

Perception of information technology students on the use of self-directed learning and industry collaboration to foster lifelong learning

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Abstract

The aim of this paper is to report on the perceptions of past students on the preparation they received during their formal university training for life as industry professionals. Life-long learners need specific skills which are compared in this paper to the skills achieved by self-directed learning (SDL) teaching. The paper explores the educational background of SDL and the application thereof in Information Technology (IT) education. A module in data warehousing has been designed according to the principles of SDL, in conjunction with an industry partner. The collaboration with industry provides a sense of reality to students. The paper details the running of this module. The formal presentation of the module focus on data warehousing theory, and students are expected to apply their knowledge in a practical project for which the data and requirements are supplied by the industry partner. An interpretive investigation was done under past students to better understand how they experienced the role of their university training in developing their lifelong learning skills. Interpretive data from questionnaires with 10 students were gathered and analyzed using content analysis. Students highlighted problem solving, basic technical skills and self-study as important aspects of university training assisting them to be successful IT professionals.

Keywords: Lifelong learning, self-directed learning, information technology practice, interpretative research

Introduction

The aim of this paper is to report on a teaching strategy based on self-directed learning (SDL) and industry collaboration to develop the required lifelong learning skills of Information Technology (IT) students.

The paper provides background information on the need for IT professionals to be life-long learners in the ever changing world of IT. Life-long learners need specific skills which are compared in this paper to the skills achieved by SDL teaching. The paper explores the educational background of SDL and the application thereof in IT education.

A module in data warehousing has been designed according to the principles of SDL, in conjunction with an industry partner. The collaboration with industry provides a sense of reality to students. The paper details the running of this module. The formal presentation of

the module focus on data warehousing theory, and students are expected to apply their knowledge in a practical project for which the data and requirements are supplied by the industry partner.

Interpretive data from interviews with students who have been working for a number of years in industry are presented to gain an understanding of the need for lifelong learning experienced by the practitioners and the role of the university.

The paper begins with a literature study on lifelong learning and self-directed learning. The research methodology is discussed, followed by results and conclusions.

LifeLONG LEARNING and SELF-DIRECTED LEARNING

This section provides brief background on the concepts of lifelong learning (LLL) and self-directed learning (DSL) before it compares the two concepts.

Defining Lifelong Learning

Lifelong learning is a philosophy more than a method of learning such as self-directed learning (Dadswell, 1978). He writes: "Lifelong learning is a philosophy which acts as a screen and an organizing principle for all learning". Faure *et al.* (1972) stated that "lifelong education is not an educational system but the principle on which the overall organization of a system is founded, and which should accordingly underlie the development of each of its component parts." Mocker and Spear (1982) identify control over the learning process taken by the learner as key to the concept of lifelong learner. They identify types of learners according to their willingness to take responsibility for their own learning in terms of typical statements made by learners:

- Group 1: "My advisor said I had to take this course to graduate."
- Group 2: "I need to learn about these new drugs, so I think I will attend that workshop."
- Group 3: "The certification board said I need to become competent in that area. Judy can teach me how to do that."
- Group 4: "I've always wanted to learn how to keep good financial records. I bet I can learn that from my son's accounting books."

The role of extrinsic and intrinsic motivational factors is clear in these quotes. On higher education level most students are extrinsically motivated to learn as far of the selection of material is concerned, with little control of their own.

Evers and Rush (1998) identify four skills required for successful lifelong learning: good self-management, good communication skills, good management of people and tasks and finally a good understanding of innovation and change.

In this paper lifelong learning refers to the broad concept of learning in formal and informal situations where people make the decision to learn new skills.

Defining Self-Directed Learning

Self-directed learning (SDL) is a concept introduced by Malcolm Knowles in 1975. Key to this concept is moving the responsibility of learning away from the teacher to the learners. The experiences of the learners provide rich information that should be combined with the formal material to add to the richness of learning of the group. Learning moves away from traditional subject-oriented learning to task-oriented learning. Learning is focused on tasks to complete rather than a large amount of factual knowledge.

