Learning Styles of Information System Students: Input for Content Development in Adaptive eLearning Systems

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Abstract: The ways an individual acquires, retains and retrieves information are termed as the individual's learning styles. While students have individual learning styles (active/reflective, sensing/intuitive, visual/verbal, sequential/global), mismatches often occur between the learning styles of students and the teaching style of instructors with unfortunate effects on the quality of the students' learning. One way to bridge this gap is to consider learning styles in the design of content for the presentation of individualized content.This paper presents an aspect of an ongoing eLearning research at the School of Information Sciences in Addis Ababa University. It aimed to address the incorporation of content for eLearning systems based on learning styles. In particular, it reports the findings of a survey conducted to determine learning styles of students using the Index of Learning Style (ILS) Questionnaire. Findings indicated that most of the students have active, intuitive, verbal and sequential learning styles. The paper also provides a high-level outline of how the findings of the survey are to be used in subsequent content development activities to address learning styles of Information System students.

Introduction

The concept of eLearning (computer assisted learning) revolves around the use of computers and other digital devices to accelerate the achievement of educational goals. It is about connecting learners to other learners, teachers to professional support services and providing platforms for learning (Department of Education, South Africa, 2003).

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Research experiences (Littlejohn, 2010; Jefferies, 2009; Choy, 2007; Mlitwa, 2007; Jhurree, 2005; Harris and Kington, 2002) suggested that eLearning enhances educational reform by enabling teachers and learners to improve the teaching and learning process. It is beneficial in terms of enabling learners to become more skilful in choosing their own goals, constructing their own strategies, assessing their own knowledge and monitoring their own progress. Schittek et al (2001) also affirmed that eLearning helps the student to learn at his/her own pace, convenience and knowledge level. It is believed that since such learning technologies offer greater diversity of learning goals than the traditional classroom, students' interest and motivation increase substantially. One can also present standard lecture materials (text books and other references) to students regardless of place or number of students. A report by Harris and Kington (2002) particularly revealed that ICT-enabled teaching and learning is often seen as an important vehicle for the development of English language competencies by teachers and learners especially in countries where English is not a native or a dominant local language.

In terms of benefits to teachers, Jhurree (2005) stated that ICT use, in the teaching and learning process, is a powerful tool to supplement teachers' instruction in classroom. It motivates learners and has the potential to make instruction easier. Teachers can select pedagogical strategies appropriate to both learning styles and individual needs of students. They may also be motivated to teach more creatively, connect with other professionals, colleagues, and mentors, with universities and centers of expertise, and with boundless sources of teaching materials.

In addition to improved teaching and learning, we find that eLearning tools can be made adaptive to support record keeping (Jhurree, 2005). They can be used to develop recording systems about student's level of knowledge and learning styles so that individualized presentation of content becomes possible. They help to provide a complete profile of a student's strengths and weaknesses in a given subject. They can also make it much easier to

examine the relationship between attendance, trials of exercises and under-achievement of a student than it would be with a paper-based system.

With this background, the eLearning pilot project at the School of Information Sciences was initiated in order to support course delivery to undergraduate students. The pilot project funded by the Development Innovative Fund (DIF) of the World Bank, had a team of eight technical experts who were involved in developing three e-courses using the Moodle open source eLearning platform. During the process of development, several experience sharing visits and workshops were conducted both internationally (with UK, USA and South Africa) and nationally (with a number of higher learning institutions in Ethiopia).

Most of the course topics in the eLearning platform contained written text with some topics supported by video and audio. Attempts were also made to evaluate the learning management platform in general and the content in particular by content experts using feedback obtained from students.

Although the project managed to set up state of the art eLearning lab and develop content for three courses, participation from the side of the students was very limited. This was mainly because the students found what they have learnt in class already posted on the eLearning platform. While this helped students who were absent from class, the feed back from students showed that the e-contents were simply repetitions of the lecture. Because of this the students would not want to waste their time on what they have already done.

