

# IMPLEMENTING AND EVALUATION OF LEARNING SEQUENCE METHOD: THIRD EXPERIMENT

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## Abstract

It is well established that people learn differently from one another and there has been considerable research into how these differences can be characterised. The work by Honey and Mumford is widely recognised and proposes 4 learning styles, Activist, Pragmatist, Theorist and Reflector. Adaptive hypermedia systems have been used to allow various types of learning material, related to the different stages of the Kolb learning cycle, to be presented to students with different learning styles in different orders.

Work being undertaken at The College Of Computer Technology Tripoli is designed to evaluate the effectiveness of this approach. E-learning material to support various different learning activities has been created for a first year undergraduate course on computer technology. The activities have been designed to match the learning styles identified by [1,2]. The material has been presented to different groups of students with the activities in different sequences. The students were later tested to establish their learning style and where the learning style matched the delivery order, students reported that they had made better progress than those students for whom there was a mismatch. Further work is planned to verify this preliminary finding by investigating whether an objective measure of the students' achievement matches their perceptions.

**Keywords:** eLearning; Learning Sequence; Learning styles; Instructional design; CAL; Logic Circuits; Matching; Mismatching;

## 1. The Four Generations of eLearning History:

The history of technology-based learning of distance education has been classified [3] into four generations on the basis of the predominant communicational media used. The first generation was characterised by printed textbooks which are not electronic tools but a stage in distance learning before digital technology-based learning started. For this generation course guides were the primary medium of instruction. The second generation called upon a multimedia model that was aimed to be self-instructional, with an emphasis on independent study and on the place and time of learning. The learning materials could be in printed form, audio-video tapes, computer based learning and interactive video that allowed students to make a virtual visit to the laboratory or workplace, or to listen and/or see the audio and/or video image of their instructor. The third generation, the so-called tele-learning model used communication technologies and included the earlier media (audio and video) to take it's advantage of the capacity for both asynchronous and synchronous human interaction. A fourth generation or flexible learning model has

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emerged and combines the major features of the first three generations with interactive multimedia, internet based access to www resources, and CMC (Computer-Mediated Communication). These are powerful new tools that integrate CMC and Web resources into the development of Learning Management Systems (LMS) such as Blackboard, WebCT and Louts Note that are used to deliver learning material on the web[3,4].

### **2. Online Learning Systems:**

[5] discuss OL as a learning process that uses the Internet with LMS platforms to deliver learning activities via the web to learners where ever the Internet can be accessed, and Khan has defined WBL in these terms: “. . . a hypermedia-based instructional program which utilizes the attributes and resources of the Web to create a meaningful learning environment where learning is fostered and supported” [5,6,7].

There have been many terms attached to learning that describe it in terms of its differing accessibility and features. It is, perhaps, helpful, following [8] to identify some of the different components of OL:

- OL programmes incorporate activities and information that are very similar to other forms of distance learning;
- OL provides learners with online and offline access;
- OL often allows learning materials, articles, and tools to be downloaded either free or on a free trial basis prior to purchase;
- OL can allow both synchronous (Live eLearning) and asynchronous formats;
- OL uses LMS platforms which contain many tools to facilitate the learning process.

#### **2.1. Synchronous Online Formats (Live eLearning):**

Synchronous communication or learning requires all those involved (learners and instructors) to be connected via an Intranet or the Internet live. [8] points out that such online activity with its use of sound and video will need a high-speed bandwidth Internet connection such as broadband. Synchronous communication will include eMeetings, Virtual Classrooms, Web Seminars and Broadcasts, Coaching and Instant Messaging.

#### **2.2. Self-paced, Asynchronous Formats:**

Asynchronous learning formats tend to virtualize the traditional, lecture-style classroom situation using an LMS program that facilitates the learning process on the Internet. [9] describe how collaborative learning facilities such as a recorded live event, assessments, tests and surveys, laboratory or workshop simulations, creation of an OL community can all help balance learning and performance by creating a learning process. Such collaborative learning facilities include;

1. A physical classroom kick-off event for acculturation and teambuilding.
2. Interactive online opportunities to introduce learners to the learning resources and their team, and enable them to be better prepared for success.
3. A series of self-paced, online tutorials covering the learning subject.

4. An asynchronous, online discussion forum created to allow participants to share the students' experiences and problems.
5. A series of live, collaborative coaching sessions where the students can talk with each other as a learning team.
6. An online, Web-based post-test that verifies students' progress.
7. An online survey that allows participants to provide their feedback about the learning program for future improvements.

