Digital Scholarship and Disciplinary Culture: An Investigation of Sultan Qaboos University, Oman

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Abstract—The emergence of networked information and communication has transformed the accessibility and delivery of scholarly information and fundamentally impacted on the processes of research and scholarly communication. The purpose of this study is to investigate disciplinary differences in the use of networked information for research and scholarly communication at Sultan Qaboos University, Oman.

This study has produced quantitative data about how and why academics within different disciplines utilize networked information that is made available either internally through the university library, or externally through networked services accessed by the Internet.

The results indicate some significant differences between the attitudes and practice of academics in the science disciplines when compared to those from the social sciences and humanities. While respondents from science disciplines show overall longer and more frequent use of networked information, respondents from humanities and social sciences indicated more positive attitudes and a greater degree of satisfaction toward library networked services.

Keywords—Academics, Arab World, Disciplinary Culture, Networked Information, Scholarly Communication, Sultan Qaboos University, Oman.

I. INTRODUCTION

FOR most computer users, networking technology was first made available with the advent of the Internet and the associated technology of the World Wide Web. As a result of the Internet, the public gained access to numerous types of networked information resources and services, including e-mail, mailing lists, bulletin boards, Internet chat, and different multimedia formats, both audio and visual.

Academic users were quick to take advantage of these developments and others that were delivered to their desktop as the World Wide Web became established as the common delivery platform for digital information services. In particular the rapid implementation and acceptance of 'networked information' in the form of web-based delivery of academic content such as e-journals, library catalogues, and bibliographic databases, transformed the processes of research and scholarly communication. Networked information has fundamentally changed the manner in which academics correspond and work, and has had a far-reaching impact on many aspects of the research environment, including the accessibility of information; collaborative research, and the dissemination of research outputs.

Sultan Qaboos University (SQU) was opened in 1986 as the first public university in Oman. Currently, the University consists of seven colleges: Agriculture and Marine Sciences; Arts and Social Sciences; Commerce and Economics; Education and Islamic Sciences; Engineering; Medicine, and Sciences. Furthermore, a College of Law was attached to SQU based on a royal decree issued by His Majesty Sultan Qaboos bin Said in April 2006, which will bring the number of colleges at SQU to eight.

Education is provided free for all students at SQU, including tuition fees, text books, on campus food, and accommodation. The University provides various educational support centres to assist student learning, such as the Educational Technology Centre, Language Centre, and the Data System Centre. The Language Centre plays a major role in preparing students to commence their higher education by providing intensive English language instruction. In addition, the University provides and supports various research centres and laboratories such as those dedicated to water, the environment, oil, telecommunications, remote sensing, earth quakes, seismology and Omani studies [1].

The Internet was made available to SQU in late 1997. Since that time the use of networked information and related technologies have become commonplace at SQU, and they are now considered essential assets in enhancing the University's teaching and research outcomes.

Although the Internet and networked information are assumed to be widely used for research related purposes at SQU, there remains a need to investigate the precise extent and patterns of their use by academics for research and scholarly communication, and how this might in turn be impacting upon the research effectiveness of the University and the nation.

II. STATEMENT OF THE PROBLEM

As early as 1994, Bailey [2] reported that "global computer networks, such as the Internet, have created a complex electronic communication system that has significantly changed the way scholars informally exchange information and has started to change formal scholarly publication activities" (p.7). By the late 1990s, these transforming effects of the Internet were being widely felt on the established systems of research and scholarly communication. The rapid diffusion of the Internet and networking technologies was impacting not only in developed countries. Globally, academics and researchers were finding they could acquire information, undertake collaborative research projects, and communicate their research findings, far more easily and rapidly with the aid

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of networking technologies.

While research on scholarly communication practices, including the use of networked information by university-based research communities, has grown steadily, very little of this research has been based in the Arab World, or Oman in particular. Use of networked information in the developed countries had an impact for some time before it was transmitted to the developing countries. As a result, the amount of research related to the impact of these technologies conducted in developed countries has significantly exceeded that conducted in developing countries. Studies of the adoption of the Internet and networked information by research communities therefore needs to be conducted in developing Arab countries in order to;

- assess the information and technology gaps that exist between developing Arab countries and developed countries and also between developing Arab countries and other groups of developing countries,
- identify if patterns of research related uses of networking technologies in developing Arab countries have been influenced by local factors, such as the existing social, educational, and linguistic conditions, and
- assess the impact that networking technologies have had on the research productivity of academics in developing Arab countries.

The major goal of this research is to investigate whether there are disciplinary differences in the way in which networked information and communication are being used in an Arabic academic environment. Since the Internet was introduced to SQU, the use of the Internet by the University's academics for purposes of research and scholarly communication has remained largely unexamined. Furthermore, there have been no significant attempts to examine Arab scholars' attitudes in the networked environment based on their academic disciplines.

III. OBJECTIVES

The primary objectives of this study are to:
1. Investigate the use of networked information and its impact on patterns of research and scholarly communication in an Arabic context, using Sultan Qaboos University as an example.
2. Identify the disciplinary differences reflected in the use of networked information for research and scholarly communication.