The eLearning sites of those institutions which where visited during experience sharing visits also confirmed the arguments posed by students. During the visits, it was observed that lecture contents should not be the major items to be posted. Instead, the site was agreed to serve as the main platform for active discussion among students and instructors. Reference materials for students were posted and assignments and other exercises were exchanged through the eLearning system.

This triggered the team at the School of Information Sciences to revise the work carried out in the development of e-courses. Attempts were, thus, made to review contents based on lessons learnt and feedback obtained from students. As part of the review of content, a survey of available literature and discussion with experts suggested that student requirements during the learning process, specifically their learning styles, need to be closely looked at to improve the content and thereby improve the quality of student learning.

The work presented in this paper is, therefore the first step in an ongoing research work to determine the requirements (learning styles) of Information Systems students and to help review and modify the contents already developed. It will also help to set a standard/benchmark for other electronic courses to be developed at the school.

The paper is organized as follows. This introductory section highlighted ICT enabled learning (eLearning) and the background for the research work. Section two gives a brief presentation of learning styles of students. Section three presents the problem and its importance. Section four outlines the methodology employed to collect data from students. The fifth section presents data obtained as a result of the surveys made. The section also discusses findings based on the presented data. While summary and conclusion are provided in section six, the last section briefly presents future directions of research.

Learning Styles

Review of published literature (Coffied et al, 2004; Felder, 1996; James and Gardner, 1995; Honey and Mumford, 1992; Kolb, 1984; Dunn and Dunn, 1978; Briggs Myers, 1962) reveals that there is no single definition of learning styles. As a working definition, this paper adopts the definition by Felder (1996) as “a description of the attitudes and behaviors which determine an individual’s preferred way of learning”. Depending on how learners prefer to process, perceive, receive and understand information,

Felder and Silverman (1988) defined learners as active/reflective, sensing/intuitive, visual/verbal and sequential/global learners.

The **active/reflective** dimension is analogous to the respective dimension in Kolb's model (Kolb, 1984). Active learners learn best by working actively with the learning material, applying the material and trying things out. They tend to be more interested in communicating with others. They prefer to learn by working in groups where they can discuss the learned material. Reflective learners on the other hand prefer to think about and reflect on the material. Regarding communication, they prefer to work alone or in a small group together with one good friend.

The **sensing/intuitive** dimension is taken from the Myers-Briggs Type indicator (Briggs Myers, 1962). Learners with a sensing learning style like to learn facts and concrete learning material. They like to solve problems with standard approaches and also tend to be more patient with details. They tend to be more practical than intuitive learners and like to relate the learned material to the real world. Intuitive learners prefer to learn abstract learning material such as theories and their underlying meanings. They like to discover possibilities and relationships and tend to be more innovative and creative than sensing learners. They score better in open-ended tests than in tests with a single answer to a problem.

The **visual/verbal** dimension deals with the preferred input mode. The visual learners remember best what they have seen (eg. pictures, diagrams, flowcharts and so on), while verbal learners get more out of textual presentations, written or spoken.

The **sequential/global** dimension is based on the learning style model by Pask (1976). Sequential learners learn in small incremental steps and, therefore, have a linear learning process. They tend to follow logical stepwise paths in finding solutions, whereas global learners learn in large heap. They tend to absorb learning material randomly without seeing connections but after learning enough, they suddenly get the whole picture.

Global learners tend to be more interested in overviews and in a broad knowledge, whereas sequential learners are more interested in details.

Many researchers (Chiya, 2003; Montgomery and Groat, 1998; Felder and Soloman, 1997; Felder and Silverman, 1988) considered learning styles as important factors in the learning process and agree that incorporating them in education has the potential to make learning easier for students. Felder (1996), for instance, argued that learners with a strong preference for a specific learning style might have difficulties in learning if their learning style is not supported by the teaching environment.

