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## Design and process of a contextual study of information literacy: An Eisenhardt approach

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### ABSTRACT

This study demonstrates how case study research can be used to do a contextual and inductive study of information literacy (IL) and develop robust models of IL. First, it identifies several key characteristics of case study research as a qualified research methodology for studies that aim to build theories. Second, it rationalizes a need for case study research in the field of IL research. Drawing on that, it demonstrates how Eisenhardt's case study process was adopted to conduct a contextual study of IL and discusses the researcher's activities and tasks in each phase of the process. It uses the researcher's experience of the research journey to justify the validity and robustness of the research. This article contributes to current IL research methodologies and can be of value for LIS researchers and practitioners who wish to holistically gain deep insight into phenomena through case study research.

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### 1. Problem statement: need for case study research in IL research

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” (Chartered Institute of Information and Library Professionals [CILIP], 2006). The core exploratory studies of IL have used phenomenography (Boon, Johnston, & Webber, 2007; Bruce, 1997; McGuinness, 2003; Webber, Boon, & Johnston, 2005), surveys (Leckie & Fullerton, 1999), and a constructivist grounded research approach (Lloyd, 2006). Although such studies provide in-depth views of IL and uncover the variation that emerges from people's different experiences and conceptions of it, they do not explore the holistic context of IL and the contextual aspects around it.

Using Eisenhardt's eight-step “process of building theories from case study research” (1989, p. 532), this article aims to demonstrate how case study research can be used to explore IL holistically in the various contextual aspects of a case and develop robust contextual models of information literacy (IL). This is demonstrated in the context of an exploratory case study of IL, which aimed at developing a contextual model of IL for an online distance learning (ODL) Geographic Information Sciences/Systems (GIS) partnership program.

The exploratory case study approach allows in-depth exploration of various contextual aspects of IL, such as the educational, disciplinary, and physical contexts. As will be discussed below, this allows for a holistic IL exploration. Although the phenomenographic studies of IL have looked at the context of IL, to some extent, they do

not illuminate IL and its context holistically. The phenomenography approach mainly focuses on the variation in people's conceptions of a phenomenon (Marton & Booth, 1997).

For example, in Bruce's study of Australian higher educators' conceptions of IL, she identified seven faces of IL that emerged from people's experiences of this phenomenon. These conceptions tend to describe IL as it was conceived by specific groups of people and demonstrate a variation that represents diversity in people's experiences of information and IL, rather than a holistic picture of IL in a particular context.

Similarly, in the studies of IL in disciplinary areas such as English and Marketing, IL has been defined in the context of people's meaning of information as well as internal and external factors (e.g., the nature of learning tasks and employment expectations) informed by the nature of disciplines (Leckie & Fullerton, 1999; Webber et al., 2005; Wu & Kendall, 2006).

Likewise, in her grounded, constructive study of IL in action, Lloyd (2006) explored fire fighters' way of locating, assessing, and using information when dealing with a fire. She identified fire fighters' physical bodies as a key source of information in this context because the environment in which fire fighters work is noisy and requires body language to communicate information. Drawing on the result of her study, however, Lloyd and Williamson (2008, p. 6) highlighted the importance of contextual studies of IL and identify IL as “a complex and holistic socio-cultural practice, which requires a person to experience information in a range of different ways in order to know the setting and its practices.”

Though acknowledging the exploratory studies of IL and their contribution to uncovering more about the nature of it, this article argues that the concept and function of IL may vary in different

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contexts, as highlighted by Lloyd (2006). This requires contextual studies of IL through which both the context and contextual aspects of IL can be explored holistically. This is achievable through an exploratory case study design.

According to the IL research literature, the case study is a methodology that broadly covers research and practices that tend to describe, implement, or examine IL and/or IL practices in a specific project, program, place or, more broadly, in a specific situation (e.g. Hadengue, 2005; Pinto & Sales, 2007; Tan & Theng, 2006). This study offers a new view of case study research, which contributes to the current IL research methodologies. In particular, it can be of value for LIS researchers and practitioners who wish to holistically gain deep insights into phenomena through case study research.

## 2. Case study: a strong methodology for theory building

Eisenhardt (1989, cited in Eisenhardt, 2007, p. 25) identifies case study as a “research strategy” to “create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence.” According to Yin (2003, p. 13), case study is “An empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident, [...] and in which multiple sources of evidence are used.”

Case study is an ideal methodology when a holistic, in-depth investigation is needed to gain deep understanding about a phenomenon or a few selected issues (Yin, 2003). It can be “qualitative or quantitative or a combination of the two” (Stake, 1998, p. 104). Case study also can be used to test a hypothesis, build or expand theories, and describe or explore a phenomenon (Denscombe, 2003; Dooley, 2002; Eisenhardt, 1989; Stake, 1978; Yin, 2003). Likewise, to meet the purpose (s) of research, case study can employ inductive or deductive methods (Eisenhardt, 1989; Yin, 2003).

Case study methodology has been used for many years in different types of research and across a variety of disciplines including sociology, political science, education, human affairs, information technology, information systems, organizations and management (Dooley, 2002; Eisenhardt, 1989; Stake, 1978; Tellis, 1997; Yin, 1994).

The key documents on case study, such as Yin's books, are full of successful case studies that have been conducted in different fields of study. These studies mainly owe their success to using robust procedures developed by major experienced case researchers such as Yin, Feagin, Stake, Eisenhardt, and others. “Robust procedures” means that case researchers (like researchers of many other research methodologies) have scientifically documented practical procedures to design and carry out a credible case study. Yin's case study protocol (2003) and Eisenhardt's process of building theories from case studies research (1989) are two of these major robust procedures that have been used by researchers successfully in different disciplines.

Because of the small size of either the case(s) or the study population, several authors (e.g., Dooley, 2002; Stake, 1978)<sup>1</sup> have questioned the strength of case study as an independent research methodology in building theories. That said, Eisenhardt's process of building theories from case studies provides a strong procedure through which “novel, testable, and empirically valid” theories can be developed (Eisenhardt, 1989, p. 547). Referring to Yin (1994), Eisenhardt states that “case studies are rich, empirical descriptions of particular instances of a phenomenon that are typically based on a variety of data sources” (Eisenhardt, 2007, p. 25).

In case study research, multiple methods of data collection and sources of evidence can be used to explore a phenomenon. Case study is known as a triangulated research strategy (Denscombe, 2003; Eisenhardt, 1989; Pickard, 2007; Stake, 1998; Yin, 1994). This methodology allows the researcher to use a variety of research methods and different types of data sources that facilitate triangulation. The data can be quantitative or qualitative and can come from fieldwork, archival records, verbal reports or interviews, observations, questionnaires, or any combination of these (Eisenhardt, 1989; Yin, 1981). This makes it possible to bring out detailed and diverse perspectives from the viewpoint of the study participants to illuminate the phenomenon under study (Tellis, 1997). This characteristic as the main strength of case study research facilitates the “development of converging lines of inquiry” (Yin, 1994, p. 93).