IV. REVIEW OF THE LITERATURE

The information use and scholarly communication patterns of researchers in all major academic disciplines have been the subject of research for some time. It has been argued that scholarly communication is a social activity wherein relationships are influenced by the disciplinary culture within which scholars are grouped. Use of information by academics in science disciplines in particular had been examined closely. Some notable earlier studies include Menzel [3] and Garvey,

Tomita, & Woolf [4]. Research into information use and scholarly communication in humanities and social science disciplines also commenced during the 1960s and 70s. Examples of these studies include Simonton [5] and Gleaves [6] in the humanities, and Line [7] and Skelton [8] in the social sciences.

It should be noted that the literature of scholarship provides no absolute consensus as to what constitutes the 'sciences', 'social sciences' or 'humanities'. The sciences are frequently grouped into the natural sciences [9], physical sciences [10], and applied sciences, but each of these groups has been differently constituted at different points in time. Meadows [11] states that at the beginning of the twentieth century 'science' referred to natural sciences in English-speaking countries. He adds that lack of a universal definition of science leads to differences in organizational structures that in turn have an effect on communication patterns. The natural sciences have been defined as "a set of separate, specialized disciplines—consisting primarily of physics, chemistry and biology—of relatively recent origin" [12] (p.287). As noted, for the of this study, science is defined by the organizational structure of Sultan Qaboos University where the science disciplines are divided into Colleges of Science, Engineering, Medicine, and Agriculture.

As with science, there is no universally accepted definition for the social sciences and humanities. Cohen [13] indicates that social sciences are comprised by a set of disciplines that study social phenomena and relationships among people. It generally includes archaeology, economics, history, political science, psychology, and sociology. For some commentators, history is considered part of the humanities [13]. Humanities is said to refer to classical studies [11], and White [14] notes that "disciplines of the humanities such as philosophy, history, and literary studies offer models and methods for addressing dilemmas and acknowledging ambiguity and paradox. They can help us face the tension between the concerns of individuals and those of groups and promote civil and informed discussion of conflicts, placing current issues in historical perspective" (p.263). In this study, social sciences and humanities are also based on the organizational structure of SQU. These include all departments affiliated with the Colleges of Arts and Social Sciences, Commerce and Economics, and Education and Islamic Sciences.

Research investigating the scholarly use of networked information in academic environments have included studies investigating a single discipline; studies that are inter-disciplinary; and studies that are multi-disciplinary or cross-disciplinary. The literature includes many studies that investigate the use of the Internet or computer networks within a single discipline. Examples include, Bishop [15]; Brown [16]; Shaw [17]; Zhang [18]. Inter-disciplinary studies investigate the use of the Internet or networked information or information seeking behavior by academics in two or more academic disciplines, within one broad area such as the social sciences. Examples of these studies are, Abdulaziz [19]; Abels, Liebscher, & Denman [20, 21]; Costa & Meadows [22]; Eisend [23]; Seyal, Abd-Rahman, & Mahbubur-Rahim [24]. Multi-disciplinary studies investigate and often compare the

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use of the Internet or networked information by academics in two or more broad disciplines, such as academics in social sciences disciplines compared to academics in the sciences or humanities. Examples of multi-disciplinary studies conducted in developed countries include Applebee, Bruce, Clayton, Pascoe, & Sharpe [25]; Applebee, Clayton, & Pascoe [26]; Bane & Milheim [27]; Bruce [28]; Budd & Connaway [29]; Heterick [30]; Houghton, Steele, & Henty [31]; Kaminer [32]; Lazinger, Bar-Ilan, & Peritz [33]; Schauder [34]; Wang & Cohen [35]. For examples of multi-disciplinary studies conducted in Arab and developing countries see Abdullah [36]; Adika [37]; Bin-Alsabti [38], Boumarafi [39]; Ehikhamenor [40]; Jirjees & Nashir [41]; Mamtora [42]; Uddin [43].

While Garvey [44] indicated that the discipline of the researcher influenced a researcher's information seeking behavior when using traditional information sources, Abels et.al [20]; Tenopir [45]; and Torma & Vakkari [46] have also asserted that the researchers' disciplinary culture is closely tied with the way in which they use networked information.

The differences in the use of networked information between scientists and social scientists are explained by Costa and Meadows [22] as being based on two factors. These are firstly, the differences in information needs and types of information used by the two groups, and secondly, because scientists were using computers some time before social scientists. Costa and Meadows also argue that although most studies conducted after the mid-1990s indicate disciplinary differences in networked information use between scientists and social scientists (Cohen [13]; Lazinger, Bar-Ilan, & Peritz [33]; Schauder [34]), some recent studies suggest that these differences have decreased over time. By 2000, for example, there were indications that academics in all disciplines were using e-mail almost equally (Costa & Meadows [22]). Costa and Meadows reported on the network based communication practices of two groups of social scientists (economists and sociologists) and compared these results with other studies conducted in science disciplines. They concluded that social scientists were using networked communication to a lesser degree than scientists. It might be difficult, however, to compare the result of an interdisciplinary study conducted in two particular environments (Brazil and the United Kingdom) to the results of multi-disciplinary studies that examined these differences in a variety of environments.