The learner should take control of the learning experience and the teacher should only facilitate this process. In teacher oriented learning the learner is externally motivated in terms of rewards and punishment, whereas in SDL the learner is internally motivated, by aspects such as accomplishment or curiosity to learn Knowles (1975).

Various authors provide models describing the components or aspects of SDL. Long (1990) discusses SDL in terms of sociological (independent task management) and pedagogical (educational) aspects. Garrison (1992) extends the work of Long (1990) by describing SDL in terms of interaction between self-management (contextual control), self-monitoring (cognitive responsibility), and motivational (entering and task) dimensions. Intrinsic motivation to acquire new knowledge is central to the success of SDL. The personal responsibility of the learner as described by Brockett and Hiemstra (1991) is central to the success of SDL in terms of lifelong learning as intended by Knowles (1975).

However, self-directedness in a learner develops in stages. Grow (1991) describes different phases of self-directed learning skills of learners as dependent, interested, involved and self-directed. Learners need to be guided to become more self-directed over time. Individual students have different levels of SDL skills and one should provide guidance to different students according to their SDL skills.

Relationship between lifelong learning and self-directed learning

Many authors view self-directed learning as the practice of being a lifelong learner with very little difference between the concepts. Grow (1991) for example states the goal of the educational process is to produce self-directed, lifelong learners. As so many models were developed to apply the ideas of self-directed learning, the concept of self-directed learning exceeds that of a method (technique) of learning. The view taken in this paper is that self-directed learning focuses on the process adopted in obtaining a specific piece of knowledge or skill where as lifelong learning has to do with the individual's willingness to learn throughout his life.

LEARNING REquirements of Information Technology proffesionals

We live in an era driven by technology change. The changes in technology are driving the way we conduct business (Malhotra, 1993). Large businesses have detailed plans to accommodate technological change (Clemens, 1991). It is changing the way we communicate. Facebook states the number of active users currently to exceed 800 million.

One of the main drivers of change in technology is the hardware capability of computers. Peha and Strauss (1997) investigate the developments in technology over the last century. With new capabilities of hardware come new developments in software. Much research is done to extend the lifespan of software products (Swanson & Dans, 2000). The reality is that operating systems change frequently and new developments requires continuous learning of new tools and skills by software developers.

Design of a module to prepare students for the changing INFORmation technology environment

The University has a role to play in equipping students in information technology to cope with the continuous change in their working environment (Evers & Rush, 1995). It is this ever changing nature of the technology that motivated the authors of this paper to develop a module in the fourth year program in such a way as to prepare students for change. The module in Data Warehousing was chosen for this purpose as data warehousing is done according to vastly different design principles than operational systems and therefore provide the challenge of studying new material to most students. This section provided a short introduction to the field of data warehousing before the design of the module is discussed in more detail.

What is Data Warehousing?

A data warehouse is an information system used in large organisations to make strategic business decisions. It is independent from the everyday online transaction processing (OLTP) systems. Data warehousing is a relatively new development in database systems. Its development was encouraged by the fact that it has become increasingly difficult to extract meaningful management information from operational systems. There are two reasons for this, namely, that enterprises have more than one operational database that serves different divisions of the enterprise, and secondly, over-normalisation impairs the speed with which queries are processed for management information. The solution to these problems is to separate the management information system from the operational system. A data warehouse is such a management information system that functions separately from the operational system. Dimensional design, in contrast to entity relationship modelling, is used to represent data.

Data warehouses are examples of decision support systems (DSS). A DSS can be defined as a “computer-based information system whose primary purpose is to provide knowledge

workers with information on which to base informed decisions” (Mallach, 2000). DSS can be divided into data-oriented DSS, model-oriented DSS and process-oriented DSS. A data-oriented DSS uses data base systems as source of the decision support, in contrast to a model-oriented DSS which uses mathematical models to support business decisions and a process-oriented DSS which simulates human decision making processes (Mallach, 2000). Data warehouses are the primary example of data-oriented DSS today.

Data warehouses are also known as online analytical processing (OLAP) systems because they serve managers and knowledge workers in the field of data analysis and decision making.