Likewise, the case study has several characteristics that qualify it as a strong methodology for inductive and contextual studies of phenomena. First, it makes it easier to explore a contemporary phenomenon in its real-life context. According to Yin (1981, p. 59), “the distinguishing characteristic of the case study is that it attempts to examine: (a) a contemporary phenomenon in its real-life context, especially when (b) the boundaries between phenomenon and context are not clearly evident.”

To highlight this feature of case study, Yin compares this methodology with experimental or historical studies. In experimental studies researchers deliberately separate a phenomenon from its context to examine it, and in historical studies research is limited only to studying past events and people, whereby the researcher usually does not have access to the relevant people to interview and/or relevant events for direct observation (Yin, 1981).

Second, it facilitates understanding processes and relationships in natural settings. Unlike experiments that are conducted in an artificially generated context where the researcher has control over some variables, in case studies, the case as the basis of the research is normally something that already exists and the researcher has no control over the actual events (Yin, 2003). To understand the phenomenon under study in its real-life context the researcher will need to gain a good understanding of the processes and relationships that are interconnected and interrelated within social settings. Eisenhardt (1989, p. 534) defines the case study method as “a research strategy which focuses on understanding the dynamics present within single settings.”

The value of case studies can be seen in the attention that researchers devote to investigating and analyzing processes and relationships and explaining why certain outcomes might happen. In fact, case studies tend “to emphasise the detailed workings of the relationships and social processes, rather than to restrict attention to the outcomes from these” (Denscombe, 2003, p. 31). Similarly, Denscombe (2003) believes that:

“The main benefit of using the case [study] approach is that the focus on one or a few instances allows the researcher to deal with the subtleties and intricacies of complex social situations. In particular, it enables the researcher to grapple with relationships and social processes in a way that is denied to the survey approach. The analysis is holistic rather than based on isolated factors” (p. 38).

## 3. Towards a contextual model of IL: An Eisenhardt approach

Eisenhardt's process is one of the most popular case study methodological frameworks. It draws heavily on the works of key grounded theory authors such as Glaser and Strauss (1967) and other major key case researchers (e.g. Yin, 1981, 1984). It has developed through comparisons of the case study research process with the

<sup>1</sup> For instance, Stake (1978, 7) argues that the best use of case studies is “to add to existing experience and humanistic understanding,” however, it can be a useful methodology for theory building as well. Dooley (2002, 346) asserts case study as “a research method and not by itself a theory-building research methodology.”

theory-building process described in other research methodologies such as grounded theory.

Eisenhardt (1989) uses several sample case studies conducted by case researchers as evidence for the fact that case studies can be used for testing a theory, generating theories, or describing a phenomenon. Like research methodologies such as grounded theory, which is well known because it can be used to build theories, Eisenhardt's process also begins with defining research questions and ends with a theoretically saturated theory or a theoretical framework. As shown in Table 1, in each step of the process Eisenhardt determines the researcher's activities and the justification for what they are supposed to do in every step and why.

This framework has been used successfully by researchers in various disciplines. A Web of Knowledge search for Eisenhardt's key paper, "Building Theories from Case Study Research," revealed that it had been cited by 1,465 scholarly works in a wide range of disciplines, of which 123 are in the field of library and information science (Bergeron, 1997; Eschenfelder, 2004; Gmur, 2003; Zach, 2006).

Adopting Eisenhardt's framework, the process of developing a contextual model of IL for an ODL GIS partnership program is described

in the following sections. This article focuses on the research design and process and not the results of the study.

### 3.1. Step one: getting started

Defining research question(s) and developing "a priori specification of constructs" are the main activities in this step to "shape the initial design of the theory building" and "measure constructs more accurately" (Eisenhardt, 1989, p. 536). When trying to build theories, it is important to ensure the originality of the topic (Eisenhardt, 2007).

#### 3.1.1. Defining research questions and constructs

As illustrated in Fig. 1, this study is original from three main perspectives:

1. Subject context. There has been no exploratory study on IL in the GIS discipline. Current studies tend to use existing models of IL, such as seven pillars of IL developed by the Society of College, National, and University Libraries (SCONUL) to implement IL in GIS (Jablonski, 2004; Massey, 2002). These models are mainly the product of librarians' and information professionals' interpretation of IL, and are not based on research or the perspectives of people who experience IL in real-life situations. From this point of view, GIS is an unresearched area in the field of IL research. Furthermore, due to some characteristics of this discipline, such as the technology-oriented and evolving nature of GIS and its wide applicability in almost every discipline and context, developing GIS professionals who are able to transfer their skills to their workplace is a dilemma in the GIS education (DiBiase, 1996; Environmental Systems Research Institute [ESRI], 2002; Gold 1989; Johnson, 2006; Librakin, 2006; Unwin, 1997). Indeed, due to the wide applicability of GIS, learners who join GIS programs come from different educational, cultural, and professional backgrounds, which means GIS programs are subject to a wide range of demands by students. This makes it almost impossible for GIS educators to develop curricula that meet such diversity (Johnson, 2006; Unwin, 1997). Such characteristics make GIS an interesting area for IL research, as developing a model of IL for this discipline can provide GIS educators with approaches to overcome these challenges.
2. Educational context. There has been no study on the conception of IL in ODL environments, and more broadly in e-environments. IL has been identified as an enabler for lifelong learning, and a literacy transferable to different learning environments and disciplines (Association of College and Research Libraries [ACRL], 2000; Bundy, 2004; Langford, 1999; Webber & Johnston, 2000). However, with the emergence of the digital age, several approaches have been taken to adapt and practise IL in a way that meets the IL needs of learners in such dynamic environments, and in ODL environments in particular. As a result, several models of IL and a wide range of IL tutorials have been developed mainly by librarians and information professionals, which tend to question, doubt, or deny the capability of IL as a transferable literacy (e.g. Martin, 2003; Williams, 2006). They mainly see IL as a marginal literacy in the bigger framework of e-literacy, or they append other literacies to the IL framework to make it work in e-environments (e.g. Martin, 2003; McClure, 1994; Savolainen, 2002).
3. Methodological approach. As mentioned earlier, exploratory studies of IL that have contributed to the understanding of the IL concept have not used case study research methodology but mainly a phenomenographic approach (e.g. Bruce, 1997; Webber et al., 2005). These studies tend to focus on the people's perception of IL.