Applebee et al. [25] reported on a survey of the disciplinary differences within broad classifications of the discipline groupings of sciences, arts/humanities, and social sciences (management, administration, and commerce). Participants from science disciplines were reported to be the most frequent users of e-mail to communicate with researchers or colleagues at the same university campus. In contrast, social scientists were reported to be the most frequent users of e-mail to communicate with researchers located remotely. In addition, Applebee et al. [25] indicated that it may be unreliable to associate frequency of use with academic disciplines, because frequency of use does not make it clear as to exactly how the Internet is used or what types of Internet services are used. Therefore, the researchers decided to assess the disciplinary

differences by comparing the usefulness of e-mail for research. Assessed on that basis, it was found that science respondents indicated a more positive response than those from the social sciences or humanities.

Budd & Connaway [29] investigated the use of networked information by sampling academics at six departments representing the three broad categories of sciences, social sciences, and humanities, but no attempt was made to examine differences based on these disciplinary categories. Differences were instead examined based on respondents' departmental affiliation, as the result of which no significant differences were reported. For instance, when asked whether they use networked information, respondents from the departments of sociology (64%), physics (56%), and chemistry (52%) indicated a majority of positive responses; whereas those from the departments of English, psychology, and history indicated a majority of negative responses. And while respondents from sociology (social sciences) indicated the highest positive response for using networked information; in contrast, psychology respondents, also from the social sciences, indicated quite low usage of networked information.

Lu [47] investigated how "electronic vehicles" (such as web site of a journal, e-mail address for a journal, electronic submission, electronic publishing) had impacted on formal scholarly communication by conducting a study of the communication practices of journals in both social science and natural science disciplines. The results indicated that the majority of 21 categories of "vehicles" were used more frequently in natural science disciplines than social sciences.

Heterick [30] compared economists' (social sciences) and humanities scholars' attitudes towards electronic resources. The findings indicate a variance of attitudes between the two groups of scholars. For example, while almost 60% of economists consider the library's online catalog "very important", nearly 90% of humanities scholars consider this to be the case. When respondents were asked whether networked information will reduce their personal visits to the physical library, almost 54% of the economists agreed, as compared to only 22% of those from the humanities. The results of this study also indicate differences between the attitudes of economists and humanities scholars toward the reliability of electronically stored information. While only 24% of the economists indicated they would trust a repository of electronic information stored locally, almost 63% of the humanities scholars reported a similar level of trust.

Talja and Maula [48] indicated that by 2000 scholars of humanities disciplines were still recognized as low users of e-journals and databases, while most scholars in science disciplines were already high level users. That conclusion was also supported by Lenares [49] who found that physical and biological scientists reported higher use than humanities and social science scholars. Lenares drew the sample for her study from twenty research universities in the United States. Another study conducted in Nigeria by Ehikhamenor [40] also revealed disciplinary differences, although these differences were not consistent. This was attributed to the ambivalence all respondents felt toward various Internet services.

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Torma and Vakkari [46] investigated how academics' disciplines and availability of "electronic resources" correlate with their frequency and purpose of use of electronic resources provided by the Finnish National Electronic Library (FinELib). Data were collected using an annual survey of users of the FinELib website. There were 629 respondents identified as belonging to one of six disciplinary groups. The findings indicated disciplinary differences, with respondents from the natural sciences (63%), economists (57%), medicine (46%), and engineering (40%) reporting using FinELib on a daily basis in more cases than academics from the social sciences (35%) or humanities (34%). However, the study found that "perceived availability" of electronic resources was a stronger predictor of the frequency of use than disciplinary differences.

Networked Information services provided by libraries have also been differently used by academics according to their disciplines. Borgman [50] and Tenopir [45] revealed that academics from science disciplines use "electronic information" sourced from academic libraries more than their counterparts from the social sciences and humanities.

V. METHODOLOGY

This study is primarily concerned with investigating the disciplinary differences in the use of networked information for research and scholarly communication in an Arabic academic environment. The methodology selected is quantitative, and the particular tool is a questionnaire survey. The survey was administered at Sultan Qaboos University, Oman, in December 2004, and the academic staff of SQU were the subjects of this study.

A quantitative approach was necessary in order to generate a basic understanding regarding the current use of networked information for research and scholarly communication at SQU. It was assumed that a questionnaire would function in two ways. Firstly, it would indicate the academics' patterns of use of, and attitudes towards, networked information for the purpose of research and scholarly communication at SQU. Secondly, the many variables associated with this research topic can be appropriately investigated by use of a questionnaire in which respondents report the necessary demographic data that is essential to developing an appreciation of the different cohorts that form parts of the population being studied.

The questionnaire was translated from English into Arabic to allow academics who do not speak English to participate. Native Arabic speakers who also speak English were given the choice of completing an English or Arabic version. The researcher undertook initial translation of the questionnaire. After the translated draft was completed, it was sent to a professional translator with extensive experience in translating bilingual documents from English to Arabic and vice versa.