Online transaction processing (OLTP) systems, or operational systems, are those information systems that support the daily processing that an organization does. OLTP systems’ main purpose is to capture information about the economic activities of an organization. One might argue that the purpose of OLTP systems is to get data into computers, whereas the purpose of data warehouses is to get data or information out of computers.

A literature study by Sen and Sinha (2005) indicated two main authors in the field of data warehousing, namely, William Inmon, who is known as the father of data warehousing, and Ralph Kimball. Their approaches to certain aspects of data warehousing differ greatly. Industry practitioners are aware of these authors and their differences. Practitioners choose to follow either an Inmon approach, or a Kimball approach. Other data warehousing literature can easily be labeled as more towards Inmon’s, or more towards Kimball’s ideas. Some of these differences will be highlighted in this section.

Inmon (1996) defines a data warehouse as a subject oriented, integrated, non-volatile, and time variant collection of data in support of management decisions. McFadden *et al.* (1999) explains each of the parts of this definition:

“Subject oriented: A data warehouse is organised around the key subjects (or high level entities) of the enterprise. Major subjects may include customers, patients, students and products.

Integrated: The data housed in the data warehouse is defined using consistent naming conventions, formats, encoding structures, and related characteristics.

Time-variant: Data in the data warehouse contains a time dimension so that it may be used as a historical record of the business.

Non-volatile: Data in the data warehouse is loaded and refreshed from operational systems, but cannot be updated by end-users.”

Kimball *et al.* (1998) simply defines a data warehouse as “the queryable source of data in the enterprise.”

Inmon advocates a lifecycle that he calls the CLDS (reverse of SDLC: Systems Development Life-Cycle) with the following phases: 1. Implement data warehouse; 2. Integrate data; 3. Test for bias; 4. Program against data; 5. Design DSS system; 6. Analyze results; 7.

Understand requirements (Inmon, 1996). This is a data-driven lifecycle methodology. Kimball *et al.* (1998) advocates the use of a requirements-driven lifecycle methodology. Their methodology begins with a data warehouse readiness test, where after user requirements are gathered, followed by modeling, data staging, end-user application design, and maintenance. The aim of this section is to give the reader background knowledge on data warehousing without focusing on different strategies.

The aim of the data warehouse is to give end-users (mostly managers) easy access to data in the organization. In order to do this it is necessary to capture everyday operational data from the operational systems of the organization. Operational systems are transactional systems, for example point of sale systems that are designed around relational databases, which form the source systems of the data warehouse. The data from the source systems go through a process called data staging to the presentation servers (Kimball *et al.*, 1998). Data staging involves four very important actions. Firstly, the data is extracted from the source systems. The data required for the data warehouse is usually distributed in various different source systems with different file formats running on different hardware and operating system platforms. Secondly, the data is transformed to the data warehouse format. Errors in the data and inconsistencies are removed during this phase. Thirdly, the data is loaded into data marts in the presentation server. The final task of the data staging area is to schedule this process.

Data access methods differ greatly between operational system and data warehouses. In operational systems fixed access methods are pre-built as standardized reports. These users use the data in a predetermined way. In data warehouses very few standardized reports are written. These users use browsers and ad hoc queries to access the data. Data in the data warehouse cannot be altered by the end-users, because of the historical nature of the data. It is possible however to add some of the report outputs of the end-users into data marts to enhance the data warehouse's functionality.

Course of the module in Data Warehousing

The module of Data Warehousing is presented to 4th year Information Technology students who have completed a three year degree programme in information technology. The main outcomes of this module are that students should be able to understand and apply the concepts of data warehousing.

In the module traditional teaching and learning is combined with self directed learning (SDL). In order to achieve the outcome of demonstrating an understanding of data warehousing, a traditional teaching and learning approach is followed sensitive to the NQF level 7 (SAQA, 2010) of this module. Students study a chapter from the prescribed text book and do the recommended reading work before each lecture. In order to demonstrate their preparation they need to complete a set of questions provided in this study guide before the class period. The class period will take on the form of a discussion on problematic areas

of the material. Unannounced class tests will be used to identify shortcomings in the understanding of the learning content.