This study took an innovative approach to explore IL. Instead of directly looking at people's conceptions of IL, it focused on the

**Table 1**  
Process of building theory from case study research (Eisenhardt, 1989, p. 533).

Step	Activity	Reason
1 Getting started	Definition of research question	Focuses efforts
	Possibly a priori constructs	Provides better grounding of construct measures
	Neither theory nor hypotheses	Retains theoretical flexibility
2 Selecting cases	Specified population	Constrains extraneous variation and sharpens external validity
	Theoretical, not random, sampling	Focuses efforts on theoretically useful cases – i.e. those that replicate or extend theory by filling conceptual categories
3 Crafting instruments and protocols	Multiple data collection methods	Strengthens grounding of theory by triangulation of evidence
	Qualitative and quantitative data combined	Synergistic view of evidence
	Multiple investigators	Fosters divergent perspectives and strengthens grounding
4 Entering the field	Overlap data collection and analysis, including field notes	Speeds analyzes and reveals helpful adjustments to data collection
	Flexible and opportunistic data collection methods	Allows investigators to take advantage of emergent themes and unique case features
5 Analyzing data	Within-case analysis	Gains familiarity with data and preliminary theory generation
	Cross-case pattern search using divergent techniques	Forces investigators to look beyond initial impressions and see evidence through multiple lenses
6 Shaping hypotheses	Iterative tabulation of evidence for each construct	Sharpens construct definition, validity, and measurability
	Replication, not sampling, logic across cases	Confirms, extends, and sharpens theory
	Search evidence for "why" behind relationships	Builds internal validity
7 Enfolding literature	Comparison with conflicting literature	Builds internal validity, raises theoretical level, and sharpens construct definitions
	Comparison with similar literature	Sharpens generalizability, improves construct definition, and raises theoretical level
8 Reaching closure	Theoretical saturation when possible	Ends process when marginal improvement becomes small

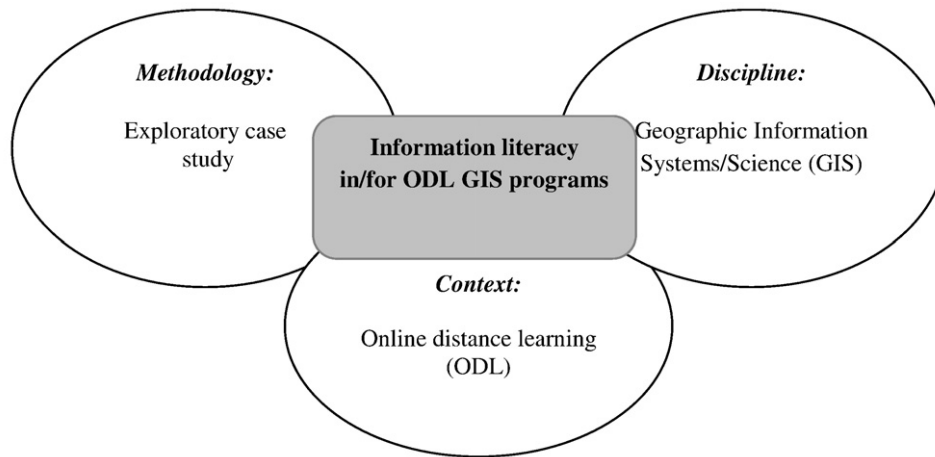


Fig. 1. The research territory and areas of study.

people's conceptions and experiences of the discipline and information when learning or teaching the subject or solving problems and their implications for IL were identified. Indeed, in this study the conceptions and experiences of information and discipline were used as key constructs or paths through which IL was explored and illuminated. Drawing on that, it identified the concept and function of IL in the "bounded system" of the case (Stake, 1998).

As this study explores IL in an educational setting, the exploration of these two constructs can play a key role in gaining deep insights into what IL means in relation to educational activities such as making sense of and use information, learning the subject, accomplishing and assessing learning tasks, and solving problems.

Because this study looked at the GIS discipline, the following terms are used as the key constructs: geo/spatial information (GI) for "information," and GIS for "discipline." As described below, this research focused on educators' and learners' conceptions and experiences of these two constructs in the context of their teaching and learning experiences.

Having identified an ODL GIS program as a theoretically and pragmatically suitable case for the purpose of this study, as is explained in the next section, the research questions of this study were designed around these constructs as follows:

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

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

The study constructs also guided the design of the study. As mentioned, conceptions of GI and GIS were identified as two key constructs for this study. This provided the researcher with two main units of analysis (i.e. learning and teaching experiences of GI and GIS) to explore IL in the context of the case. This guided the researcher to adopt an embedded single case study design as the study focus on two units of analysis in the context of one single case (Yin, 2003). As shown in Fig. 2, this design helped to identify the competencies needed to learn the subject, interact with and use GI and GIS, and accomplish GIS tasks. Altogether these contributed to the illumination of IL in the ODL GIS program.

Likewise, the embedded design of the study facilitates different levels of analysis focusing on more than one unit of analysis, as explained in Step five (Yin, 1994, p. 40).

### 3.2. Step two: selecting cases

In this step, first the population of interest is specified, then the sample of units are determined based on their theoretical usefulness (Eisenhardt, 1989, p. 533).

A GIS ODL master's degree partnership program delivered by the Universities of Leeds and Southampton, in the United Kingdom, and Pennsylvania State University, in the United States, was selected as a theoretically and pragmatically suitable case. As explained below, this selection enabled the researcher to "replicate or extend theory by filling conceptual categories" (Eisenhardt, 1989, p. 533).

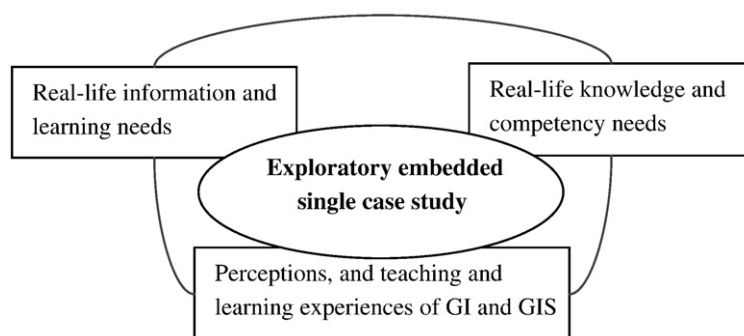


Fig. 2. The research design.

Theoretically, this program contributed to the achievement of the purpose of this study in three ways:

First, this program delivered over 25 different modules with different orientations (Appendix A). In addition, there were some overlaps and similarities in the modules delivered by different study sites (Appendix B). Such diversity, overlap, and similarities in the modules, and accordingly variety in the learning and teaching experiences of GIS and GI provided the researcher with a strong case, which resulted in a wide range of perspectives on the phenomenon under study and replication in the emergent results which enhanced validity of the emergent model of IL (Eisenhardt, 1989, p. 537). For example, diversity in the nature of information, information tasks, and processes of solving GIS problems identified by GIS educators and learners uncovered various dimensions of the concept and function of IL in the ODL GIS programs under study.

Second, the program was an ODL one in which learning takes place online where learners have no or little face-to-face contact with their tutors or peers. Learners used a wide range of generic and subject-relevant information and communication technologies and resources to accomplish their learning tasks in an ODL setting. Such learning experiences enabled the researcher to identify the nature and scope of the information and competency needs of the learners in the ODL environments.

Third, the GIS educators (the key informants of this study) had broad experience of developing and delivering different GIS modules for online distance learners who were from different educational, cultural, and professional backgrounds. The educators had a deep knowledge of the competencies learners need to interact with and use information and GIS and accomplish GIS tasks in ODL environments.

