

# A Contextual Model of Information Literacy

**Maryam Nazari**

Department of Humanities, Golpayegan Branch, Islamic Azad University, Isfahan, Iran

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## Abstract

This article reports a contextual model of information literacy (IL) which emerged from an exploratory case study of IL in a joint online distance learning (ODL) Geographic Information Sciences/Systems (GIS) programme and demonstrates how it contributes to the development of information literate GIS learners in ODL environments. Adopting Eisenhardt's (1989) "process of building theories from case study research", it explored IL in the context of a wide range of teaching and learning experiences in the programme, using interview, questionnaire, students' reflection, observation and document study as data collection methods. The two level within- and across-case analysis, suggested by Eisenhardt, were innovatively combined with grounded theory data analysis approaches to analyse the data. It appeared that in the ODL GIS programmes IL is needed, not just as a set of transferable skills, but as an enabler for independent, connective, transferable and lifelong learning.

## Keywords

Contextual model of information literacy; Geospatial information; Geographic Information Sciences/Systems (GIS) discipline; Online distance learning; Exploratory case study

## 1. Statement of the Problem

According to CILIP [1], information literacy (IL) is "knowing when and why you need information, where to find it, and how to evaluate, use and communicate it in an ethical manner".

The core models of IL, which are used internationally or influence the practices of IL worldwide, are mainly the product of librarians' and information professionals' views of IL in particular geographical locations (i.e. in the US, UK and Australia). As has been argued in several qualitative studies of IL [2; 3; 4; 5; 6; 7; 8], these models deliver a picture of IL which does not represent the ones identified by people who have directly experienced IL in some real-life contexts. This has been evidenced in several studies such as [9]:

- Bruce's study of Australian's higher educators' conceptions of IL which looks at IL in the context of users' experience of information world [5].
- Webber and her colleagues' study of British academics' conceptions of IL which explores the concept of, and pedagogy for, IL in the context of four disciplines: Marketing, English Literature, Chemistry and Civil Engineering [2].
- Lloyd's study of firefighters in a workplace context which investigates people's way of locating, assessing and using information for the purpose of their profession [4].
- Hughes and Shapiro's description of, and proposal for, IL which illuminates IL in the context of information society identifying IL as a liberal art [10].

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### Corresponding author:

Maryam Nazari, Department of Humanities, Golpayegan Branch, Islamic Azad University, Isfahan, Iran Email: [maryamnazari76@gmail.com](mailto:maryamnazari76@gmail.com)

This implies IL mean different to different people and in different contexts, hence to conceptualise and practice it in different contexts, we need to holistically understand the context in which IL is designed for. This requires a methodological approach that produces such holistic and contextualised picture of IL [9].

Phenomenography [5; 2] and constructive grounded research approach [4] form the core qualitative research methodologies used for IL research contributing to the illumination of IL concept in several different contexts. Although these methodologies have produced in-depth and various views of IL emerged from people's experiences' and conceptions' of IL, they have not holistically explored IL [9]. This mainly lies in the limitations of the methodologies employed to investigate IL, as each methodology meant to answer certain types of questions and achieve particular objectives.

As discussed in the next sections, case study, however, is an ideal methodology when aiming to conduct in-depth and holistic studies of a phenomenon [11]. It allows exploration of a contemporary phenomenon in the real-life and bounded context of a case where the researcher can holistically understand and analyse processes and relationships, because this methodology permits employing multiple methods of data collection and sources of evidence which generate multiple triangulated theories [11; 12; 13; 14; 15]. In other words, it contributes to the illumination of a phenomenon [9]:

- from the perspectives of different stakeholders who have some experiences of the phenomenon in a specific context, that is, the bounded context of the case;
- in various contextual aspects of a case focusing on different sources of evidence; and
- from different angles using different methods of data collection.

As discussed in this article, results from such research constitute the contextual foundations needed to build contextual models of IL that are most likely to meet the needs and tastes of the stakeholders in corresponding contexts. Emergent results from case study also provide stakeholders with contextually-emergent evidence on why certain outcomes might happen and what are the best approaches to design and implement IL in the particular context of the case.

Adopting Eisenhardt's "process of building theories from case study research" [14], this study reports a contextual model of IL which emerged from Nazari's doctoral study of IL in an ODL GIS programme [16].

There are several reasons behind the selection of the ODL context, as a form of e-learning, and GIS discipline in this study. Firstly, although there is a dramatic shift in delivering educational services in ODL environments, there is almost no systematic study of what IL mean, and how it should be implemented, in these environments. The e-learning practices tend to adopt the generic models of IL which seem to be inadequate for the dynamic needs of learners in these technology-oriented information and learning environments [e.g. 17; 18; 19]. These practices mostly follow the view of IL which tends to question, doubt, or deny the capability of IL [20; 21] as an enabler for lifelong learning [22; 23] by situating IL under the umbrella of e-literacies or attaching other literacies to the IL framework to make it work in these environments [e.g. 21; 24; 25].

On the other hand, although the existing core frameworks of IL such as ACRL standards have made some revisions to the introductory section of the standards' key document to justify the workability of these standards in "the contemporary environment of rapid technological change and proliferating information resources", almost no effort has been made to holistically illuminate the evolving nature and aspects of this context and its influence on the depth and breadth of IL competencies. From a contextual perspective, only two areas of IL competencies have been, to some extent, contextualised: a) the ability to select information due to the "diverse, abundant information choices" that individuals are exposed in the new environment; b) the ability to use a broader range of information sources, media and channels. This obviously does not represent a holistic image of IL context intending to serve the Higher Education in the evolving era of the 21st century [26].

Secondly, from a disciplinary view, GIS is one of the less-researched disciplines in the territory of IL research. There is no exploratory study of IL in the context of the GIS discipline. Current studies tend to use existing models of IL, such as seven pillars of information skills developed by the Society of College, National, and University Libraries (SCONUL) [27] to practice IL in this discipline [28; 29].