As indicated earlier, incorporating the learning styles of students in the teaching learning process makes learning easier for students to increase their interest and learning efficiency. To this end, questions such as what are the learning styles of our target student population? Which of these styles should be considered in the preparation of eLearning contents? And how should these be incorporated in a specific content development process? and the like are some of the questions that need to be dealt with in addressing ways and means of incorporating preferences in eLearning contents. Sections that follow will attempt to present the learning styles of students in the context of the courses offered at the School of Information Sciences at Addis Ababa University.

The Problem and its Importance

While one can realize the advantages of eLearning systems, it is also important to note that the contents and organization of courses in eLearning systems as well as the way the information is presented may play a significant role in making the students understand the material presented.

Graf (2007) stated that current eLearning systems focus on supporting teachers in creating and holding online courses. They, however, typically do not consider the individual differences of learners. While Learning Management Systems (LMS) are very successful in eLearning, they provide little 'adaptivity', i.e. most of them track and store the behavior of learners during all courses but they are not designed to meet individual learner's styles.

The findings from a survey of eLearning facilities in Ethiopia (Rahel, 2006), also revealed that recent initiatives of using eLearning systems in Ethiopian higher education are no different. Most of the works involved preparation of content in the form of power point presentation or other formats for uploading in a selected eLearning platform. The materials provided are mostly lecture notes and reference materials already addressed in the class but digitized and uploaded for later use by students. These initiatives are primarily aimed at addressing the challenges and problems related with large class size and shortage of text and reference materials. However, the content and material preparation is not tailored to address the individual learner's styles. This limits the exploitation of the digital contents to improve the quality of student learning.

Moreover, as has been stated by Felder and Henriques (1995), most instructors teach with a reflective, intuitive, verbal and sequential emphasis. In this regard, discussion with instructors at the School of Information Sciences, coupled with the researcher's observations, showed that instructors teach students with reference to their own learning styles.This, according to Felder and Henriques (1995), might lead to a considerable

teaching/learning preference mismatch for many students. In most cases, for instance, visual learners do not get as much material as verbal learners and most lectures are text and sound (i.e., straight lecture format) based. These, altogether, result in unfortunate potential consequences. Students tend to be disengaged and inattentive in class. They do poorly in exams. They can get discouraged and lose interest in the course (Oxford et al, 1991; Felder and Silverman, 1988; Godleski, 1984). According to these authors, this might eventually lead to failure and high student dropout rates.

On the other hand, in the traditional teaching learning environment, the prospect of tailing instruction to somehow accommodate 16 (2^4) different learning styles might not seem practical for instructors. Related discussions with instructors at the department showed that such concerns are not unreasonable. Extensive use of some of the learning styles particularly those that involve opportunities for student activity during class – could add to the time it takes to present a given body of material, thereby leading to shortage of time to complete the course.

From the foregoing discussion, we realize that knowledge of students' learning styles is vital if we are to provide tailored strategies for individual students in order to improve their retention and motivation. However, as mentioned earlier, addressing learning styles of each student might be challenging in the traditional classroom environment. In the course of findings, ways to address each learner's learning style one may consider to supplement the teaching/learning process by eLearning systems where students have access to electronic resources (after the normal class hours). Among the values of eLearning systems is that they are generally interactive. Compared to traditional media, eLearning systems do not only display learning content by sequential text or graphics but also by user exploration and choice. Since learning styles are more and more incorporated in technology enhanced learning, developers can boost eLearning systems efficiency by using a variety of content that tends to address the learning styles of individual students.

Moreover, although it is known that students have a variety of learning preferences, it is unknown if gender difference in learning preference exists among information systems students. It is, therefore, felt to be more interesting, and perhaps more helpful to note how male and female students differ[1] in their learning styles. Rather than looking for a gender neutral solution, we need to develop an effective eLearning system tailored to the needs of both sexes.