Pragmatically, this selection assured accessibility to the study sites. This study received an award from the Worldwide Universities Network (WUN) and, hence, was supported by the study sites from the very beginning. This ensured accessibility to the study sites and participants as an important factor in case study research (Pickard, 2007, p. 88).

Selection of key informants was made using three criteria:

1. Modules with different orientations. The ones that were selected were delivered during August 2006–March 2007 when the data were gathered. This included 23 modules: 14 in the UK sites, nine in the US site (Table 2).

**Table 2**  
GIS modules selected for this study in the partnership program.

Modules studied at the UK sites	Modules studied at the US site
Principles of GIS	The nature of geographic information
Using databases and GIS	Problem-solving with GIS
Spatial analysis and GIS	GIS database development
GIS in the workplace	Geospatial system analysis and design
Introduction to Java programming	Cartography and Visualisation
Geo-demographics and database management	GIS programming and customization
Census analysis and GIS	GIS application development
GIS and geo-computation	Environmental applications of GIS
Retail decision support systems	Individual project work supervised by a graduate faculty advisor
GIS and planning	
Applied environmental GIS	
GIS for environmental management	
GIS for analysis of health	
GIS for health care management	
Dissertation	

2. Accessibility to GIS educators and learners. Fortunately, the educators in the 10 UK sites were all available to the researcher. In the US site, only two educators were not available as they were geographically remote from the researcher's location. Otherwise the rest (10) were easily accessible to the researcher as they all were located in the same building where the researcher had an office. Thus, 91% of the educators were included in the study.

Due to the context nature of the study, which was an ODL program, there was no easy access to students as they studied at a distance. However, perspectives from 55 students were solicited using multiple methods of data collection as demonstrated in Table 3.

3. Suitability of sources of evidence for the purpose of this study. Although both GIS learners and educators were identified as key informants suitable for the purpose of this study, because the researcher did not have easy access to the learners she used GIS educators and program directors as the key informants in this study. However, other sources of evidence such as module outlines and curriculum documents, and several methods of data collection such as questionnaires, observation, and students' reflection were alternatively used to gather needed data for this study.

Overall, considerations taken into account in this phase of the research process provided the researcher with a rich case to conduct an in-depth exploration of IL in the context of various GIS modules and tasks and to develop a robust model of IL in/for the ODL GIS program (Pickard, 2007; Yin, 2003).

### 3.3. Step three: crafting instruments and protocols

In this step, Eisenhardt (1989) calls for multiple methods of data collection to triangulate evidence and accordingly to strengthen grounding of the emerging model/theory (Denscombe, 2003; Yin, 1981).

Using multiple methods of data collection to triangulate evidence and, accordingly, to strengthen grounding of the emerging theory are the main tasks in this step (Eisenhardt, 1989). This contributes to converging lines of inquiry as the emergent results of the study are triangulated multidimensionally. As shown in Fig. 3, the emergent model of IL in this study was triangulated using multiple methods of data collection and sources of evidence (i.e., interviews, questionnaires, students' reflection, document study, and observation). Using the perspectives of program directors, learners, and educators also facilitated the theory triangulation (Patton, 1990, cited in Yin, 1994, p. 92).

The research questions and constructs were used to design these data gathering instruments. However, depending on the type of instrument, questions were manipulated. For example, for the interviews, questions were designed to be open and semi-structured in the sense that the interviewees' answers to each of the core

**Table 3**  
Distribution of the study's informants.

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

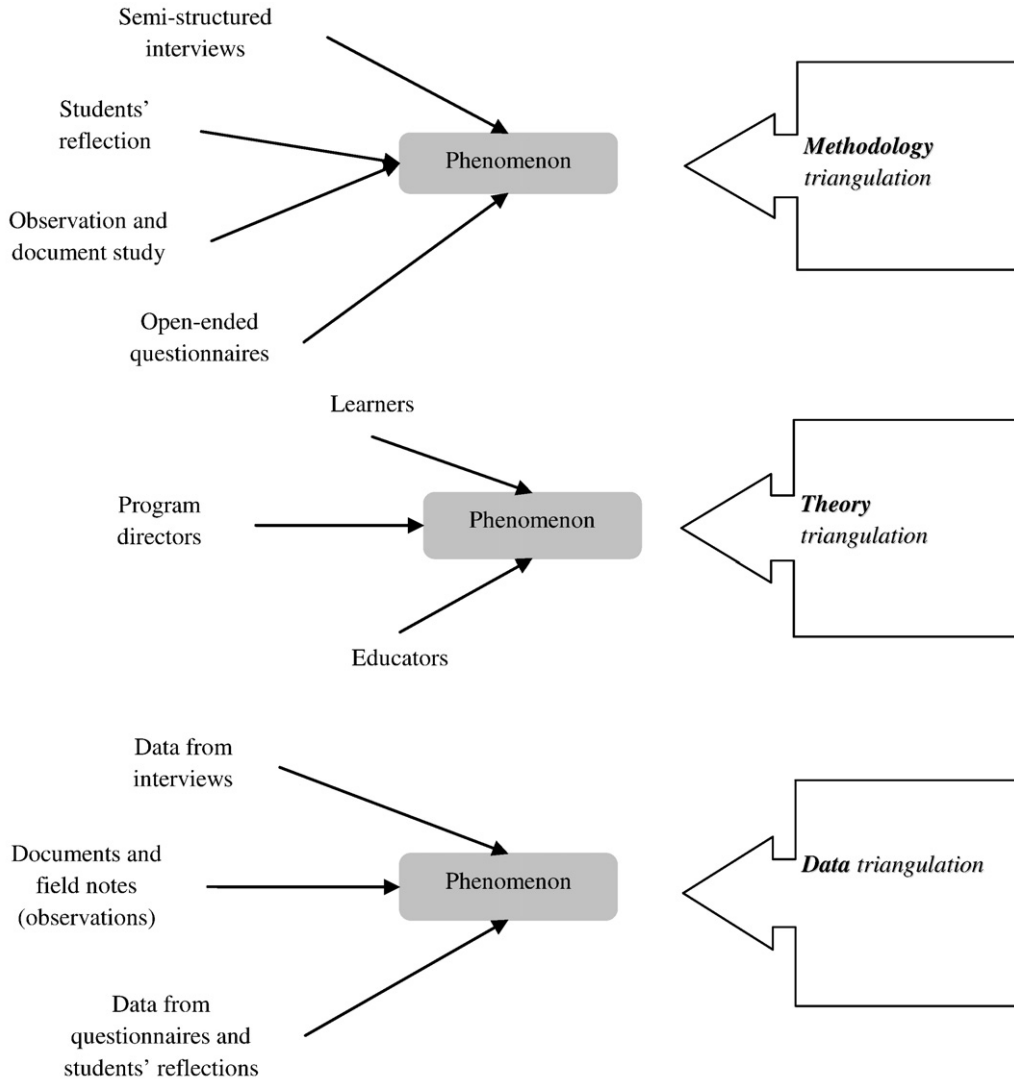


Fig. 3. Multiple triangulations achieved through the rich context of this study.