### 3. Honey and Mumford Learning Style Model.

Honey and Mumford developed their learning styles system as a variation on the [10], while working on a project for the Chloride Corporation in the 1970's. Honey and Mumford say of their system: "Our description of the stages in the learning cycle originated from the work of David Kolb. Kolb uses different words to describe the stages of the learning cycle and four learning styles" and the "similarities between the Kolb model and Honey and Mumford are greater than the differences" [11].

[10] saw learning as a process that requires different styles of activity at different stages of the process. He proposes a four stage cycle comprising of concrete experience, reflection on the experience, abstract conceptualisation and active experimentation. Effective learning then consists of proceeding round the cycle. [1] developed a learning style questionnaire which identifies an individual's relative strengths in the various stages of the cycle and then labels the learner as an Activist, Reflector, Theorist or Pragmatist, depending on the stage in which he/she is strongest.

However, because these views suggest that learners should complete all four stages of the cycle, the meaning of matching or mismatching the material to the student becomes less clear.

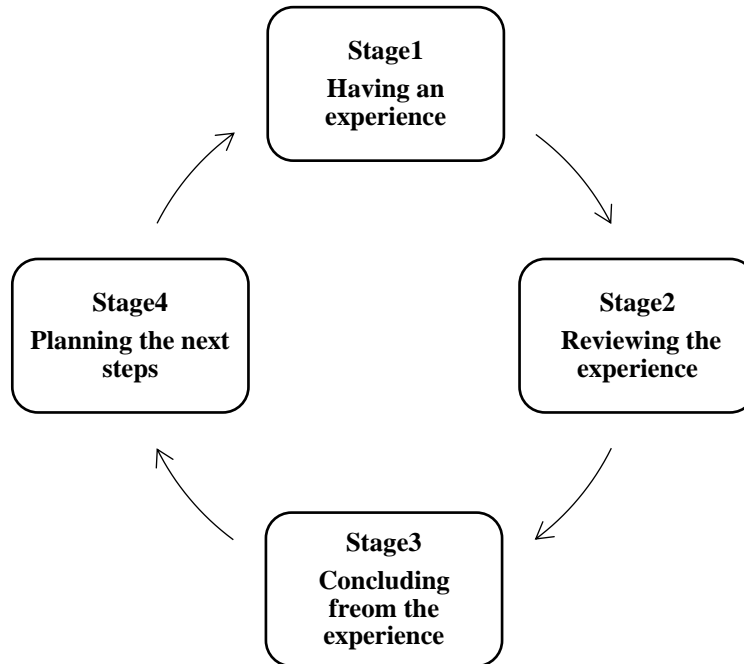
Following [11] the four stages of the Kolb cycle are:

- Having an experience: the two types of experiences one can have are reactive (letting the experience come to you) and proactive (deliberately seeking the experience). Opportunities to learn from experience are greatly increased if the normal things that happen to us are supplemented by extra experiences we create.
- Reviewing the experience: if one is to learn from an experience it is vital to review what has happened.
- Concluding from the experience: this involves scanning the raw material from the review for conclusions, answers or lessons learned.
- Planning the next step: planning involves translating some of the conclusions into a form where they can be put into action.

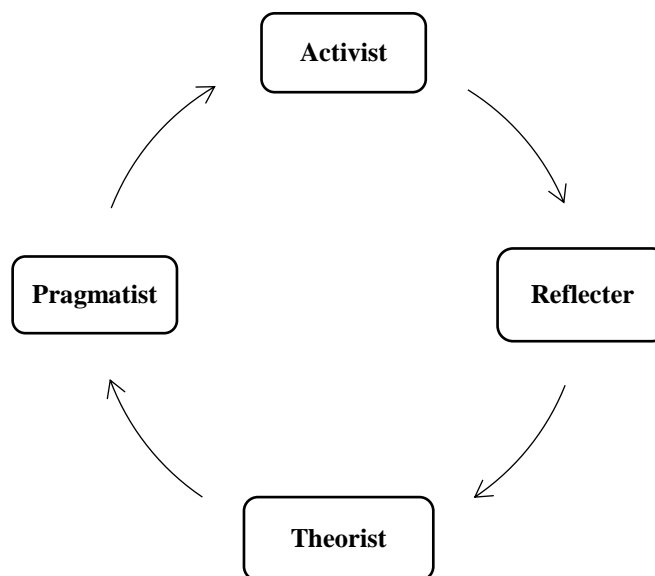
In the learning cycle according to Honey and Mumford, see Figure1, the learner can start anywhere, not necessarily at Stage 1, because each stage feeds cyclically into the next. For example, an individual could start at Stage 2 by acquiring some information and think about it before reaching some conclusions at Stage 3 and then decide how to apply this knowledge at Stage 4[11].