The research questions that arose in view of the problems stated above are, therefore:

(i) Which aspects of learning styles are particularly popular with information systems students?
   - How do the students prefer to process information?
   - What type of information do the students preferentially perceive?
   - Through which modality is information most preferentially received?
   - How do the students progress towards understanding?

(ii) What kind of content is appropriate for incorporation in the learning management system to enable all students to use the system in spite of their different learning styles?

(iii) Are there differences between male and female students in learning styles?

It is believed that the research process and results may contribute to the ongoing research in the area of determining and incorporating learning styles of students to improve the teaching and learning process and reduce the attrition rate of students at all levels of education. The attempt also aims at promoting the presentation of electronic content according to the learning styles of a student during the use of eLearning systems. Furthermore, this

[1] There is a large body of literature available on gender differences in learning styles. Since providing a comprehensive review of this topic is beyond the scope of this paper, readers interested in further details may refer to Wehrwein et al. (2007), Milgram (2007); and Tamaoka (1987).

line of work may motivate information technology experts and educationalists to jointly contribute to (or participate in) such a multidisciplinary area of work.

Methodology

Data Collection Instrument

For the purpose of collecting data on preferences, the researcher used the Index of Learning Styles (ILS)[2] questionnaire developed and enriched by Soloman and Felder (2002) on the four learning style dimensions namely: Active/Reflective, Sensing/Intuitive, Visual/verbal, and Sequential/Global. The ILS consists of 44 forced-choice items (11 items for each of the four dimensions where each item has a value of -1 or +1 depending on the response of the student). The learning styles are, therefore, described by using scales from -11 to +11 for each dimension.

Felder and Spurlin (2005) used three studies to examine the independence, reliability and construct validity of the four instrument scales. Based on their findings, they concluded that the ILS meets standard acceptability criteria for instruments of its type. Moreover Graf (2007) argued that, because the ILS questionnaire combines major learning style models, it can be used in research related to adaptive issues in learning management systems. Review of the questionnaire and discussion with experts also revealed that the questionnaire could be used as is without any customization.

Student Profiles

The ILS questionnaire has been completed by students of information systems (1st year, 2nd year and 3rd year) from the Department of Information Science and School of Information Sciences and Technology at Addis Ababa University. In order to ensure the acquisition of a reasonable size of data, all students were made to fill out the questionnaire. Table 1 presents

[2] The ILS questionnaire can be accessed at http://www.engr.ncsu.edu/learningstyles/ilsweb.html

summaries of level of study (by year) and sex categories of the students who completed questionnaire.

Table 1: Student Profiles by Level of Study and Gender

Level of Study	Male	Female	No. of Students
First Year	45	24	69
Second year	38	12	50
Third Year	49	24	73
Total	**132**	**60**	**192**

Administration of Questionnaire

Students were first asked for their consent to participate in completing the questionnaire. They were assured that the data collected would be kept completely confidential and no information was required that could identify them as a person. Almost all showed willingness to fill out the questionnaire. The ILS questionnaire was then distributed to each of the students during their normal class hours. Oral instructions, in addition to the written general and specific directions, were also given to the students to emphasize honesty in filling out the questionnaire. However, some students (8% of the total number of students who filled out the questionnaire) were reluctant to fill out the questionnaire properly. There were also other (7%) who returned incomplete questionnaire. These questionnaires were discarded. Altogether questionnaire that was completed by 85% of the total respondents was used to gather the data used in the study. Apart from the ILS questionnaire, students who returned the completed questionnaire voluntarily provided gender information.

Data Analysis

Since the nature of the data collected was quantitative, a statistical package (SPSS 16) was used to code, process and analyze the data. Data are reported by percentages of student responses in each category of learning styles. In order to determine the percentage, the number of students who

preferred each mode of learning was divided by the total number of responses. The responses for some of the ILS items were separately analyzed for male and female students and the response differences were checked for significance using the chi-square test at 0.05 significance level.