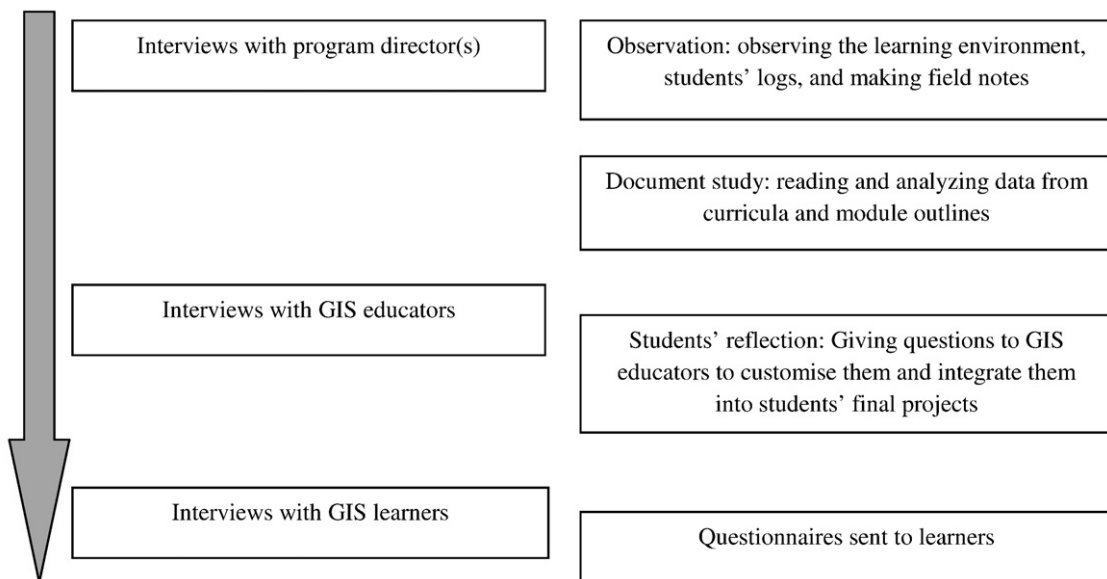


Fig. 4. Overlaps in the phases of data collection.

questions affected the subsequent questions. For students' reflection, educators had a chance to customize the questions and embed them in students' projects in such a way that learners would give their answers to the questions when doing and reflecting on their projects.

3.4. Step four: entering the field

Doing simultaneous data collection and analysis and being “flexible and opportunistic” to data collection methods are two main elements that the researcher took into consideration in this phase of research (Eisenhardt, 1989, p. 533).

After following research ethics procedures both in the UK and US sites, the data collection was undertaken in three main stages and completed with four supplementary phases in each study site. As shown in Fig. 4, there are overlaps in the phases of data collection; this helped the researcher develop her understanding of the phenomenon under study and refine her approach and, on some occasions, the questions when needed in later phases. This contributed to the establishment of a robust foundation for the resultant model of IL which emerged from this study.

The researcher was open to new opportunities that would enable her to deepen her understanding of the phenomenon under study. Simultaneous data collection and analysis enabled her to “make adjustments during the data collection process” (Eisenhardt, 1989, p. 539). For example, data from the first interviews and documents showed there are some challenges to helping learners transfer their skills to more advanced modules as well as to their real workplace experiences. However, in the curriculum design and educators' words there was a lot of emphasis on transferable learning. This guided the researcher to add a new question to the initial list of questions, which enriched the emergent results: What are the challenges and approaches to transferable learning in the ODL GIS programs?

It also appeared that it was not possible to get hold of students' experiences through interviews as they were studying at a distance in different countries around the world. Thus, questionnaires and students' reflection were identified as appropriate alternatives to bring students' perspectives to the study.

Indeed, employing multiple methods of data collection and sources of evidence gave some flexibility and opportunity to the researcher to gain insights into the phenomenon under study from different angles. For example, using semistructured interviews meant questions could be changed or revised at any point of the study to gain a better understanding of the phenomenon under study. An open-ended questionnaire and questions embedded in the students' projects were two data collection tools used as alternative tools to

bring learners' perspectives to the study. The questionnaire was developed based on the results from interviews with the educators and a few learners. Questions for learners' reflection also were designed in close collaboration with educators. This assured consistency between the questions and the study aim and objectives.

Indeed, using each piece of evidence as a source of learning helped the researcher to gain a deeper understanding of the phenomenon under study and various contextual aspects around it (Eisenhardt, 1989). Table 4 demonstrates how different methods of data collection and sources of evidence contributed to understanding the educational, disciplinary and physical contexts of the case.

Finally, to design a valid report of the study, a database containing various sources of evidence was developed as recommended by Yin (2003). This contained documents with information about the program and modules, interview transcripts, data from questionnaires, and students' reflections. This provided an easy-access point to various sources of evidence when writing the study report and resulted in a well-supported model of IL.

3.5. Step five: analyzing data

Eisenhardt (1989, p. 539) identifies data analysis as “the heart of building theory from case studies,” but also “the most difficult and the least codified part of the process.” She identifies two key steps in analyzing case studies data: (a) within-case analysis and (b) searching for across-cases patterns. As this study has adopted an embedded single case study, it contains several units of analysis (learning and teaching experiences of GI and GIS) within the context of one case (an ODL GIS program). Thus, instead of the terms “within-case” and “across-cases,” “within-unit” and “across-units” are used.

According to Eisenhardt (1989), within-unit analysis is a write-up for each unit that generate insights into the phenomenon under study in each unit. In the across-units analysis, then the within-case write-ups are used to find patterns through viewing the data from diverse lenses (Eisenhardt, 1989).

Due to the qualitative nature of the data, the grounded theory data analysis approach (Glaser & Strauss, 1967) was used to codify, interpret, and categorize the data obtained from different sources of evidence. This approach was applied also for the within-units and across-units analysis in four main phases as follows:

3.5.1. Stage one: within-unit analysis

GI and GIS were extracted from each unit of analysis (or teaching and learning experience) codes that represented learners' and educators' perceptions, and they were transferred into a separate document.

3.5.2. Stage two: across-units analysis

The researcher looked for similarities in the perceptions of GI and GIS across the units to identify patterns. Having categorized similar codes in the same category, four conceptions of GI and four conceptions of GIS were identified, which formed two theoretical frameworks of the GI and GIS conceptions.

3.5.3. Stage three: within-unit analysis

As shown in Fig. 5, the frameworks of the GI and GIS conceptions were used as a theoretical lens to illuminate ways in which GI and GIS have been viewed, used, described, or experienced in each unit of analysis (each teaching and learning experience). Likewise, each learning and teaching experience was explored to identify (a) competencies needed to interact with and use GI and GIS and accomplish GIS tasks, and (b) challenges that learners faced or educators identified in relation to task accomplishment in the context of each unit, as well as approaches they took or recommended to overcome the challenges.