Furthermore, GIS discipline has particular characteristics which make it an interesting and demanding area for IL research. GIS is a multidimensional and technology-oriented discipline constantly affected by the emerging technological advancements. Likewise, GIS is applicable in any discipline and context. Accordingly, there is diversity both in the educational, professional and cultural backgrounds of the people who join GIS programmes, and in the problem scenarios and applications of GIS, i.e. where and how GIS may be applied. Thus, developing GIS programmes that are capable of responding to such diversity in the learners' needs, learning styles and workplace demands is one of

the core dilemmas of GIS education [30; 31; 32; 33; 34; 35] which, to a large extent, can be resolved by developing a contextual model of IL for these programmes [36]. This is fully discussed in this article.

## 2. Methodology

This study aimed to develop a contextual model of IL, thus it adopted Eisenhardt's "process of building theories from case study research" [14]. According to Eisenhardt [14] case study is a "research strategy" which is appropriate for building theories from case-based, empirical evidence. Her eight-step case study process is one of the most codified case study methodological frameworks which heavily draws on the works of key grounded theory authors such as Glaser and Strauss [37] and other major key case researchers [e.g. 11; 38]. It begins with defining research questions and constructs, follows by selecting case, crafting instruments and protocols, entering the field, analysing data, shaping hypotheses, unfolding literature, and ends with reaching closure which tend to be a theoretically saturated theory or model.

The design and process of this study has been fully described in Nazari's article [9]. Thus, this article will deliver a summary of the methods used to develop the contextual model of IL and will focus on the components and function of the model in generating information literate individuals in the context of the case.

### 2.1. The case and key informants

This study selected a joint Masters ODL GIS programme delivering by the Universities of Southampton and Leeds in the UK, and Pennsylvania State University (Penn State) in the USA. Diversity in the subject areas (25 modules) and overlaps in the nature of modules delivered in this programme made the case theoretically a strong one as it facilitated the exploration of IL in a wide range of modules.

23 modules; 14 in the UK sites and 9 in the US site, were selected based on their delivery throughout the course of the data collection as well as the researcher's accessibility to their educators. The key informants were 10 (all academics in the UK sites and 10 (out of 12) academics in the US site. Thus, 91% of the academics were included in the study. In addition, 55 students participated in the study and were approached through different methods (Table 1).

**Table 1 - Distribution of the study's informants**

Informants	Study sites	Methods of data collection	Number of informants
Academics	Leeds	Interview	8
	Southampton		2
	Penn State		10
Students	UK sites	Interview	3
	US site	Interview	4
		Questionnaire	12
		Students' reflection	36

### 2.2. Research questions and constructs

As a contextual exploration of IL was the core aim of this research, instead of focusing directly on the people's conceptions of IL, as used in major exploratory studies of IL such as Bruce [5] and Webber et al. [2], this study focused on the concept and nature of IL in terms of several different educational activities such as a) conceptions of information and competencies needed to make sense of, and use information in the context of the discipline and learning tasks, b) conceptions and characteristics of the discipline and competencies needed to learn the subject and accomplish tasks, and c) the nature and characteristics of learning and teaching GIS in the ODL environment of the programme. Data emerged from each area then were interpreted to illuminate IL in the context of the case. Thus, this study explored the following questions:

- How has geo/spatial information (GI) been perceived and experienced in the ODL GIS programme, and what are the implications for IL?
- How has GIS been perceived and experienced in the ODL GIS programme, and what are the implications for IL?

- What competencies are needed to (a) analyse and solve GIS problems; (b) to find, evaluate, and use GI; and (c) solve GIS problems?

### 2.3. Data collection

Five main methods were used to explore the research questions in the context of the case. These were: interview with academics and students, questionnaire for students, students' reflections, and observation and document study. As shown in Table 2, this range of methods and evidence contributed to the holistic illumination, and development, of the contextual model of IL. This also facilitated theoretical, methodological and data triangulation in the emergent results [9].

The questions and data collection tools were revised through simultaneous data collection and analysis, suggested by Eisenhardt [14]. For example, the analysis of the very first interviews revealed that both students and educators face some challenges to transfer their learning experience to their workplace when discussing their learning and teaching experiences of GI/S in this study. Similarly, educators reported that students seem not to be able to recall the skills and knowledge which they have obtained in the earlier modules or units when dealing with their projects or more advanced lessons. Likewise, the educators mentioned that due to the diversity in the applications of GIS it is almost impossible to design problem scenarios that cover the learning needs of all learners, as they are from a wide range of professional backgrounds, that is, they are interested in particular aspect or way of using/learning GIS.

**Table 2 - Contribution of multiple methods/evidence to understanding the contextual aspects of IL**

Method	Evidence	Contribution
Interviews with educators	Educators' perceptions and experiences of GI and GIS in the context of different GIS modules	Educational and disciplinary context of IL
Interviews with learners	Learners' perceptions and experiences of GI and GIS in the context of different GIS tasks/modules	
Questionnaires		
Students' reflection		
Document study	Module outlines, curriculum design/content, pedagogy, assessment methods	Physical and educational context of IL
Observation	Learning environment, content and design	Physical context of IL

Overall, these informed the researcher of a new researchable area which was not initially included in the research questions. As a result, a new question was added to the initial list as follows:

- What are challenges and approaches to transferable learning in the ODL GIS programmes?

### 2.4. Data analysis

As illustrated in Figure 1, innovatively, the process of within-units and across-units analysis, suggested by Eisenhardt [14], was iterated in four stages in the light of Grounded Theory data analysis approaches, known as coding, memo writing, sorting or grouping concepts and themes, and writing theory [37].

In stage one, students' and educators' perceptions and experiences of GI and GIS in every unit (teaching and learning experience of GI and GIS) as well as descriptions of GI/S as appeared in the module's outlines were codified in the form of several concepts and themes. In stage two, the emergent themes were searched across the units to seek patterns. This resulted to four conceptions of GI and three conceptions of GIS. In stage three, the emergent conceptions were used to explore ways in which GI/S were viewed or used in the context of each unit. This facilitated the illumination of the GI/S conceptions in the context of different teaching and learning experiences and module outlines. In this stage, each teaching and learning experience (unit of analysis) were explored to a) identify competencies needed to interact with and use GI/S and solve GIS problems; and b) illuminate characteristics of GIS education and challenges and approaches to transferable learning. In stage four, the emergent themes from the within-units analysis, emerged in stage three, were searched for patterns. This resulted to the emergent of a five-phase process of problem-solving geospatially and a framework of the characteristics of GIS education and challenges and approaches

taken/recommended by academics or students to facilitate transferable learning, that is, to enable learners transfer their learning to their workplace experiences.