Results and Discussions

Summary of Responses

As can be seen from the summary table (Table 2), most students showed a clear active, intuitive, verbal and sequential learning styles. While both first year and second year students expressed the same overall preference, the seniors' preference was less active (more reflective) and less sequential (more global).

The ILS responses of students by gender showed that the female students also have preference for active, sensing, visual and sequential learning styles.

Table 2: Responses on four ILS scales

Scale	First year	Second year	Third year	Total	Males	Females
	69	**50**	**73**	**192**	**132**	**60**
Active/Reflective	71% (Act)	58% (Act)	41% (Act)	56% (Act)	54% (Act)	62% (Act)
Sensing/Intuitive	65% (Int)	62% (Int)	57% (Int)	58% (Int)	77% (Int)	18% (Int)
Visual/Verbal	52% (Ver)	72% (Ver)	71% (Ver)	64% (Ver)	72% (Ver)	48% (Ver)
Sequential/Global	61% (Seq)	54% (Seq)	48% (Seq)	54% (Seq)	50% (Seq)	63% (Seq)

The electronic content development, as discussed in this article, particularly addresses multimedia content incorporating sound, image and text as well as practical and theoretical exercises. It should also support collaborative work

environment. It was, therefore, found meaningful to discuss items from the questionnaire that were particularly relevant for electronic content development. These items are analyzed and discussed in subsequent sections.

Active/Reflective Dimension

Out of the items measuring the active/reflective dimension, four items that were specifically related to content and interaction were selected for further analysis. Particularly, these items dealt with ways of understanding concepts, preference when learning new things, study preference as well as grading preferences in group work environment. The Table 3 below summarizes the responses.

Table 3: Summarized Responses to some of the Items in the Active/Reflective Dimension

Item	Responses		
1. I understand something better after I	**Male**	**Female**	**Total**
Try it out	44%	(38%)	42%
Think it through	56%	(62%)	58%
5. When I am learning something new, it helps me to	**Male**	**Female**	**Total**
Talk about it	73%	73%	73%
Think about it	27%	27%	27%
21. I prefer to study	**Male**	**Female**	**Total**
In groups	45%	55%	48%
Alone	55%	45%	52%
41. The idea of doing homework in groups with one grade for the entire group	**Male**	**Female**	**Total**
appeals to me	29%	38%	32%
does not appeal to me	71%	62%	68%

With regard to the question of ways of understanding concepts, it was found out that there was no statistically significant gender difference (χ^2 =0.532, df=1, p>0.05). Results indicated that a larger number of students like to think through the concept they have learnt in order to understand it better. However, it was also observed that there are some students who like to try the concepts they have learnt instead of simply thinking through.

This indicates somehow the need for making arrangements (by instructors) for students after class hours to try out the concept they have learnt. It should be noted here that instructors might supplement the lectures with eLearning systems that incorporate relevant content with examples, questions and reference materials.

Most students indicated that they like to talk about a new material they have learnt. The test for independence also showed that there was no gender difference on the responses to this item (χ^2 =0.008, df=1, p>0.05).

In this connection, eLearning systems that are designed to facilitate the use of such features as discussion forums and chat sessions may provide opportunities for students to talk after class hours with fellow students or others interested in the subject. The discussion forums can either be mediated by the instructor for easy follow up on what the students are doing or it can be mediated by students who are motivated more to participate in such discussion features.

In relation to the question of whether students like to study alone or in groups, the chi-square test of independence revealed that there was no significant difference between the responses of male and female students (χ^2 =1.505, df=1, p>0.05). Moreover, responses of students to this item showed that it is not a must for students to work in groups. As already discussed in previous sections, eLearning systems allow for individualized instructions where students are able to learn at their own pace. In addition, studying in groups without time and distance bound is possible with the use of the Internet. One can also develop guides for incorporation in the

eLearning system of how to study specific topics in a course either in groups or alone.