**Table 4**  
Contribution of multiple methods/evidence to understanding the contextual aspects of the case.

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 the case
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	Physical and educational context of the case
Observation	Learning environment, its content and design	Physical context of the case



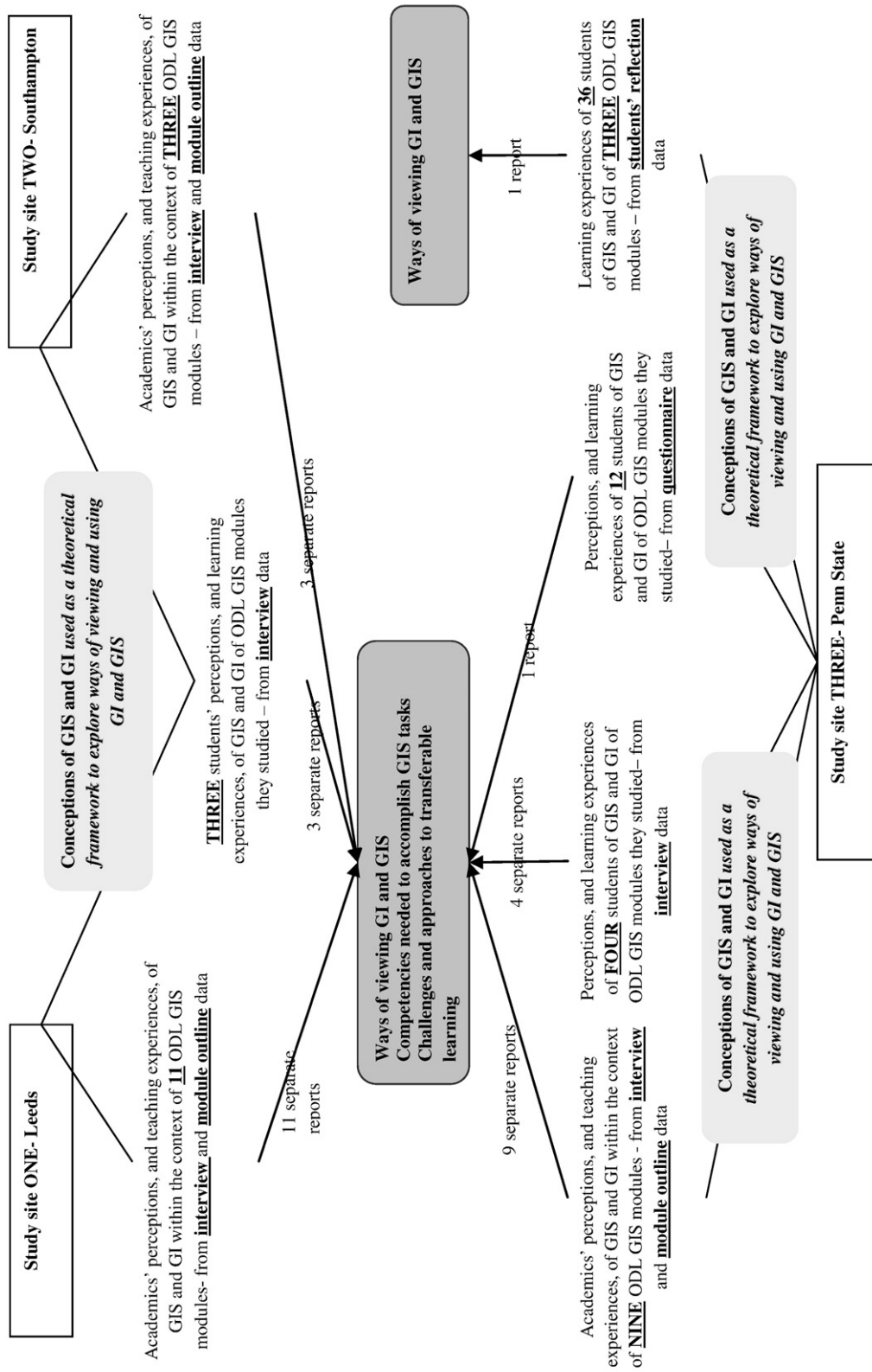


Fig. 5. Procedure of within-unit analysis – Phase three.