To conceptualise IL and design the contextual model of IL for the ODL GIS programme, the overall findings were questioned as follows:

- How has GI and GIS been conceived and described in the ODL GIS programme and what are their implications for developing information literate individuals in this programme?
- What is the nature and process of problem-solving in the ODL GIS programme and what are their implications for developing information literate individuals in this programme?
- What are the characteristics of GIS education in the ODL GIS programme and what are their implications for developing information literate individuals in this programme?

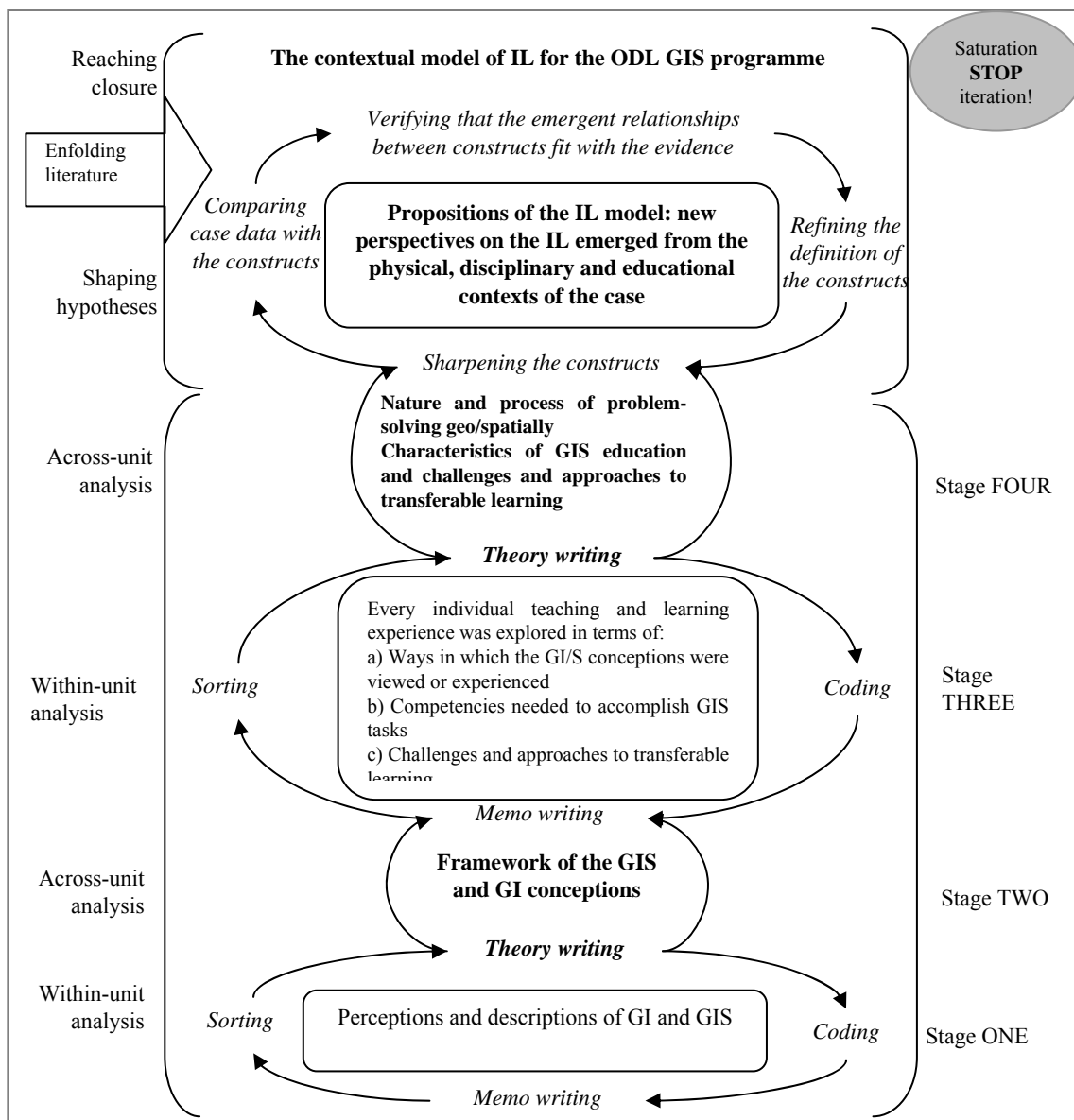


Figure 1- The process of data analysis

Due to the multi-disciplinary nature of this study, the emergent results were compared with the literature in several different areas as follows:

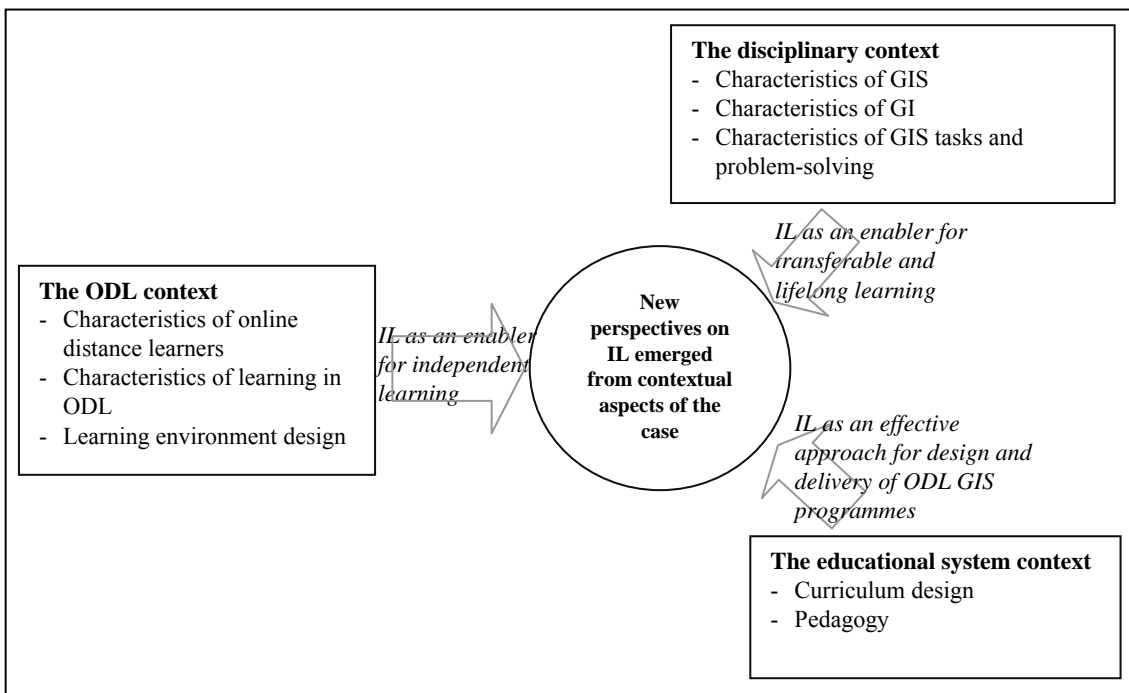
- Nature and characteristics of ODL and competencies needed to perform as competent online distance learners;
- Adaptation approaches to IL in e-environments, in general, and in e-learning programmes, in particular;
- Key models of IL (i.e. ACRL and SCONUL);
- Characteristics of GIS education and approaches taken or recommended by scholars and practitioners to design and deliver GIS curricula that support the development of information literate GIS professionals;
- Concepts or definitions of GI and GIS