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A particular learning style is associated with each of the stages identified in Figure 1, as shown in Figure 2. The four learning styles identified are Activist, Reflector, Theorist and Pragmatist[11]. These learning styles are briefly described below.



**Figure1: The Honey and Mumford Learning Cycle [11].**



**Figure2: The Honey and Mumford Learning Styles [11].**

**Activists:**

[12] describe this group of people as follows: “*Activists involve themselves fully and without bias in new experiences. Their philosophy is I will try anything once. Their days are filled with activity, and they tend to act first, considering the consequences later.*” Activists enjoy being at the centre of attention and seek to focus activities around themselves. “*They get easily bored, and once the excitement of an activity has died down will be busy looking for the next challenge*”. [12]

**Reflectors:**

[12] refer to Reflectors as being keen on standing back and deliberating about experiences from many different perspectives. “*They like to have all information available about a problem or subject so they can chew it over and come to a conclusion in their own time. They tend to adopt a low profile, taking a back seat in meetings, preferring to listen carefully to others' points of view before making their own*”. [12]

**Theorists:**

According to [12], Theorists “*[a]dapt their observations and experiences into complex but logically sound theories. They use logical step-by-step processes to solve problem. They tend to be perfectionists who do not rest until things fit into a rational scheme, and reject anything which does not. They will ask questions like: How does this fit with that? and What are the basic assumptions? They tend to be detached, analytical and objective, and steer away from anything which is subjective or ambiguous.*”

**Pragmatists:**

Pragmatists are most interested in trying out new ideas, theories and techniques to check whether they work in practice [12]. They positively seek new ideas and take the first opportunity to experiment with applications; their philosophy is that there is always a better way, and if it works it is good [12].

**4. Instructional Design and Learning Styles**

Web-based learning systems must incorporate the cognitive flexibility to represent concepts in different ways and levels, and so stimulate the learner to adaptively re-organize and apply knowledge to authentic, real situations. Information embedded in hypermedia studies must be coded conceptually for different uses and perspectives in complex situations. Learners must explore and develop their own knowledge structures, and in this they can be aided by expert mentors as well as tools to manage complexity [13,14]. Use of hypermedia does not automatically develop cognitively flexible knowledge structures. Within this kind of learning environment instructional designers should provide understanding through a mixture of meaningful knowledge representations and challenges. The learner must engage actively in order to explore the information presented, and create meaning through interactive experiences with other learners and across multiple scenarios. In such a learning process the learner can experience both similarities and differences in content across a variety of contexts and cases. Through these experiences the learner can

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create a flexible knowledge structure for applying knowledge within complex, ill-structured domains [13,14].

Whilst use of the Web has these advantageous educational effects, one problem is that Web Based Instruction (WBI) does not provide an effective instruction program tailored to the needs of each individual. [5] argue that many online learning systems are poorly designed and to be effective learning programs must take into account the preferences of the individual. That is, all learners are provided with the same instructional content and in the same context, with little consideration of individual learning styles. However, a primary principle of adaptive instruction is that no single instructional strategy is best for all students. [15,13] argue that it is worthwhile to develop learning programs that provide more efficient instruction methods for individual learning on the grounds that students will be able to achieve learning goals more efficiently when pedagogical procedures are adapted or accommodated to individual preferences.

Assessing students' learning styles provides an awareness of their particular preferences, which can then be used to design, develop, and deliver educational resources to maximally motivate and stimulate their acquisition of subject matter in an attempt to individualize instruction [16,17]. Understanding individual learning styles can improve the planning, producing, and implementing of educational experiences, so that they are more appropriately compatible with students' desires in order to enhance learning, retention, and retrieval[16]. This research program focuses on attitudes among individual students to identify their different learning and cognitive styles since "*the success of education depends on adapting to individual differences among learners*"[17,18]. This is confirmed [19] who surveyed twenty two studies to investigate how effective it was to apply LS in WBL, and found that it is essential that educators consider the different learning styles of individual students when designing web-based learning materials. With the advances in web technology; sound, animation and movies can be incorporated into web-pages to enhance the teaching and learning environment and that made it easier to design the teaching methods used in the study to accommodate diverse learning needs.

### **5. The Research Objectives.**

The objectives of the research were:

1. To determine whether the same learning material can be structured and delivered in forms matching the different learning styles of the students.
2. To determine whether by changing the sequence of delivery of the elements of the learning material, it can be made to match different learning styles.
3. To determine what advantage(s) are gained from using different learning sequences in the learning process.
4. To investigate whether the Honey and Mumford learning model offers a satisfactory practical model of a real learning environment that enables increased interactivity in the given online course module.