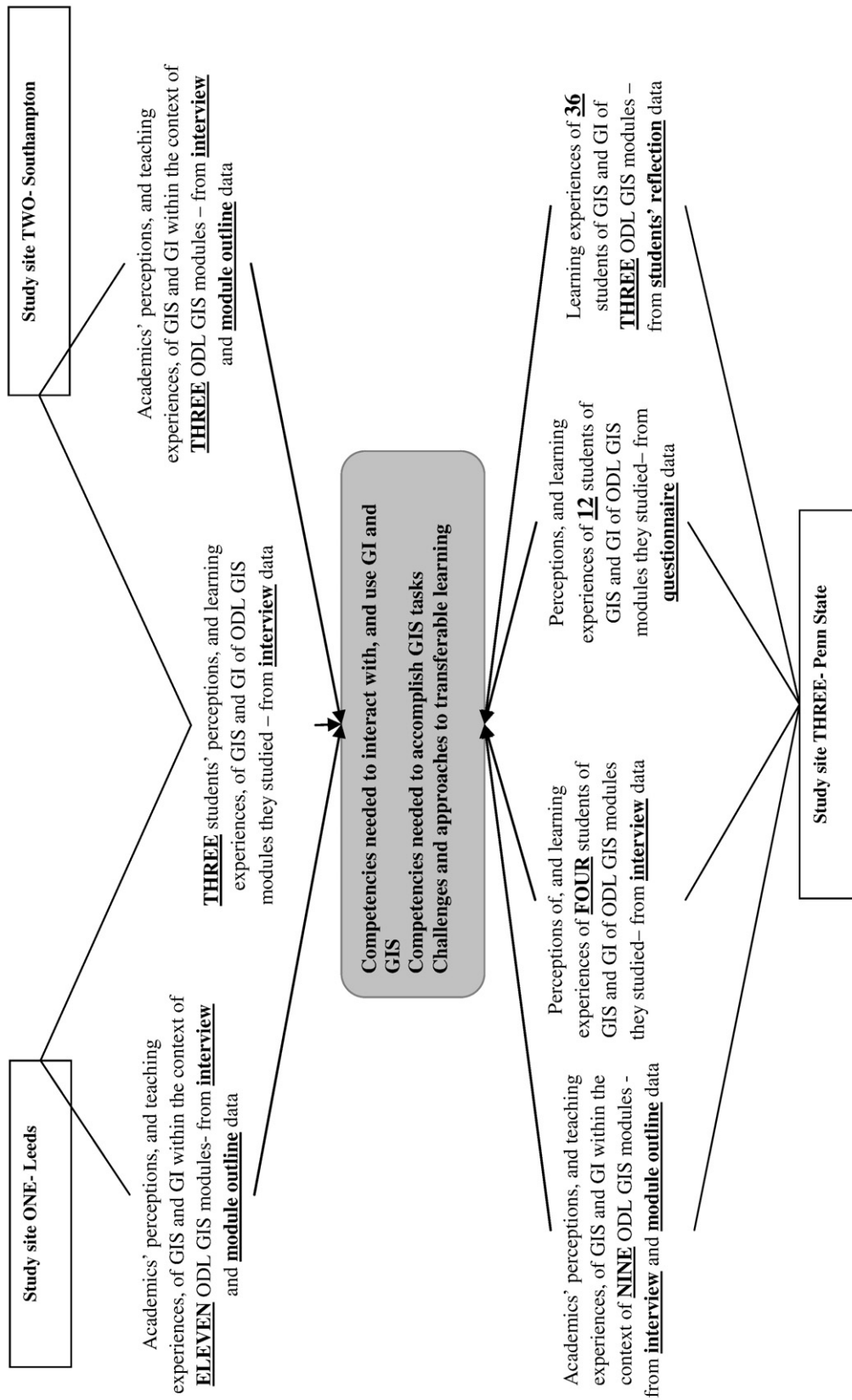


Fig. 6. Procedure of across-units analysis—Phase four.

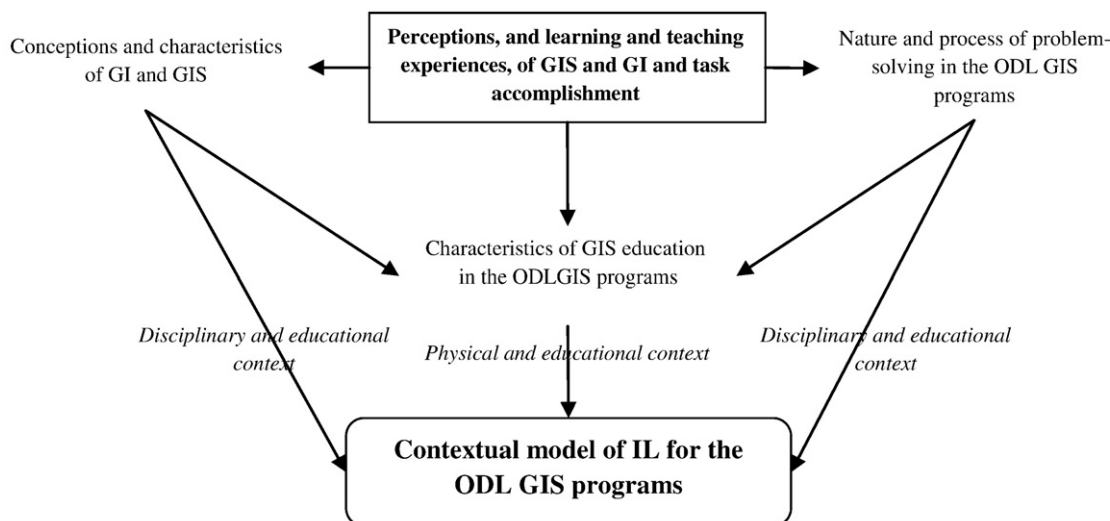


Fig. 7. Foundation of the contextual model of IL.

Overall, these three main areas formed the format of reports written for each unit of analysis.

3.5.4. Stage four: across-units analysis

Finally, as shown in Fig. 6, the overall write-ups for each unit of analysis in each study site were studied for patterns to identify (a) the competencies GIS learners need to interact with and use GI and GIS and to accomplish GIS tasks in the ODL GIS program, and (b) a pattern for challenges and approaches to transferable learning in the program under study.

3.6. Step six: shaping hypotheses

Eisenhardt identifies two steps to shape the hypotheses: (a) “sharpening the constructs,” and (b) “verifying that the emergent relationships between constructs fit with the evidence in each case.” To sharpen the constructs, she recommends “a two-part process involving (1) refining the definition of the construct and (2) building evidence which measures the construct in each case [unit].” This requires the researcher to undertake “constant comparison between data and constructs so that accumulating evidence from diverse sources converges on a single, well defined construct” (Eisenhardt, 1989, p. 541). This helps to establish construct validity.

Owing to its innovative analysis approach in which the two phases within-unit and across-units were iterated, the process of shaping the hypothesis were started in the early stages of data analysis in two main phases: (a) phase two of analysis, when the conceptions of GI and GIS were built upon the perceptions that emerged from each within-unit analysis and as the researcher could confirm the consistency between the conceptions and the codes (perceptions of GI and GIS) identified in each unit of analysis; and (b) phase four of analysis, where the emergent patterns in each unit were studied to identify the overall patterns in the units of analysis. Three main themes (i.e. competencies needed to interact with and use GI and GIS, competencies needed to accomplish GIS tasks, and challenges and approaches to transferable learning) identified in each unit of analysis in phase three of analysis were used to form the final report of the case. Indeed, replication of the same pattern in the context of a wide range of teaching and learning experiences of GI and GIS (see Fig. 6) in phases two and four of analysis shaped the hypothesis and sharpened the constructs in this study.

To shape the components of the emergent IL model in the study, the analysis of the overall findings obtained from the data analysis

step were deepened one more level. The overall findings were questioned in terms of the research aims and objectives. This resulted in four core themes, which shaped the foundation of the ultimate contextual model of IL (Fig. 7). These were:

- The nature and characteristics of GIS education in the ODL GIS program
- Conceptions and characteristics of geo/spatial information (GI) and GIS
- The nature and process of problem solving geo/spatially
- IL in and for the ODL GIS program

Indeed, the contextual model of IL was built upon the frameworks of the conceptions and characteristics of GI and GIS as well as the nature and process of problem solving in the ODL GIS programs as emerged in the context of this case study.

This portrait of IL also represents the physical, educational, and disciplinary contexts of the case and their implications for IL in the specific context of the case.

It appeared that IL is a contextually constructed phenomenon which needs to be contextually researched in order to be adopted in different disciplines/contexts. New perspectives on IL emerged from the disciplinary (educators' and students' conceptions of GI, GIS, and experiences of problem solving), physical, and educational contexts of the case. According to these new perspectives, the need for IL in ODL GIS programs lies in the challenging nature of GI/S education and the variation in the ways of viewing and using GI/S by different people and in different situations. This requires approaches facilitating independent, connective, transferable, and lifelong learning.

Using the systematic and highly iterative process of within- and across-units analysis, the main themes and answers to the research questions emerged. This facilitated the development of the robust model of IL which closely fitted the data (Eisenhardt, 1989).

3.7. Step seven: enfolding literature

According to Eisenhardt (1989, p. 544), “an essential feature of theory building is comparison of the emergent concepts, theory, or hypotheses with the extant literature,” which “involves asking what is this similar to, what does it contradict, and why.” For this matter, the researcher needs to use literature that may support or conflict with the emergent theory. Comparison with conflicting literature “builds internal validity, raises theoretical level, and sharpens construct definitions.” Comparison with similar literature, on the other hand,

“sharpen generalizability, improves construct definition, and raises theoretical level” (p. 533).