Overall, the highly iterative process of data analysis and constant comparisons of the emergent theory with the units and case data, which carried out from the very early stages of the data analysis phase, verified that there are meaningful relationships between the emergent patterns and theory and the data in this study. Likewise, similarities and overlaps in the GIS modules, and accordingly in the students' and educators' experiences of GI/S resulted in replication in the emergent results and generated a saturated and robust model of IL [14].

As discussed below, overall, three new perspectives on IL emerged from the physical, disciplinary and educational contexts of the case based on which IL was contextually rationalised and conceptualised and the contextual model of IL was developed. This article does not aim to report the findings, but to present this model, the rationale behind it and to demonstrate how it operates to develop information literate individuals in the context of the ODL GIS programme, considering the contextual aspects of the case.

### 3. Rationalisation of the contextual model of IL

As shown in Figure 2, new perspectives on IL emerged from the disciplinary, physical/ODL and educational contexts of the case. They identify IL as an enabler for independent, transferable and lifelong learning and as an effective approach for design and delivery of ODL GIS programmes that support the development of information literate online distance GIS learners.



**Figure 2 - An illustration of IL as a contextually-emergent phenomenon**

Drawing on these new perspectives of IL, below the rationale behind the architecture and components of the contextual model of IL designed for the ODL GIS programme are discussed.

### 3.1. Perspectives on IL which emerged from the physical/ODL context of the case

The ODL context of the case, including the online distance learners, learning and the learning design, in the ODL GIS programme has particular characteristics which require IL to act as an enabler for independent learning.

There is a wide diversity in the learners' backgrounds, abilities and ambitions for learning GIS. This highlights a need for approaches that enable learners to determine their own information and competencies throughout their learning journey, and more specifically when solving problems.

In the ODL environments, learners need to have a wide range of competencies to be able to manage their learning and meet their learning needs independently as they have almost no face to face contact with their peers or educators. This is even more challenging in the field of GIS as GIS is a technology-oriented discipline involving learners in accomplishing technology-oriented tasks which require them dealing with many technical problems. This implies every learner needs to be able to independently adopt appropriate information behaviour to diagnose and meet their information and competency needs.

In terms of the ODL environment design, learners have access to a wide range of learning materials and spaces through which they can communicate, discuss, and share learning experiences and find solutions for problems and challenges they face. Being able to navigate such an environment effectively, address questions in an understandable way, and benefit from others' experiences and knowledge through the ODL facilities are some of the key requirements for learning in the ODL environment. From this perspective, IL can be seen as a facilitator for navigating the learning environments effectively, to develop and sustain effective networking and communication skills in order to meet learning needs. This contributes to independent learning.

### 3.2. Perspectives on IL which emerged from the disciplinary context of the case

This section illuminates how the characteristics of the GIS discipline and GI as well as the nature and process of solving GIS problems guided the researcher to identify IL as an enabler for transferable and lifelong learning.

Firstly, GIS is a multi-dimensional discipline; it is a combination of science and technology which is constantly evolving and influenced by the technological advancements in the field as well as the changes taking place in the disciplines and contexts in which GIS is applied, as it is applicable in almost any discipline and context.

Because of the wide applicability of GIS, people who join GIS programmes come from different educational and professional backgrounds with different workplace demands. Thus, there is a variation in their way of viewing and using GIS and GI. This was illuminated in three conceptions of GIS and four conceptions of GI [42] emerged from this study. Each conception represents a specific way of viewing and using GI and GIS. This implies depending on the way of viewing and using GI/S different set of skills and knowledge may be needed to learn GIS and solve GIS problems and these may vary from one learner to another and from one task to another. This requires every individual GIS learner to be able to identify their own way of viewing and using GI/S and determine their competency needs when dealing with GIS problems. Likewise, the learner needs to be able to connect and transfer their skills to their workplace experiences. From this perspective, IL acts as an enabler for transferable learning.

Furthermore, the evolving nature of GIS requires learners to be able to update their knowledge and skills both in the field of GIS and in the application areas they are willing to use GIS. This implies in the ODL GIS programme IL also is needed to act as an enabler for lifelong learning.

Secondly, GI is multi-dimensional; it has time, location, and some attributes components. Thus, to make sense of, and use GI a wide range of operations and tools may be needed. This requires the learner to have a wide range of skills and competencies to make GI geo/spatially meaningful and usable for a particular purpose and the required competencies may vary depending on the type of needed GI and the learner's way of using it. From this view, IL can be seen as an enabler for critical thinking that would enable the learner to develop their way of viewing and using GI and to determine operations, tools and skills/inputs needed to make sense of, and use, GI. As fully discussed in Nazari and Webber (2010) [39], the characteristics of information in the GIS discipline greatly effect on the depth and breadth of the current key models of IL such as the SCONUL [27].