The response rate to the survey was 48% (n=287) of the 599 distributed questionnaires. The overall response rate of the whole population of academics at SQU (765) was 37.5%. Therefore, if 37.5% is considered to be the valid response rate, it is quite acceptable given that the response rate to academic surveys is generally low (eJUST [51]; Tomney & Burton [52]; Weingart & Anderson [53]).

The questionnaire data were coded and entered into the Statistical Package for Social Sciences (SPSS). Both descriptive and inferential quantitative analysis were used to extract maximum information from the data. Firstly, descriptive analysis involving frequency and percentage distribution of all variables, as well as calculating mean scores whenever required; and secondly, inferential analysis for testing associations between particular variables using both parametric and non-parametric statistics. Three types of inferential statistical tests were undertaken, but only the parametric technique of One-Way Analysis of Variance (One-Way ANOVA) is reported in this study, as the supplementary testing did not produce any variations in results.

ANOVA is best used to investigate how several independent variables interact with each other and how these interactions affect the dependent variables [54]. In this study One-Way ANOVA was used to determine whether there were significant relationships based on differences of group means between particular variables and disciplinary differences.

Moreover, although it was appropriate to use the Independent-Samples T test to compare mean groups of two levels of independent variables [54], in the case of disciplinary differences ("1" Humanities and Social Science, and "2" Sciences), significance differences in the results should not vary to a large extent if One-Way ANOVA is alternatively used. It is claimed that One-Way ANOVA is suitable to compare mean groups of two levels of independent variables and more, whereas the Independent-Samples T test is only applicable for comparing mean groups of two levels of independent variables [55].

Both the Kruskal-Wallis test and Independent-Samples T test (results not reported) were used to verify and qualify the result of ANOVA in this study. This process enhanced the reliability and the trustworthiness of the inferential analysis used in this study. For all of the inferential analysis results, the minimum level of significance was determined at .05.

There were several techniques used to increase the quality and reliability of this study. The questionnaire was developed with reference to the existing literature and the research objectives and questions of the study. Before the questionnaire was distributed for the major collection of data it was piloted and also examined by expert referees in the area of the research. Modifications based on feedback were made whenever applicable. All academics at SQU were considered probable respondents to the questionnaire, thereby increasing the response rate and improving the likelihood of measuring variations in academics' perceptions and attitudes. All colleges at SQU were sampled which allowed for the comparison of the results within and between different sample groups.

VI. FINDINGS

The categorization of disciplines in the current study has been based on the organizational structure of SQU, in which colleges have been divided into two broad disciplinary arrangements. These are humanities and social sciences as one major division, and sciences as another division. The Humanities and Social Sciences Division includes three colleges; namely the College of Arts and Social Sciences, the

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College of Commerce and Economics, and the College of Education. The Science Division consists of four colleges; the College of Agriculture and Marine Sciences, the College of Medicine and Health Sciences, the College of Engineering, and the College of Science. Therefore, One Way ANOVA is used to determine whether there are significant differences in the respondents' opinions and attitudes according to the broad disciplinary categories associated with SQU's two Divisions.

Use of Networked Information

Table I refers to the following items:
1. How would you describe your skills as a user of networked information?
2. How important is it for you to be proficient in using and applying networked information?
3. How long have you been using networked information services?

TABLE I ANOVA TEST OF DISCIPLINE VERSUS SKILLS, IMPORTANCE OF USE AND LENGTH OF USE

Item		Sum of Squares	df	Mean Square	F	.Sig
1	Betwn Groups	.241	1	.241	.79	.374
	Within Groups	85.393	280	.305		
	Total	85.635	281			
2	Betwn Groups	2.060	1	2.060	8.55	.004
	Within Groups	67.898	282	.241		
	Total	69.958	283			
3	Betwn Groups	15.717	1	15.717	25.79	.000
	Within Groups	171.843	282	.609		
	Total	187.560	283			

Participants assessment of their proficiency in using networked information differs significantly across the disciplinary groupings. It is concluded from the ANOVA table (Table I) that there are statistically significant differences in mean groups at .005 for items 2 and 3. Descriptive data illustrates that respondents from science disciplines consider the proficiency of using networked information is more important than do their counterparts from the humanities and social sciences. Moreover, respondents from science disciplines have been using networked information longer than respondents from humanities and social sciencess. Despite these differences in perceived importance and duration of use, there was, however, no significant difference between the disciplines regarding their perception of their current level of skill in using networked information.

Frequency of Use of Networked Information

Table II refers to the following items:
1. How frequently do you use E-mail?
2. How frequently do you use Mailing Lists?
3. How frequently do you use Bulletin Boards?
4. How frequently do you use Internet Chat?
5. How frequently do you use Video Conferencing?
6. How frequently do you use E-journals?

7. How frequently do you use Full-texts other than E-journals?
8. How frequently do you use Web-based Library Catalogues?
9. How frequently do you use Web-based Databases?
10. How frequently do you use Internet search engines?