This preference of students (i.e., the tendency to like to be graded alone for a group work), can also be shared by instructors. Experiences indicated that instructors are obliged to give one grade for the entire group because of the difficulty in differentiating who did what. This also avoids unnecessary quarrels with students who get lower grades. On the other hand, eLearning systems can be useful to easily take care of this problem. Instructors can post questions related to the topics of the group work for students to answer. Without the involvement of the instructors, the system can check the answers to decide whether or not the student has been actively involved in the group work.

Sensing/Intuitive Dimension

Five items were selected from the Sensing/Intuitive Dimension Table 4 below summarizes student responses to some of the items in this dimension.

Table 4: Summarized Responses to some of the Items in the Sensing/Intuitive Dimension

Item	Responses		
6. If I were a teacher, I would rather teach a course:	**Male**	**Female**	**Total**
that deals with facts and real life situations	20%	83%	40%
that deals with ideas and theories	80%	17%	60%
10. I find it easier:	**Male**	**Female**	**Total**
to learn facts	39%	63%	46%
to learn concepts	61%	37%	54%
30. When I have to perform a task, I prefer to:	**Male**	**Female**	**Total**
master one way of doing it	69%	50%	63%
come up with new ways of doing it	31%	50%	37%
38. I prefer course that emphasize:	**Male**	**Female**	**Total**
concrete material (facts, data)	21%	80%	63%
abstract material (concepts, theories)	80%	20%	37%
42. When I am doing calculations:	**Male**	**Female**	**Total**
I tend to repeat all my steps and check my work carefully	34%	77%	47%
I find checking my work tiresome and have to force myself to do it	66%	23%	53%

In general, the findings showed that male students were more in the intuitive dimension than the female students. It is observed that most male students would teach ideas and theories while most of the female students would teach facts and concepts related with real life situations. The responses to teaching preferences also yielded statistically significant gender differences (χ^2 =68.3, df=1, p<0.001).

This finding should the need for providing contents in eLearning systems including ideas, theories, facts and examples connected to the real life situations. This may address the learning styles of both sexes.

It was observed that the majority of male students find it easier to learn concepts. On the contrary, female students find it easier to learn facts. The responses also revealed statistically significant gender differences (χ^2 =10.655, df=1, p<0.01).

The overall response rate for preference related to performing a task revealed that a large number of students preferred to master one way of performing a task rather than coming up with new ways of doing it. The responses also revealed statistically significant gender differences (χ^2 =6.682, df=1, p<0.01). Such preferences may be addressed in an eLearning system by incorporating some features such as demonstration of different ways of solving a problem. This might encourage students of sensing and intuitive learning style to try out the problem.

Most students preferred to learn courses with concrete materials, facts and data. These responses have actually revealed significant gender differences (χ^2 =64.5, df=1, p<0.001).

From long years of teaching experience of the researcher as well as discussions with colleagues, it may be stated that most students do not have the culture of re-checking steps to the solutions of a given problem. This was also proved to be true with 53% of the students who indicated that they found checking their work tiresome, and often, they have to force themselves to do it. 76% of the female students indicated that they prefer to repeat all the steps and check their work carefully. The gender differences were also statistically significant (χ^2 =25.60, df=1, p<0.001).

Since eLearning can record the number of times the student changed the answers before final submission, one can design adaptive systems to show the student where he/she went wrong. This encourages the student to do the solution again. This may increase student performance as well as self confidence in the subject.

Visual/Verbal Dimension

Student responses to four items selected from the items related to measuring the visual/verbal dimension are summarized below.