Thirdly, GIS problems have a location component and several different contexts that reflect different dimensions (i.e. subject, time and location context) of the problems. It appeared that the learners go through a five-phase process to solve GIS problems geospatially. By geospatially, it means solving problems three-four dimensionally, considering time, location and other related contextual components of the problems. As discussed in the next section, to solve GIS problems learners need to accomplish specific tasks, i.e. to perceive, prepare for, and operate appropriate tools and data to solve GIS problems and to communicate and update the solution. Again, type of competencies needed in each phase of the problem-solving may vary from one learner to another, due to the diversity in the GIS problem scenarios, the

learners' abilities and their way of viewing and using GIS. Altogether these characteristics highlight the need for IL as an enabler for transferable and lifelong learning in order for GIS learners to act as information literate individuals.

### 3.3. Perspectives on IL which emerged from the educational context of the case

The educational context of the case revealed that IL should act as an effective approach to design and deliver GIS courses if aiming GIS programmes that support the development of online distance GIS professionals.

Although, there were some differences in the educational systems of the US and UK sites, they were not of the major focus of this study. For example, the American educational system tends to be instructional and course-based, whereas the British educational system is considered to be more broadly constructive in approach [40].

However, in this study the design of the GIS curriculum and pedagogic seem to have more influence because of the nature and requirements of education in the ODL environments and the requirements of the GIS discipline itself. For example, due to time limits of the ODL programmes, the GIS curricula have been designed on a fixed- and tightly-scheduled basis that provides learners with certain start and finish (or departure and arrival) points in their learning journey. This means there are certain assumptions about the level of learners' knowledge and abilities, both in terms of ODL and GIS relevant skills.

Pedagogically, due to the technology-oriented nature of GIS tasks which require learners to have a wide range of skills to deal with them, as well as diversity in the learners' abilities and skills, educators tend to use instruction-led approaches to teaching GIS. With this approach, learners mainly rely on self-contained task packages in which they have access to detailed step-by-step instructions, cleaned (qualified) data, and their needed tools to accomplish their tasks. To ensure learning has taken place some educators adopt a developmental teaching approach, gradually reducing the instructions to scaffold learners' progression to more advanced tasks. Although this approach would involve learners in recalling their past skills achieved in the previous modules or units, the findings from this study revealed that due to the diversity in the instructions needed for each task, learners usually forget the instructions and request for instructions. In addition, the GIS programmes may not cover problem scenarios in the application areas which address the professional needs of every individual learner.

The fixed and tightly scheduled nature of GIS curricula and the instruction-led pedagogical approaches in the GIS ODL programmes highlights a need for approaches that engage the learner in active and connective learning, that is, it enables the learner to connect their knowledge base (KB) and value system (VS)<sup>1</sup> with the curriculum, tasks and, more broadly with their learning experience, and transfer that to their real-life experiences and become lifelong learner.

In this context, IL can be used as an effective educational approach to develop GIS curricula and pedagogical approaches that support such connective, transferable and lifelong learning experiences.

## 4. The contextual model of IL for the ODL GIS programme

The contextual model of IL has been constructed on the various contextual components of IL as emerged from the bounded context of this case study. This includes both the rationale for why IL is needed in the ODL GIS programme and how the IL model has been designed to support the development of information literate GIS online distance learners in this programme.

As contextually illuminated, in the ODL GIS programme IL should be designed in a way that facilitates/supports independent, transferable and lifelong learning. This is because of a) the diversity in the learners' backgrounds, competency needs, and ambitions which may result in variation in their ways of viewing and using GIS, hence differences in the competencies they may need to accomplish a GIS task/problem, and b) the evolving nature of the GIS which requires updated knowledge and skills, hence lifelong learners who are capable of adopting appropriate information and learning approaches to sustain their knowledge and skills in the course of their professional life.

Taking into account these contextual factors, the contextual model of IL has been designed in a way that engages the learner in a constant process of thinking and questioning their KB and VS while interacting with various contextual components of the IL model throughout the process of problem-solving. This enables the learner to develop their conception and experience of IL in the dynamic context of their personal, professional and educational needs and while fulfilling the requirements of each phase of the problem-solving process.

<sup>1</sup> In this article, Knowledge base (KB) means the learner's abilities and knowledge that are mainly influenced by their educational and professional backgrounds and value system (VS) means the learner's goals and ambitions for learning and using GIS mainly influenced by their cultural and professional backgrounds as well as their personal and professional interests.



As shown in Figure 3, the learner's experience of IL develops throughout a seven-stage process guided by three main contextual components, i.e. the process of problem-solving geospatially, and the GI and GIS conceptions. The process of problem-solving geospatially is a five-phase process emerged from the students' and academics' teaching and learning experiences of GI/S in the ODL GIS programme as well as the researcher's contextual exploration of the module outlines and curricula in this programme. It illuminates the nature and process of problem-solving or task accomplishment in the context of the programme and identifies the scope of competencies that the learner needs to be able to solve a GIS problem. Situating this process on the top section of the model means the learner needs to be exposed to the components of this process throughout their course of study. This can be in the form of a module or embedded in the curriculum to assure that the learner has an in-depth understanding of the nature, process and requirements of problem-solving geo/spatially in the ODL environment.