TABLE II ANOVA TEST OF DISCIPLINE VERSUS FREQUENCY OF USE OF NETWORKED INFORMATION

Item		Sum of Squares	df	Mean Square	F	.Sig
1	Betwn Groups	22.709	1	22.709	21.75	.000
	Within Groups	293.298	281	1.044		
	Total	316.007	282			
2	Betwn Groups	23.651	1	23.651	6.59	.011
	Within Groups	950.956	265	3.589		
	Total	974.607	266			
3	Betwn Groups	.111	1	.111	.034	.854
	Within Groups	896.798	273	3.285		
	Total	896.909	274			
4	Betwn Groups	19.203	1	19.203	8.05	.005
	Within Groups	660.280	277	2.384		
	Total	679.484	278			
5	Betwn Groups	2.776	1	2.776	3.15	.077
	Within Groups	240.742	274	.879		
	Total	243.518	275			
6	Betwn Groups	7.569	1	2.776	4.47	.035
	Within Groups	475.116	281	.879		
	Total	482.686	282			
7	Betwn Groups	6.123	1	6.123	3.69	.056
	Within Groups	467.342	282	1.657		
	Total	473.465	283			
8	Betwn Groups	.533	1	.533	.26	.606
	Within Groups	561.495	281	1.998		
	Total	562.028	282			
9	Betwn Groups	7.025	1	7.025	3.12	.078
	Within Groups	621.950	277	2.245		
	Total	628.975	278			
10	Betwn Groups	5.342	1	5.342	4.96	.027
	Within Groups	300.188	279	1.076		
	Total	305.530	280			

Of the ten items listed in the questionnaire that measure the frequency of use of networked information, five items (1, 2, 4, 6 and 10) across the disciplinary grouping of the participants are found to be statistically significant at .05 level (Table II).

Descriptive data illustrates that respondents from science disciplines use e-mail, mailing lists, Internet search engines, and e-journals more frequently than respondents from the humanities and social sciences. In contrast, respondents from humanities and social sciences disciplines use Internet chat more frequently than do their colleagues from the sciences.

Scholarly Communication Activities

Table III refers to the following items:
1. To communicate with academics or researchers at same institutions.
2. To communicate with academics or researchers at different institutions in Oman.

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3. To communicate with academics or researchers at different institutions within the Arab states.
4. To communicate with academics or researchers at different institutions globally.
5. To exchange documents or information about issues or topics in an area of research.
6. To obtain bibliographic references.
7. To provide or obtain updates on research.
8. To ask questions or provide answers.
9. To keep current in an area of research
10. To learn about conference announcements.
11. To communicate with publishers.

TABLE III ANOVA TEST OF DISCIPLINE VERSUS SCHOLARLY COMMUNICATION ACTIVITIES

Item		Sum of Squares	df	Mean Square	F	.Sig
1	Betwn Groups Within Groups Total	35.713 167.241 202.954	1 281 282	35.713 .595	60.00	.000
2	Betwn Groups Within Groups Total	1.839 274.067 275.915	1 280 281	1.839 .979	1.87	.172
3	Betwn Groups Within Groups Total	1.659 251.124 252.784	1 280 281	1.659 .897	1.85	.175
4	Betwn Groups Within Groups Total	40.133 243.357 283.489	1 280 281	40.133 .869	46.17	.000
5	Betwn Groups Within Groups Total	15.087 248.360 263.447	1 282 283	15.087 .881	17.13	.000
6	Betwn Groups Within Groups Total	4.853 214.551 219.404	1 280 281	4.853 .766	6.33	.012
7	Betwn Groups Within Groups Total	9.621 211.397 221.018	1 279 280	9.621 .758	12.69	.000
8	Betwn Groups Within Groups Total	12.056 221.590 233.645	1 280 281	12.056 .791	15.23	.000
9	Betwn Groups Within Groups Total	4.711 188.243 192.954	1 281 282	4.711 .670	7.03	.008
10	Betwn Groups Within Groups Total	4.808 200.389 205.197	1 282 283	4.808 .711	6.76	.010
11	Betwn Groups Within Groups Total	52.998 264.284 317.281	1 279 280	52.998 .947	55.94	.000

The ANOVA test reported in Table III revealed that of the above listed scholarly communication activities, nine items (all items except 2 and 3) differ significantly as a function of disciplinary affiliation at .05 level. The descriptive data illustrates that respondents from science disciplines indicated more positive responses for all above scholarly communication activities than respondents from humanities and social science disciplines.

Impact of Networked Information

Table IV refers to the following items:
1. I enjoy using networked information.
2. Networked information makes it easier for me to research and publish collaboratively.
3. Networked information has helped me access new tools for my research and scholarly communication.
4. Networked information provides me with the capabilities to easily work beyond geographic boundaries.
5. Networked information has helped me establish new relations with other researchers.
6. The use of networked information will increase my number of publications over the next few years.
7. The use of networked information will improve the quality of my research over the next few years.
8. Some of my research will be published electronically over the next few years.
9. Networked information will widen the scholarly community within which I am in contact over the next few years.
10. I will become increasingly dependent on networked information over the next few years.