The students will take full responsibility, based on SDL, for the practical implementation of the data warehouse from industry data. Students should determine what tools are required and how to obtain and use the tools to satisfy the project requirements. Students will also be involved in the setting of evaluation criteria of the practical project. Each study unit is divided into 2 sections to accommodate the theoretical and practical aspects of the content. The aim of the practical section is only to give guidance in terms of scheduling of activities.

Since data warehousing is a complete new field to these students a help-yourself type of practical textbook is prescribed and the following high level phases of the project are identified to guide the students:

1. The data is received in SQL server format.
2. Perform Extract, Transform, Load (ETL) on the data and load it into an Oracle Database
3. Develop a data warehouse browser in C# or similar connecting to Oracle
4. Develop a OLAP Cube in SQL Server connecting to Oracle
5. Use MDX to develop queries on the cube
6. Use Share point to generate reports
7. Create an Excel pivot table to access the cube from Excel.

The learning management system of the University is used to provide guidance to the students on a day to day basis. This is done to prevent delays between the scheduled weekly contact sessions. For each contact session, the students are requested to *prepare, attend and reflect* in terms of:

Prepare: In preparation for each contact session, they should study the appropriate chapter from the textbook by answering preset questions. The questions are formulated in such a way as to guide them through the study material.

Attend: The contact sessions are designed to be informal discussions on key aspects of the study material. The lecturer might decide to give a class test on the chapter before discussing it in class. Students should identify parts of the chapter they need clarification on before going to class.

Reflect: After each contact session students should update their answers of the questions to incorporate their new insights. They need to understand how the work will be evaluated. They are encouraged to contact the lecturer to clarify any question they may have.

The main focus of this method of instruction is to provide a deep understanding of the basic concepts of data warehousing by means of the theoretical material and to allow the student to apply these concept by means of the practical component. The practical tools used require knowledge to apply the theoretical concepts and this knowledge is obtained

through SDL methods by the students. They need to take responsibility to find and apply solutions to the problems they encounter.

The knowledge is evaluated by means of formative and summative theoretical question papers that test the insight of the students into the concepts of data warehousing and specifically dimensional modelling and a practical evaluation. During the practical evaluation students are given the time to present their data warehouse to the lecturer and a representative from the industry partner. This provides the students the opportunity to present their work in a formal environment. Their presentation and communication skills are explicitly evaluated. Students are encouraged to discuss the processes followed and corrective explanations are given by mostly the representative from the industry partner. Students experience this as a valuable learning experience in preparation for their final examination and presentation.

Collaboration with Industry

Collaboration can be seen as a joint effort wherein each party provides specific products and services towards a common goal (Beckham, 1997). An industry partner (which is a consulting firm who among other things provides data warehousing consulting services) was selected for the practical work of this module. They provide data to the University to be used in this module. The data is desensitised and realistic. They also provide suitable realistic requirements. Students are required to develop a data warehouse from these requirements and data according to the Kimball lifecycle. Students are able to communicate with a representative from this partner to clarify the requirements. This representative fulfils the role of the end-user.

The industry partner also takes part in the evaluation of the projects. By taking part in the evaluation they are able to evaluate the student in terms of suitability for employment and often approach students for further evaluation aimed at employment.

research methodology: INterpretive study of views of alumni

This study is done in the interpretive research paradigm which focusses on understanding of the perceptions of participants. The aim of the interpretive survey is to better understand the work environment of students who completed a four year degree-programme in IT in terms of learning demands and their ability to handle these demands. They were encouraged to reflect on their formal studies in terms of its preparation for their survival in the ever changing field of IT. A research question can be formulated as: How do students experience the ever changing field of IT and which part of the formal training assisted them in handling changes in their environment?

An interpretative questionnaire consisting of only open-ended questions was used to collect data from alumni. As the aim of this paper is on linking lifelong learning to self-directed learning of these students questions focussed on how they experience change in their work environment and how they reflected back on their formal study from a SDL perspective. The aim of an interpretative study is to understand the phenomenon under investigation from the point of view of the participant (Myers, 1997). In order to better understand the context of the students they were asked to give a brief description of their working career.