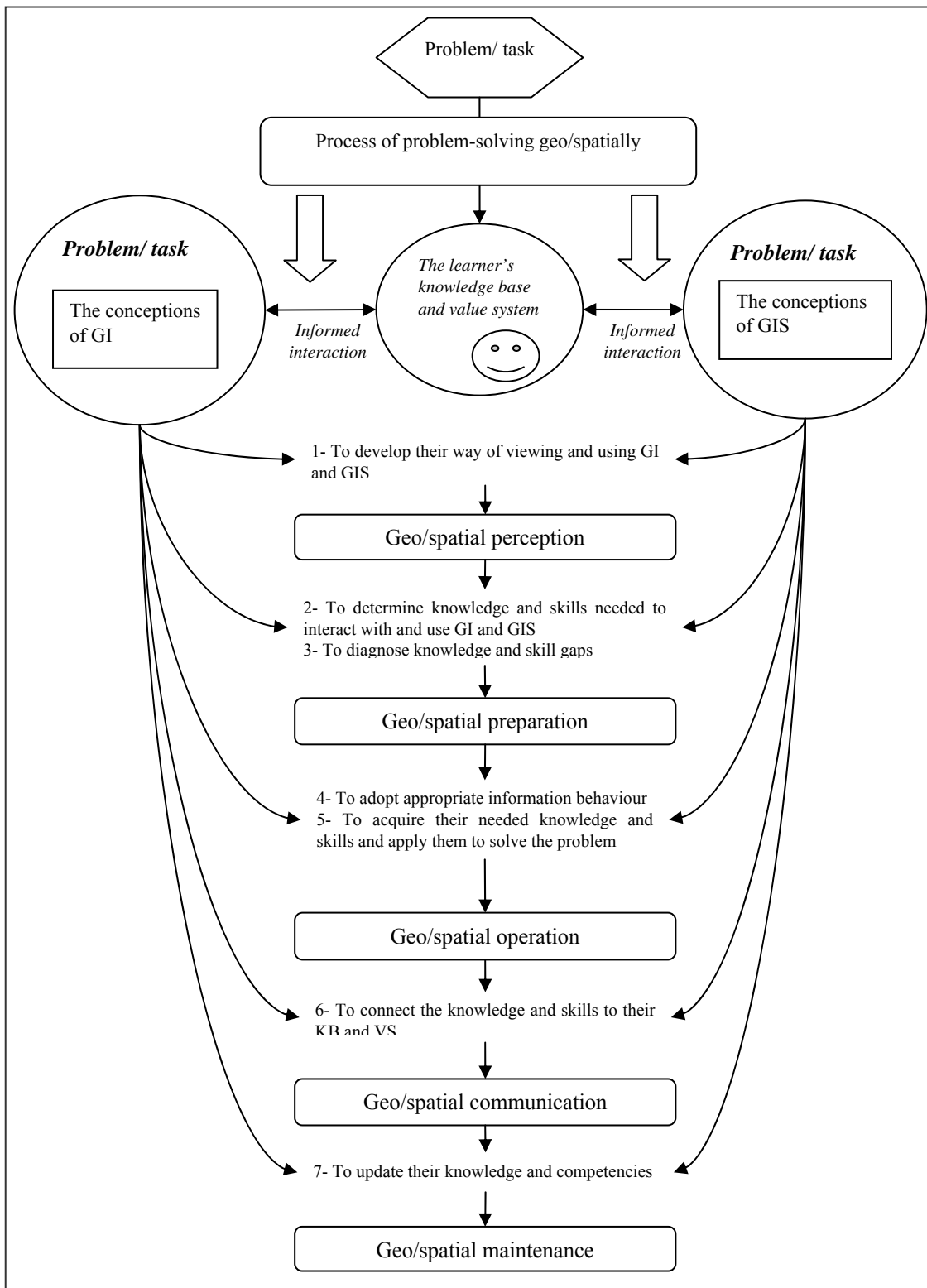
Similarly, the framework of the GIS and GI conceptions composed of three conceptions of GIS and four conceptions of GI which emerged from the students' and educators' conceptions, and experiences, of these two phenomena as well as the researcher's exploration of the module outlines and curricula. These two frameworks also need to be integrated into GIS modules or curriculum so that the learner gains some ideas about the nature and characteristics of GI/S and understands that experiencing each conception may require different sets of competencies.

The contextual components of the IL model provide the learner with new ways of conceiving information and the discipline and approaching a learning task. Altogether these would shape their experience of learning and IL. For example, variation in the conceptions of GI and GIS encourage the learner to openly think of their own conception and way of using GI/S when dealing with a learning task/problem. This contributes to the learner's informed interactions with the components of the IL model and leads to the formation of informed decisions in each phase of the problem-solving process. Firstly, this is because the learner is expected to consult with the GI/S conceptions in order to determine their own way of viewing and using GI/S. This interaction informs the learner of the variation in the ways they can conceive and use GI/S, and that how each selection may require a different set of competencies. Secondly, the learner's problem-solving behaviour is guided by the five-phase process of problem-solving geospatially. This again informs the learner of the data, tools, and competency requirements to deal with the tasks in each phase of the process of problem-solving. Finally, the learner's final decision on how to use GI/S and what competencies to acquire are guided by their interactions with their KB and VS.

Overall, the contextual model of IL engages the learner in a seven-stage interactive process through which they contextually construct their conception and experience of IL and build confidence they need to deal with various problems, both during their course of study and after their graduation. In this seven-stage process, the learner will need to:

- develop their way of viewing and using GI and GIS through interaction with the GI/S conceptions;
- determine the knowledge and skills needed to interact with, and use, GI and GIS in the context of the problem;
- diagnose their knowledge and skill gaps;
- adopt appropriate information and learning behaviour to meet their information/competency needs;
- acquire their needed knowledge and skills and solve the problem;
- connect the achieved knowledge and skills to their KB and VS;
- update their knowledge and skills so that they can deal with different problems.

As discussed below, IL is a constructive concept and process which contextually emerges from the learner's informed interactions with the various contextual components of the IL model throughout the process of problem-solving geo/spatially, guided by the IL tasks identified in the seven-stage process of IL. Indeed, the learner builds their experience of IL and develops their learning experience in each phase of the process of problem-solving geo/spatially through the tasks they need to accomplish in each stage of the seven-stage process of IL.



**Figure 3 – The contextual model of information literacy**

Stage 1 - To develop their way of viewing and using GI and GIS

This study revealed that there is a variation in the ways in which GI and GIS are used and perceived in the ODL GIS programmes. Thus, in the first stage of the IL process, the learner needs to develop their conception and way of using

GI/S when dealing with the problem. This is guided by four main elements: the nature of the problem, the process of problem-solving geo/spatially<sup>2</sup>, the conceptions of GI and GIS, and the learner's KB and VS.

The nature of the problem and an understanding of the process of problem-solving geo/spatially inform the learner of the type and boundary of information and competencies they need to be able to perceive the problem geo/spatially. The learner's interactions with the conceptions of GI/S inform them of several different ways they can view and use GI/S. Depending on the nature of the problem and the learner's personal and professional interest in GIS, the learner may construct their conception and way of using GI/S in the context of the problem. In other words, this enables the learner to geo/spatially perceive the problem.