As shown in Table 4, each core theme of study was compared with three areas of literature, i.e. IL, GIS, and ODL, depending on their relevancy to these areas.

As mentioned earlier, this article does not aim to present or discuss the results of this study but to demonstrate how the design and specific considerations taken into account throughout the research process supported the development of a robust contextual model of IL. Thus, here a brief overview of the comparisons of the results of study with the literature is presented below.

From an ODL perspective, apart from some disciplinary differences it appeared that there are similarities in the emergent rationale for IL in ODL environments (e.g., a need for information technology (IT) literacy and being IT confident to cope with problems with least or no face-to-face assistant), which means this rationale to some extent can be used to define IL in ODL contexts.

From a disciplinary point of view, although there were some similarities in the conceptions of GI and GIS with the ones in the literature, due to the novelty and approach by which the conceptions emerged, they brought new insight to the conceptions of GIS research and education. The conceptions of GI and GIS, for example can be used to design and evaluate GIS curricula as they emerge from some real experiences of these phenomena in an on-going GIS program and in the context of a wide range of GIS modules and tasks.

From an IL perspective, the results of this study have a big influence on the depth and breadth of the current models of IL such as SCOUNL, as the conceptions of information (GI) and discipline (GIS) uncovered new faces of IL. For example, GI is temporal, which means it has a time component representing the earth's features. This means GI needs to be updated or maintained to become meaningful and useable for different purposes. This adds a new pillar—maintaining information—to the seven pillars of IL (SCOUNL, 1999).

### 3.8. Step eight: Reaching closure

Eisenhardt highlights two issues as important in the final stage of theory building from case studies: “when to stop adding cases, and when to stop iterating between theory and data” (1989, p. 545). She recommends two occasions as ideal time to stop adding cases: (a) when theoretical saturation takes place: This is when “incremental learning is minimal because the researchers are observing phenomena seen before” (Eisenhardt, 1989, p. 545, quoting Glaser & Strauss, 1967); (b) when this is combined with pragmatic considerations such as time and money to gather more data.

As mentioned in step six, in this study, constant comparisons between data and theory, both when doing within- and across-units analysis, kept the researcher informed of the theoretical saturation. Altogether, such iteration enabled the researcher to decide to stop adding to the units and also stop iterating between the data.

It is worth noting that the overlap in the nature of some of the GIS modules and tasks in this research provided the researcher with replication in the emergent results in similar modules in the very early stage of the study. For example, in the software/technology-oriented modules similar conceptions of GI and GIS were illuminated. This had a great contribution to the identification of theoretical saturation in this study.

## 4. Conclusion

Overall the design and process adopted in this study contributed to the novelty and validity of the emergent model of IL in eight ways, which can provide information and IL researchers and practitioners with a robust methodology and methodological tools to conduct case studies. These are:

1. Novelty of the areas of research justified the exploratory and theory-building nature of this study (Eisenhardt, 1989). The study constructs guided the focus of study and facilitated the design of research questions that fulfilled the aim of this study.
2. Theoretical sampling used for the selection of the case and units of analysis provided the study with a rich context through which the conceptual gaps in IL were filled. In particular, this uncovered various aspects of the physical, disciplinary and educational contexts of IL in the bounded system of the case, that is, ODL GIS programs.
3. Such in-depth contextual understanding was fulfilled through using multiple methods of data collection and sources of evidence. This supported the development of an IL model, which is triangulated in three ways: theory, data, and methodology.
4. Overlaps in different phases of data collection provided the research with a flexible and opportunistic approach, allowing the researcher to revise questions and add to the methods of data collection to obtain the most relevant data from different sources of evidence.
5. Simultaneous data collection and analysis, and the iterative and innovative process of data analysis developed/used in this study deepened the researcher's insights into the phenomenon under study and resulted in robust results.
6. Comparing each emergent theme of the study with three main areas of literature assured validity and generalizability of the results.
7. Constant comparisons of data with the emergent themes from the very early stage of data analysis shaped the sharpened hypothesis and saturated propositions that formed the foundation of the emergent model of IL in this study.
8. This study adopted an embedded single case study design which facilitated viewing the phenomenon under study from different perspectives using different units of analysis. This also facilitated multiple layers of analysis.

This article provides IL researchers with a new view of case study research and a methodological approach through which they will be able to go beyond the descriptive and theory-testing studies of IL. In particular, the IL constructs, methods of data collection, and analysis delivered in this article provide IL researchers and practitioners with a strong methodological approach to holistically explore IL and conduct IL research in various contexts and settings. Such contextual studies will then contribute to the illumination of the concept and function of IL in a wide range of contexts (e.g. public, community, school, disciplinary), which can result in more successful IL practices because the practices will be contextually-structured in/for particular contexts. More broadly, the case study research guidance presented in this article can be of value for contextual studies in IL and LIS research.

It is recommended to use this methodological design to conduct contextual studies of IL in contexts such as other disciplinary areas and educational settings. This will contribute to the development of contextualized conceptions and models of IL, which then can guide research-led practices of IL in the corresponding contexts.

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**Appendix A. Distribution of the GIS modules categorised based on their orientation**

Orientation of the modules	Title of modules	Leeds	Southampton	Penn State
Principle-oriented	The nature of geographic information			✓
	Problem-solving with GIS			✓
Software/tool-oriented	Principles of GIS	✓		
	GIS programming and customization			✓
	Cartography and visualization			✓
	GIS and geocomputation	✓		
Application-relevant	Introduction to Java programming	✓		
	GIS application development	✓		
	GIS for environmental management		✓	
	GIS for analysis of health management		✓	
	GIS for health care management		✓	
	Retail decision support systems	✓		
	Census analysis and GIS	✓		
	GIS and planning	✓		
Geo/spatial system-relevant	Environmental applications of GIS			✓
	GIS database development			✓
	Geospatial system analysis and design			✓
Geospatial data-oriented	Using databases and GIS	✓		
	Spatial analysis and GIS	✓		
	Acquiring and integrating geospatial data	✓		
Research/independent study-oriented	Census analysis and GIS	✓		
	Individual studies–capstone project			✓
	Individual studies–peer review			✓
	Internship supervision and mentoring			✓
	Individual project work supervised by a graduate faculty adviser			✓
	GIS in the workplace	✓		
	Dissertation	✓		

**Appendix B. Distribution of the selected GIS modules with overlaps**

The UK modules	The Penn State modules
(a) Leeds Principles of GIS	> The nature of geographic information > Problem-solving with GIS > GIS database development
Using databases and GIS <i>has overlaps with</i>	> Problem-solving with GIS > GIS database development
Spatial analysis	> Cartography and visualization > Geospatial system analysis and design > Geographical information analysis
GIS in the workplace Dissertation	> GIS application development > Individual project work supervised by a graduate faculty adviser
(b) Southampton GIS for environmental management	> Environmental applications of GIS

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