TABLE IV ANOVA TEST OF DISCIPLINE VERSUS IMPACT OF NETWORKED INFORMATION

Item		Sum of Squares	df	Mean Square	F	.Sig
1	Betwn Groups Within Groups Total	.163 145.625 145.788	1 280 282	.163 .518	.315	.575
2	Betwn Groups Within Groups Total	3.849 132.620 136.468	1 280 281	3.849 .474	8.12	.005
3	Betwn Groups Within Groups Total	.042 151.550 151.592	1 280 281	.042 .541	.078	.780
4	Betwn Groups Within Groups Total	1.695 169.273 170.968	1 282 283	1.695 .600	2.82	.094
5	Betwn Groups Within Groups Total	10.636 209.761 220.396	1 278 279	10.636 .755	14.09	.000
6	Betwn Groups Within Groups Total	1.964 215.167 217.131	1 281 282	1.964 .766	2.56	.110
7	Betwn Groups Within Groups Total	1.907 193.417 195.324	1 282 283	1.907 .686	2.78	.097
8	Betwn Groups Within Groups Total	.124 191.819 191.943	1 280 281	.124 .685	.181	.671
9	Betwn Groups Within Groups Total	.078 132.791 132.869	1 280 281	.078 .474	.164	.686
10	Betwn Groups Within Groups Total	1.357 208.163 209.519	1 281 282	1.357 .741	1.83	.177

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Among a list of items that investigated the impact of networked information on research and scholarly communication, only two items (2 and 5) were found to differ significantly across the participants' disciplinary groupings at .05 level (Table IV). Descriptive data illustrates that respondents from science disciplines indicated more positive responses for the two significant items than do participants from humanities and social science disciplines. These results support the commonly held view that science scholars are more likely to form research teams than those in other disciplines, They also indicate that they have adopted the use of networked information sources to assist in this regard.

Training and Library Support

Table V refers to the following items:
1. I am able to access all networked information from my office or lab.
2. The university runs occasional training sessions for faculty members to use networked information.
3. The university commitment to improving the process of electronic scholarly communication is highly appreciated.
4. The library website is easy to navigate and gives comprehensive instructions and information.
5. The availability of networked information resources at the library is sufficient.
6. The library's web-based catalog is clear and easy to use.
7. E-journals in my field are adequate and useful.
8. Computer facilities and electronic equipments in the library are adequate.
9. I receive updates from the library through a networked medium such as email or group mailing lists.
10. The library informs me about networked information resources and services that are newly available.
11. The library invites me to attend sessions on networked information.
12. Librarians are very collaborative and helpful.
13. I am overall satisfied about the networked information services facilitated by the library.

TABLE V ANOVA TEST OF DISCIPLINE VERSUS TRAINING AND LIBRARY SUPPORT

Item		Sum of Squares	df	Mean Square	F	.Sig
1	Betwn Groups Within Groups Total	.008 265.586 265.594	1 279 280	.008 .952	.009	.925
2	Betwn Groups Within Groups Total	.684 214.313 214.996	1 278 279	.684 .771	.887	.347
3	Betwn Groups Within Groups Total	3.004 195.496 198.500	1 278 279	3.004 .703	4.27	.040
4	Betwn Groups Within Groups Total	6.599 260.493 267.092	1 280 281	6.599 .930	7.09	.008
5	Betwn Groups Within Groups Total	23.509 242.881 266.390	1 275 276	23.509 .883	26.6	.000

Item		Sum of Squares	df	Mean Square	F	.Sig
6	Betwn Groups Within Groups Total	7.771 222.000 229.771	1 278 279	7.771 .799	9.73	.002
7	Betwn Groups Within Groups Total	1.938 352.177 354.115	1 276 277	1.938 1.276	1.51	.219
8	Betwn Groups Within Groups Total	.461 235.506 235.968	1 278 279	.461 847	.545	.461
9	Betwn Groups Within Groups Total	13.827 371.808 385.635	1 280 281	13.827 1.328	10.4	.001
10	Betwn Groups Within Groups Total	.166 367.851 368.018	1 280 281	.166 1.314	.127	.722
11	Betwn Groups Within Groups Total	.242 292.320 292.562	1 279 280	.242 1.048	.231	.631
12	Betwn Groups Within Groups Total	4.486 211.710 216.196	1 278 279	4.486 .762	5.89	.016
13	Betwn Groups Within Groups Total	11.649 240.152 251.801	1 279 280	11.649 .861	13.5	.000

It is concluded from the above ANOVA table (Table V) that the respondents' attitudes to training and library support differ significantly according to disciplinary groupings at .05 for items 3, 4, 5, 6, 9, 12, and 13. The descriptive data illustrates that participants from humanities and social science disciplines indicated more positive responses to those statically significant items than respondents from the sciences.

Perception of Arabic as a Scholarly Language

Table VI refers to the following:
1. The availability of networked information in English sufficiently substitutes for the extreme shortage of networked information in Arabic.
2. Sufficient availability of Arabic networked information would have increased my intellectual productivity.
3. Sufficient availability of Arabic networked information would have encouraged me to think about publishing more in Arabic.
4. Sufficient availability of Arabic networked information would help me to remain current in my field.
5. Teaching and learning in Arabic within my discipline is getting difficult due to the lack of networked information in Arabic.
6. I strongly encourage colleagues and students to use English in writing and publishing.
7. Learning the fields of sciences and technology nowadays in Arabic will risk the learners' academic and career future.