#### Stage 2 - To determine the skills and knowledge needed to interact with, and use GI and GIS

Depending on their way of viewing and using GI/S, in this stage the learner needs to determine the scope of knowledge and competencies needed to effectively interact with, and use GI/S in different phases of the problem-solving process. As presented in Table 3, in each phase of the problem-solving process, different types of competencies may be needed. For example, in the first phase, i.e. geo/spatial perception, the learner needs to have some knowledge of the nature and characteristics of GI and GIS. In the second phase, i.e. geo/spatial preparation, the learner needs to have some knowledge of the ways of making sense of, and using, GI as well as some knowledge of the capabilities, applications and limitations of GIS, and that how it works. Viewing these features in the context of the problem will enable the learner to determine the boundary of the knowledge and skills needed to interact with and use GI and GIS in each phase of the problem-solving process.

**Table 3 – Knowledge and competencies needed to interact with, and use GI and GIS in each phase of the process of problem-solving geo/spatially (extracted from [16])**

Phases	GI	GIS
Perception	Knowledge of the nature and characteristics of geo/spatial data (GI)	Knowledge of the nature and characteristics of GIS, and ways of viewing it
Preparation	Knowledge of ways of making sense of, and use of, GI	Knowledge of capabilities, applications, limitations of GIS, and how it works
Operation	Knowledge of the tools and techniques capable of making data geo/spatially meaningful and usable	Knowledge of GIS tools and techniques as well as operations that contribute to creating or customising GIS tools and software
Communication	Knowledge of the process of formation and transformation of geo/spatial data to geo/spatial knowledge	Knowledge of GIS as a way of, and a tool for, presenting and communicating solutions geo/spatially
Maintaining	Knowledge of GI as a dynamic type of data that needs to be updated	Knowledge of GIS as an evolving, multi-dimensional discipline that requires updating in various dimensions of the problem

Indeed, in this stage, the GI/S conceptions inform the learner of the characteristics of GI and GIS as well as the boundary of the knowledge and competencies needed to interact with and use GI and GIS in every phase of the problem-solving process. This includes the types of operations and user inputs may be needed to make GI geospatially usable in the GIS software or customise GIS tools to meet the problem-solving requirements.

#### Stage 3 - To diagnose knowledge and skill gaps

Having identified the scope of the knowledge and competencies needed to interact with and use GI/S in the context of the problem, in this stage the learner needs to question their KB to identify their knowledge and competency gaps, that is, to identify whether there is a gap between what they know or are able to do with what they need to know or be able

<sup>2</sup> In this article, geo/spatially refers to the multidimensional characteristics of GIS problems which have time and space components. These components may refer to geographical, spatial, political, social, cultural and any other contexts which may relate to the core subject of the problem. As the spatial context of problems can be Geographical or non-geographic, slash (/) has been used to cover both situations.

to do to solve the problem. For example, assuming the learner needs to use Microsoft Access to manipulate data, they need to question their KB to see whether or not they are able to use Access applications to manipulate the data.

By accomplishing tasks in stages two and three, the learner will be able to *identify* the requirements of the problem-solving, including the data, tools, and user inputs, i.e. knowledge, competencies and operations needed to prepare GI and GIS for problem-solving. In sum, the learner will geo/spatially prepare the requirements of problem-solving.

#### Stage 4 - To adopt appropriate information and learning behaviour

Having identified the knowledge and competency gaps, the learner needs to think of an appropriate information and learning behaviour to achieve their needed knowledge and competencies to fill the gaps. To be more specific, they need to determine appropriate information sources and channels, and select appropriate searching tools and strategies in the field of GIS to acquire their needed knowledge and competencies.

In so doing, the learner needs to understand how the GIS knowledge is produced, organised, and disseminated, and how to search for, evaluate, synthesise and use GI. Besides, they need to have some knowledge of searching strategies, tools as well as places where they can obtain their needed information and learning materials. For example, in the GIS discipline, people and organisations were identified as two key sources of information. Thus, it is essential for the learner to have some communication and networking skills to be able to get in touch with these two [16; 39].

Likewise, they need to be familiar with various sources of information and learning materials so that they can select appropriate ones to meet their competency needs in the process of problem-solving. These can be in the form of online tutorials, online forums, blogs, youtube videos, textbooks etc.

In sum, depending on the learner's needed knowledge and competencies, and their knowledge of the existing information sources, tools, and searching strategies, they may adopt different information and learning behaviour approaches which will take them to the most appropriate information and learning resources.

#### Stage 5 - To acquire and apply the competencies and solve the problem

Depending on their identified information and learning needs, the learner may use different sources of information to acquire their needed knowledge and competencies.

For example, if the learner needs to gain some competencies in how to use SPSS software or Microsoft Access, then they may need to use a certain tutorial or use a particular textbook focusing on these issues. They may also need to navigate the learning environment and use some instructions delivered in the previous modules or presented as part of generic learning materials in the course.

This requires a learning environment that supports such information and learning behaviour. For instance, the learning environment may be designed in a way that provides the learner with some links to various tutorials and information resources both inside and outside of the ODL environment of the course.

Having acquired their needed knowledge and competencies, the learner needs to apply them in a way that they can solve the problem. In the contextual model of IL, the ways in which the learner needs to apply the knowledge and competencies can be determined by the nature of the problem and activities related to each phase of the process of problem-solving. For example, this may include developing or using certain data analysis methods, doing particular operations, using specific tools outside of the GIS software, synthesising and presenting the results of the project in three-dimensional format etc. To accomplish each of these activities a different skill-set and approach may be needed. As mentioned earlier, this implies that the GIS curricula and courses should be designed in a way that ensure the learner gets familiar with the nature and process of problem-solving geo/spatially.

By accomplishing tasks in stage four and five, the learner will *fulfil* the requirements of problem-solving that they need to operate GI and GIS in a way that they can produce solutions.

#### Stage 6 - To connect the knowledge and skills to their KB and VS

In this stage the learner needs to relate their achieved knowledge and competencies to their KB and VS and communicate them with others. In so doing, the learner needs to contextualise the solutions and competencies in their KB and VS to identify how they may relate to what they do or are interested in. This enables the learner to communicate the solution and their learning experience with others and transfer them to their real-life experiences.

In this stage, the learner needs to interact with the conceptions of GI/S to contextualise the solution in the context of the problem and in the process of the problem-solving. This helps the learner to justify their selections and decisions in each phase of the problem-solving process and present the solution(s) in a way that can be geo/spatially communicated with the audience. For example, the learner may write a report or draw three-dimensional maps to justify their way of viewing and using GI/S in the context of the solution and explain why they have used specific methods, tools and data

or why they have conducted certain types of operations. Then they may reflect on their learning experience and explain what they have learned, how that relates to their KB and VS and contributes to the field.