Table 5: Summarized Responses to some of the items in the Visual/Verbal Dimension

Item	Responses		
7. I prefer to get new information in	**Male**	**Female**	**Total**
pictures, diagrams, graphs or maps	33%	43%	40%
written directions or verbal information	67%	57%	60%
11. In a book with lots of pictures and charts, I am likely to	**Male**	**Female**	**Total**
look over the Pictures and charts carefully	33%	30 (50%)	40%
focus on the written text	67%	30 (50%)	60%
15. I like teachers	**Male**	**Female**	**Total**
who put a lot of diagrams on the board	57%	68%	60%
who spend a lot of time explaining	43%	32%	40%
19. I remember best	**Male**	**Female**	**Total**
what I see	14%	78%	34%
what I hear	86%	22%	66%

As can be understood from the Table, most of the students tend to prefer written directions or verbal information. The respondents' school background reveals that they went to schools which promoted the lecture method which mainly focused on finishing course content within a specified schedule. It was, however, observed that female students focused more on pictures, charts, diagrams and graphs, i.e. they preferred to learn with visual objects. Further analysis also indicated that there was no statistically significant gender difference between the responses in relation to preference for getting new information (χ^2 =2.24, df=1, p>0.05).

It can also be noted that students focus most on written text instead of pictures and charts. It was, however, found out that there was a significant difference between the responses of male and female students (χ^2 =5.01, df=1, p<0.05).

With regard to the question of which type of teachers the students liked most in terms of ways of presenting a material, the chi-square test of independence revealed that there is no significant difference between responses of male and female students (χ^2 =2.41, df=1, p>0.05). The finding that 57% of male students prefer teachers who put on a lot of diagrams on the board also seemed to contradict the responses to items asked in connection with students' preference of getting new information and the type of material focused on most in a book.

In relation to the question of whether students remember best what they see or what they hear, statistically significant gender difference was also observed between the responses (χ^2 =76.47, df=1, p<0.001).

In summary, it can be seen that students have preferences for mixture of both visual and verbal learning. Contents of eLearning systems may, therefore, require the inclusion of various sources with visual and verbal information on a given topic. In addition to verbal instructions, instructors might use their own diagrams. When this is not possible, they might look for other sources with different ways of explaining the same topic so that the students capture the content as much as possible.

Sequential/Global Dimension

Five items were selected from the items designed to measure the sequential/global dimensions. These were items related to habits of understanding content, ways of solving math problems, preference of learning a course and course focus. The result is presented below.

Table 6: Summarized Responses to some of the Items in the Sequential/Global Dimension

Item	Responses		
8. Once I understand	**Male**	**Female**	**Total**
all the parts, I understand the whole thing	45%	63%	51%
the whole thing, I see how the parts fit	55%	37%	49%
9. Once I solve math problems	**Male**	**Female**	**Total**
I usually work my way to the solutions one step at a time	46%	43%	45%
I often just see the solutions but then have to struggle to figure out the steps to get to them	54%	57%	55%
20. It is more important to me that an instructor	**Male**	**Female**	**Total**
layout the material in clear sequential steps	45%	45%	45%
give me an overall picture and relate the material to other subjects	55%	55%	55%
36. When I am learning a new subject, I prefer to	**Male**	**Female**	**Total**
stay focused on that subject, learning as much about it as I can	60%	51%	56%
try to make connections between that subject and related subjects	40%	49%	44%

According to the responses, the majority of the students understand all the parts of a material once they understand the whole thing. This is contrary to the responses of the female students, where they indicated that once they understand all the parts, they understand the whole thing. The chi-square test for independence also revealed that there is a significant difference between responses of male and female students (χ^2 =5.277, df=1, $p<0.05$).

With regard to the question of ways of solving math problems, no statistically significant gender differences were observed between the responses (χ^2 =0.138, df=1, $p>0.05$).

In relation to preference of learning a course, the response rates were found to be the same for both male and female students with no statistically significant difference (χ^2 =0.002, df=1, p>0.05).

In most of the cases, students like to stay focused on a course instead of making connections between that subject and related subjects. The chi-square test also indicated that there is no significant difference between the responses of male and female students (χ^2 =2.228, df=1, p>0.05).

From the foregoing discussion, eLearning systems may need to provide ways of addressing both learning preferences. It might also be desirable for eLearning systems to provide the overall picture and content for all topics of a course so that the students will not be obliged to follow sequential lectures. This could also be supported by audio and video to increase the motivation for student learning as well as retention of the learned material for future use.