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8. Absence of Arabic E-journals and sufficient Arabic networked information is a reason why Arab academics favour English.
9. Without being electronically available, the Arabic language will not be able to contribute to the human and scientific development.
10. The domination of English language will lead to the continuous decline of the Arabic language for the academic purposes.
11. The presence of Arabic networked information on the Internet will improve to a great extent in the next few years.
12. I would certainly prefer to write and publish in Arabic if the language was sufficiently available in a networked environment.

TABLE VI ANOVA TEST OF DISCIPLINE VERSUS ACADEMICS' PERCEPTION

Item		Sum of Squares	df	Mean Square	F	.Sig
1	Betwn Groups Within Groups Total	1.707 275.813 277.520	1 198 199	1.707 1.393	1.225	.270
2	Betwn Groups Within Groups Total	12.783 210.880 223.663	1 200 201	12.783 1.054	12.12	.001
3	Betwn Groups Within Groups Total	31.448 225.448 256.896	1 200 201	31.448 1.127	27.89	.000
4	Betwn Groups Within Groups Total	35.364 241.745 277.109	1 200 201	35.364 1.209	29.25	.000
5	Betwn Groups Within Groups Total	2.581 244.703 247.284	1 199 200	2.581 1.230	2.099	.149
6	Betwn Groups Within Groups Total	11.255 184.446 195.701	1 199 200	11.255 .927	12.14	.001
7	Betwn Groups Within Groups Total	12.243 225.010 237.253	1 196 197	12.243 1.148	10.66	.001
8	Betwn Groups Within Groups Total	2.201 229.112 231.313	1 199 200	2.201 1.151	1.912	.168
9	Betwn Groups Within Groups Total	.828 329.635 330.463	1 201 202	.828 1.640	.505	.478
10	Betwn Groups Within Groups Total	2.579 319.005 321.584	1 200 201	2.579 1.595	1.617	.205
11	Betwn Groups Within Groups Total	1.619 127.130 128.749	1 201 202	1.619 .632	2.560	.111
12	Betwn Groups Within Groups Total	25.681 231.670 257.351	1 200 201	25.681 1.158	22.17	.000

Respondents' perception of Arabic as a scholarly language in the Arabic networked environment across discipline groups

revealed statistically significant differences in group means at .005 level for six items (2, 3, 4, 6, 7, and 12) in Table VI.

It should be noted that all the colleges in the Science Division teach their programs in English, while colleges in the Humanities and Social Sciences Division teach in Arabic, with the exception of the College of Commerce and Economics which teaches in English. It is therefore apparent that the responses to six statements in Table VI correlate not only with discipline but also with the language used for teaching and research. The first three statistically significant statements (2, 3, and 4), all of which address the issue of sufficiency of "Arabic networked information" reflect the greater reliance on Arabic by social science and humanities scholars. Statements 6 and 7, which address the importance or need to use English (or languages other than Arabic) recorded a significantly more positive response from the science scholars. Interestingly, the science-based respondents also indicated (more than their colleagues in other disciplines) that they would "prefer to write and publish in Arabic if the language was sufficiently available in a networked environment". This strongly suggests that the use of English is a choice that is made for them by the ubiquitous use of English for science communication.

VII. DISCUSSION

As indicated previously, categorization of disciplines in this study has been based on the organizational structure of SQU, in which colleges have been divided according to the broad disciplinary arrangement of the humanities and social sciences in one Division, and the sciences in another Division. The purpose of this section is to discuss the use of networked information at SQU from a multi-disciplinary perspective, in which the two broad disciplinary categories used by the University for administrative purposes are compared.

In general terms the results from this study indicate that science scholars at SQU are significantly more active users of networked information than their social science and humanities colleagues. The results reported in Tables II, III and IV in particular indicate the extent to which science respondents are more heavily engaged in the use of networked information for research purposes. These tables record a statistically significant difference in response by discipline for a variety of activities that are essential components of research productivity. These results reflect disciplinary differences regarding the use of, and attitudes towards, networked information at SQU, and can therefore be compared to results from similar studies conducted elsewhere. It is also the case, however, that such comparisons need to be undertaken with caution, as the results may reflect not only differences in the research and scholarly communication based on disciplinary characteristics, but are also likely to be indicative of particular aspects of socio-educational development in Oman and Arab countries more generally. These additional factors include the state of the Arabic language as a means of scholarly communication, and the level of development of an effective research culture in developing Arab countries.