Such contextually constructive learning process will enable the learner to not only transfer their learning experience to their workplace, but also to apply their IL conception and experience to their educational and professional life and share it with others.

#### Stage 7 - To update their knowledge and competencies

Due to the evolving nature of GIS and GI, the learner needs to be able to update their knowledge and competencies so that they can update the solution and use new tools and technologies to deal with new problems.

The learner's interactions with the conceptions of GI/S will inform them of the evolving nature and characteristics of GI/S, that is, they need to update the GI in order to keep the solution updated. This is because GI may change as it usually represents some features of the earth, as a changing phenomenon [39; 42]. Similarly, GIS is a technology-oriented discipline which is influenced by the new technological advancements in this field and corresponding application areas. This also requires the learner to learn how to learn about, and use, new tools and technologies for various GIS problems [36].

Meanwhile, through the process of problem-solving, the learner will learn how to update each aspect of the tools, data and solution. They will also learn that they need to constantly diagnose their knowledge and competency gaps and adopt appropriate approaches to fill the gaps and stay updated. In fact, the process of problem-solving provides the learner with the way of thinking as well as knowledge they need to achieve this.

## 5. Concluding points

This study showed that IL is a contextually-constructed phenomenon which needs to be contextually researched in order to be adopted in different contexts and disciplines. As emerged from the exploration of the physical, disciplinary and educational contexts of this case study, it is essential to illuminate the nature and characteristics of discipline, information, problem-solving, learning and teaching in educational programmes in order to conceptualise and implement IL in higher education contexts.

In the evolving context of e-environments, including the ODL, these elements are affected by the advancements rapidly emerging in the information and communication environments. Thus, they should be considered as dynamic components which may influence the depth and breadth of IL and the way IL operates to generate information literate individuals who are able to learn how to learn and to become lifelong learners.

This provides the stakeholders with a new view of IL which will no longer marginalise IL, doubt or deny its workability in e-environments [21; 20]. In this view, the IL components are seen as dynamic organisms which need to be broadened or deepened when situated in the dynamic contexts. For example, in this study IL was identified as an enabler for independent, transferable and lifelong learning that requires learners to not only identify and meet their information needs but also to diagnose their competency gaps and adopt appropriate approaches to acquire the competencies they need to actually solve GIS problems in the ODL environment.

This implies that the "information need" component of IL needs to be broadened to "information and competency needs". Accordingly, learners need to look for both information and learning resources to meet their information and competency needs, that is, the "needed information" component of IL needs to be expanded to "needed information and learning resources". Likewise, learners may need to adopt information behaviour that may vary from the ones suggested in the key models of IL [e.g. 22; 41].

In this view, as presented in the contextual model of IL, instead of attaching other literacies to IL [24; 25] or marginalising it under the umbrella of e-literacies [21], the learner gets engaged in a constant process of questioning and diagnosing their way of viewing and using GI/S and corresponding knowledge and competencies they may need to effectively use GI/S and solve problems while interacting with their KB and VS. In other words, this model empowers the learner with the confidence, knowledge and skills they need to independently diagnose their information and learning needs and construct their learning experience and conception of IL in various contexts.

### 5.1. Pedagogical implications

It appeared that diversity in different aspects of GIS education and the technology-oriented nature of the GIS discipline are the key characteristics of the GI/S education affecting the nature and role of IL in the ODL GIS programme. Diversity in the GIS education was illuminated in the wide applicability of GIS, types and nature of GIS problems that

learners need to deal with in their workplace as well as diversity in the personal, professional and educational backgrounds of GIS learners. Altogether these may influence the way(s) in which GIS learners may conceive and use GI/S. Technology-oriented nature of the GIS discipline, on the other hands, influences the process and requirements of problem-solving and learning the subject. Thus, the contextual model of IL was developed with some pedagogical and educational design concerns to guide GIS educators dealing with these challenges too.

The IL model composed of three main contextual components emerged from the learning and teaching experiences and the exploration some other contextual factors affecting the teaching and learning of GI/S in the ODL GIS programme. The design of the model guides educators to design GIS curricula and courses that provide the learner with the knowledge they need to understand and practice the process of problem-solving geo/spatially and expose them to the variation view of the conceptions of GI/S. It also suggests that GIS curricula should be designed around the GI/S conceptions if it aims to overcome the challenge of diversity in the needs and tastes of GIS learners. This approach provides learners with the chance to develop specific competencies that suite their learning needs and style and help them to learn GI/S in a way that match their personal and professional tastes.

Indeed, the design of the contextual model of IL supports every individual learner to construct their own conception and experience of IL while making sense of information and the discipline throughout their learning experience. Such a constructive experience of learning facilitates independent, transferable and lifelong learning and helps the stakeholders to overcome the challenges of the GI/S education mentioned earlier.

## 5.2. Methodological implications

This study provides the stakeholders with a new approach to holistically explore IL and develop contextual models of IL for various contexts. Due to the emergent diversity in the contexts of IL, both in the disciplinary areas and electronic information and learning environments, this approach can greatly contribute to the research and practice of IL in these evolving contexts. Indeed, to appreciate the origins of IL and fully exploit its capacities in e-environments, it is essential to conduct contextual research of IL in these contexts.

As an example, the ACRL standards (and other key models of IL) can use the same approach to revisit the rationale of IL in the higher education in a way that illuminates how the depth and breadth of IL may be affected by the broader context of the evolving era of technology. Drawing on the emergent rationale, then, the IL standards and their corresponding performance indicators and outcomes can be revisited in a way that assure the workability of IL as an enabler for learning how to learn and lifelong learning in the evolving context of higher education.

This study also introduces new directions in the IL practice in the field of GIS. It informs the practitioners of the particular information and competency needs of GIS learners. This can be particularly of value to Geography and GIS librarians. They can design services that fit the needs of GIS learners and educators.

Two suggestions for future researchers: a) to examine the contextual model of IL emerged from this study in some similar contexts, e.g. in other technology-oriented disciplines and ODL programmes; b) to use the same methodological approach to conduct IL research in some other disciplinary areas or any other educational contexts.

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