groups. The number of participants with different learning styles was not equal and in some styles the number was low which might have affected the analysis. It would be useful to conduct a similar study where collaborative tools are embedded in, rather than separate to, the digital library.

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