The United Nations Development Programme in its influential *Arab Human Development Report* (2003) [56] pointed to the "crisis of the Arabic language" (p. 122) when

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used for scholarly purposes and called for the "Arabisation" of university education—particularly science education—in the Middle-East region. The Report noted the domination of English for use in scholarly communication, and the failure—due to a series of socio-political and technical issues—to adapt Arabic for scholarly use in the digital environment. For these reasons Arab scholars' attitudes towards the use of the two languages for teaching and research purposes are of great importance. As noted previously disciplines and language are currently closely aligned at SQU and the results reported in Table VI seemingly reflect the different experience of respondents who teach and research in English (from the sciences) and those who use Arabic (from the social sciences and humanities). The results recording the significantly lesser reliance by social science and humanities scholars on networked sources of information are very likely indicative of the under-representation of Arabic on the Internet and in other digitised information sources. It should also be noted that the results also point to the uncertain attitude towards the two languages held by science scholars, whereby they recognise the necessity of using English while retaining a preference for Arabic.

The *Arab Human Development Report* also argued that Arab humanities and social science scholars have been working in a vacuum, as their 'invisible college' or social networks are poorly formed. This claim is supported by the results of the current study, with respondents from the humanities and social sciences reporting that they communicate with colleagues less frequently than respondents from the science disciplines, and that they have been less successful in working "collaboratively" or establishing "new relations". It can be speculated that science scholars, due to their use of English and the more international focus of science research, have been able to make use of networked communication to attach themselves to established international, collaborative research communities. This is apparently not the case, however, for the social sciences and humanities wherein scholarship is frequently limited by a local or regional focus and further confined by the use of Arabic. As a result such collaborative communities are yet to develop for these disciplines, and even opportunities for regional networking appear to be limited. Whereas collaborative research cultures have generally been slower to develop in the social sciences and (particularly) the humanities, the evidence suggests that this is strongly the case in Arab countries.

As noted, earlier studies [20, 45, 46] conducted in developed countries recorded similar differences between disciplines in a networked environment, but more recent studies have suggested that the disciplinary 'gap' in the use of networked information might be closing [22]. The current study contradicts this trend as disciplinary differences are still strongly indicated in the use of networked information at SQU, suggesting that there is a 'lag' in closing this gap. This is possibly due to the comparatively late uptake of networking technology at SQU—and elsewhere in the Arab world—but may also be due to the issues associated with language and underdeveloped research cultures.

An intriguing element of the results is the extent to which social science and humanities respondents reported a more positive response to the networked services provided by the SQU Library (Table V). It is likely that this reflects a generally greater dependence on library services and support within these disciplines, but it is relevant to note that the higher level of satisfaction extends to "networked information services", when other elements of the results indicate that social science and humanities respondents use these resources less than their science counterparts, and also report being comparatively dissatisfied with the level of these resources available in their preferred language (Arabic).

With regard to library use respondents were also asked to record their use of various networked library services. Although the results were not statistically significant, it was the case that the use of web-based library catalogs and web-based library databases was found to be more frequent by respondents from the social sciences and humanities. This finding contradicts that of Torma and Vakkari [46], who reported that science scholars use networked library services more frequently than do those from the social sciences and humanities. The finding also contradicts those of Borgman [50] and Tenopir [45] who claimed that academics from science disciplines use "electronic information" in academic libraries more than those from the social sciences and humanities disciplines. In the Arab World, Ibrahim [57] investigated the use of networked information and library services at the United Arab Emirates University and reported that academics from science disciplines indicated higher use than their counterparts in the social sciences and humanities.

The extent to which the results from this study might be extrapolated to other Arab countries, or developing countries more generally, is also relevant. It can be hypothesised that as other Arab countries in the Persian Gulf region share similar circumstances in terms of the development of their higher education, research and communication infrastructure that they may demonstrate similar results. They also experience many of the same social and linguistic circumstances that contextualize the results of this study. It would be less safe to assume the results would be replicated in other Arab countries (for example those of the Maghreb region), or to developing countries more generally.

VIII. CONCLUSION

The research reported above indicates that science scholars at Sultan Qaboos University are more dependent on networked information that those from the social sciences and humanities. This situation likely reflects differences that are intrinsic to the nature of scholarship within the disciplines and have previously been reported with regard to more 'traditional' forms of scholarship. While other research suggests that these differences might to some extent be minimised within a networked environment there is little indication that this had occurred at Sultan Qaboos University at the time this research was conducted. It is concluded that this may be due in part to the comparatively recent uptake of networking technologies in Oman, but it is also likely to reflect aspects of the current state of scholarship in developing Arab countries, in particular the

poor utilization of Arabic in digital information environments and the lack of developed research cultures. In both respects the results from this study indicate that scholars in the social sciences and humanities are disadvantaged in a manner which is likely to negatively impact on their use of networked services for research and communication.

Additional research is required in developing Arab countries in order to understand more about the particular circumstances faced by scholars when using networked information services. This research could focus on the educational and social contexts in which the technology is deployed, in order to better understand their impact on research productivity in different disciplines.

The conclusions of this study also have implications for the development and implementation of digital library services aimed at optimising the research productivity of Oman and other developing Arab countries. In particular academic librarians need to develop strategies to provide scholars— particularly those working in the social sciences and humanities—with support in compiling and accessing digitised Arabic resources; and to assist in using networking technologies to build and sustain regional research communities for these same disciplines.

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