Summary and Conclusion

This paper presented the first report in a series with a focus on the results of a survey made to determine student requirements (learning styles) for consideration in the preparation of content for eLearning systems so as to improve the quality of student learning in information systems courses. Based on the findings, effective and efficient eLearning systems may be developed in order to address learning styles by incorporating more of active, intuitive, verbal and sequential components. At the same time, in connection with students who cannot be reached with some standard format, attempts need to be made to incorporate reflective, sensing, visual and global components. The e-contents can be made to supplement the face-to-face straight lecture method to motivate students who have different learning styles. As such, eLearning systems can serve as channels for alternative presentation of the same topic with examples taken from real life situation supported by audio and video.

Findings indicated that students learn more when information is presented in a variety of modes than when only a single mode is used. This should convince instructors that they should use multiple modes of information presentation at least by way of implementing learning management systems to address learning styles of students. It is also important to note that the results do not suggest an innate difference in learning styles between genders, nor do they promote separation of genders in the eLearning process.

What must be done in the eLearning system development to supplement the face-to-face instruction is, therefore, to balance instructional methods and structure content so that all learning styles are simultaneously or at least sequentially accommodated for both genders. The approach summarized in this paper to meet this goal is as follows:

- The straight lecture method followed in class may need to be supplemented with eLearning systems by way of providing more open-ended, unstructured activities and practical exercises that emphasize both individual and group work.
- As much as possible, eLearning systems should be able to motivate learners – teach new materials in the context of situations to which the students can relate in terms of personal, social and cultural experiences rather than providing digitalized content of the same lecture material from class.
- Make liberal use of visual objects: use photographs, drawings, sketches to illustrate concepts. With the use of the eLearning system, one can also provide links to other sources irrespective of the geographical and time differences.
- Provide for reflection time so that students think about what they have read and seen. Promote the use of discussion forums and chats. Raise questions and problems to be reflected on and discussed by students in small groups.

Future Directions

The following are some of the future research directions that have emerged from the results of this work and the discussions that followed.

- On the basis of the findings, activities are underway currently in terms of revising the existing course content. Existing network facilities at AAUNet and the open source content management system (Moodle) are being used for the purpose. In order for effective test of the eLearning systems, assistants are assigned to help instructors who volunteered to participate in the research so that appropriate content that addresses all learning styles are in place for students' use.
- The task that follows this survey is to work out and to implement strategies for an action oriented research to assess and measure the extent to which this work improved the quality of learning.
- An automatic student modeling approach, which analyzes the actual behavior of a student during the use of eLearning, is an area for future research. It is believed that such an automatic approach has the advantage that students do not have to make additional effort to provide information about their learning styles. The program can be designed to keep track of the student's activities and change of learning behaviors. This could be useful input to further enhance system performance in presenting individualized content for the student.
- Research experience indicates that one may not be 100% certain of the information contained in the student model. As such, building a student model which truly represents the student's behavior and learning styles may be challenging. It is believed that recent advances in knowledge representation and reasoning offer valuable tools for dealing with such an uncertain problem domain. Hence, evaluating the use of uncertainty management techniques such as Bayesian networks for detecting information from a student (learning behavior, knowledge level, personality traits, etc.) is also one future area of research.
- In cooperation with the relevant professionals, attempts are also underway to identify learning styles of students in the various fields of studies at AAU. These attempts are believed to decide the minimum standard type of content during electronic content development.

Acknowledgements
The author would like to thank eLearning project members and students at the School of Information Sciences, Addis Ababa University, for their cooperation in survey administration and for their overall support of this study. My Special thanks also go to Dr. Tesfaye Biru for his valuable inputs and editorial work. I also like to extend my gratitude to Professor Dr. Wolfgang Menzel for his comments on the article and his provision of excellent office and research facilities at the University of Hamburg, Germany.

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