The participants of this study are alumni of the North-West University in Potchefstroom who completed the B.Sc. in IT degree and the Honours degree in Information Systems and Computer Science. Most of the students also completed the earlier versions of the module in Data Warehousing described in this paper. This module evolved over time and not all the participants completed the module in the format described above. About 30 students were contacted via social media and e-mail. At the time of developing this report, ten students returned the questionnaire.

Content analysis was used to analyse the answers provided by the participants. General codes were assigned to the answers provided by the participants. These codes were grouped into themes to classify the answers. Although only ten students returned the questionnaire, their answers had similar content. A high degree of saturation was achieved as most of the students presented the same arguments.

REsults

The first question asked enquired about their work context. All students answered this in more detail than expected, this might be due to the fact that they have up to date *curricula vitae*. Experience of the participants is mostly in software development, with five having experience in data warehousing development. Their work experience is between 2 and 8 years.

The second relevant question concerns the expectations of learning new information. All participants but one reported that they are continuously expected to learn new development tools. The participant who reported that he was not required to learn new things was a very successful student at university who reported frustration with his junior developer position and he was expressing hope to learn more in future. The rest of the students indicate both formal and in-formal training. Three participants reported on courses with certification examinations. One participant said: *"It is possible to go on a course, but by the time it is booked the project had progressed very far"*. Another participant said: *"One thing I will never forget is that Google is your best friend!"* Two others also mentioned Google. One participant argued that being on the forefront of technology is his niche area. One participant with 7 years of experience said that if you want to be competitive you need

to learn new technology on your own; he stated that he uses three hours of his day to learn new technology.

When asked which modules from their university programme assisted them to cope in this ever changing world, three themes were identified:

(1) Those modules that had a self-study component:

One participant reported that all modules assisted him in learning new things as all modules had a self-study component. Other participants referred to specific modules with a self-study section. Specific detail was provided of modules that required practical work in tools that were not formally presented in that module (as in the data warehousing module).

(2) Modules with basic technical information:

Most students reported on the advantages of have good basic skills when new technology is to be studied; one reported "If you have good knowledge of one ETL tool you are able to study any ETL in a week". Eight students explicitly referred to programming and database modules and argued that those were the modules that provided basic information.

(3) Modules that promoted problem solving:

Most students referred to a specific module called: IT developments. In this module students are given requirements and are expected to provide solutions with very little technical guidance. Three participants referred to general practical project work. Two participants referred to more mathematical modules such as operational research aimed at teaching problem solving techniques.

When reflecting on this results one is reminded that the aim of andragogy is to guide students to become independent learners from the answers provided be the participants of this study, it is clear that the data warehousing module should always ensure a good understanding of basic principles. If the students have a sound understanding of basic principles they have confidence to study new tools on their own. The data warehousing module should challenge the students. The participants gained confidence from modules where they struggled to solve problems. It is important to guide current students to understand why the need to struggle with some parts of the content receiving little guidance. Current students should be told that learning to solve problems independently is as important in this module as the basic data warehousing knowledge.

Conclusions

Practitioners in the ICT industry are required to study new technology on their own. They do this formally and informally. Due to the fast pace of the work environment, formal courses are sometimes too slow in meeting the knowledge demands. Practitioners are responsible for their own competence and their ability to master new technology gives them the competitive edge in their work environment.

When the results of this small survey are viewed from a module design perspective, one should focus on basic skills applied in a widely used software environment. One should create problem solving challenges where students need to solve problems with limited guidance. Finally one should require them to study software tools independently.

This paper provided the outline for a data warehouse module that satisfies these requirements. The theoretical part of the course is presented in a manner that will provide good basic knowledge while the practical section is developed in such a way to develop the self-study and problem solving skills of the students.

In the fast pace world of IT one has to be a lifelong learner with good self-directed learning skills to develop your own skill set. Module content should focus explicitly on the skills required to develop successful practitioners.

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