## 6. Hypotheses

Four hypotheses have been formulated to define the research question more precisely and clarify the particular variables to be investigated:

**Hypothesis 1:** Matching a student's learning style to the sequence in which the course material is delivered will have a significant effect on the student's test score or on their appreciation of the course. Null hypothesis: There will be no significant difference between the mean scores for matched and non-matched students in their level of knowledge either before beginning or after completing the online course, nor in the Pre- and Post-test marks obtained.

**Hypothesis 2:** Matching a student's learning style to the sequence in which the course material is delivered will have a significant effect on the student's confidence, interest and comfort levels. Null hypothesis: there will be no significant difference in student ranking of preferred learning sequence.

**Hypothesis 3:** Matching a student's learning style to the sequence in which the course material is delivered will offers an equal balance of learning opportunity to all students no matter what their learning style. Null hypothesis: there will be no significant difference in the performance of students with different learning styles, as measured by their achievement in any of the assessments (student ranking their level of knowledge after completing the online course, and Post-test scores).

**Hypothesis 4:** It is expected that students with different learning styles will differ in their confidence with the course material, their level of interest in the course, and their comfort level when using different learning sequences. Null hypothesis: there will be no significant difference in student ranking of preferred learning sequence according to learning style.

## 7. Design of the Third Experiment.

The results of a third experiment that was also aimed to correct the problems faced in the first, and complement and add to the results of the second experiment. The design and the research method were the same as for the second experiment [20]. The sample for this experiment was nineteen students (eleven students as the matched group one and eight students as the mismatched group two). Before commencing the third experiment, the plan was that the sample would contain be at least 20 to 25 students in each group. The procedure followed was exactly the same as for experiment two, meeting the students as a cohort, describing the experiment and its purpose, and asking if they agree to participate. However, most of the students did not attend the first laboratory session with the researcher and so did not complete either a LSQ or a Pre-test, nor did they login to the online course. As the course leader explained, said there was no mechanism to make these students attend the laboratory session if they did not want to. In this way the sample size for the third experiment was reduced substantially. it was agreed to proceed with and report the third experiment separately, even though the total number in the sample was nineteen.

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In group one there were 11 students ( 7 Activists, 1 Reflector, 2 Theorists and one Pragmatist), and in Group two there were eight students (7 Activists and 1 Theorist). There are two parts to the data in analysis: the first part focuses on differences between the matched and non-matched groups, the second part focuses on differences between students with the Activist Learning style as there were so few students with other learning styles.

### **8. Comparison of Data for the Three Experiments.**

The results obtained from the three experiments and on this basis concludes that the use of online technologies in higher education can improve the effectiveness of student learning by allowing the matching of the order of the delivery of taught material to the user's learning style. The essential research question was to find whether any correlation existed between student learning styles and the order in which the component parts of the course material was presented to them, this has been answered affirmatively.

#### **8.1. Hypotheses Tested by the Three Experiments:**

**Hypothesis 1:** Matching a student's learning style to the sequence in which the course material is delivered will have a significant effect on the student's test score or on their appreciation of the course. Null hypothesis: There will be no significant difference between the mean scores for matched and non-matched students in their level of knowledge either before beginning or after completing the online course, nor in the Pre- and Post-test marks obtained.

Table 1 summarises the results of the measured levels of significance for the differences in student level of knowledge Pre and Post-test, and mean scores in the Pre and Post-tests, between matched and non-matched groups in the three experiments. Note: Pre- and Post-test comparison was included only in experiment two. The results for the first and final experiments showed that no significant difference between the two groups in the students' level of knowledge before beginning or after completing the online course. According to these experiments the relevant null hypothesis can be accepted. Clearly, one would expect no significant differences between the groups in the mean Pre-test score, nor in the level of understanding prior to commencing the course. Indeed, a repeated pattern of significant differences arose in this aspect that would be surprising and worthy of investigation. However, the lack of a significant difference between the two groups after completing the course is – in the opinion of the researcher – due to all the students in these experiments obtaining 100% in the Post-test. In experiment this was due to using the same questions for both Pre and Post test, and was one aspect of the research that was corrected for the second and third experiments. It should also be noted that in experiment three all the students had some knowledge of the subject matter before the course started.

In experiment two a significant difference between the groups was obtained in their levels of knowledge after completing the online course, and in the mean Post-test marks. The student group who used the learning sequence that matched their learning styles (N=30, M=4.20 between Good and Very Good, SD=0.71) considered their knowledge of logic gates to be significantly better than the group (N=34,



M=2.24 between Very little and Moderate, SD=1.01) who's learning sequence did not match their learning styles. According to the result of experiment two the null hypothesis can be rejected.

Here, the findings from experiment two do not agree with those from experiments one and three. Of course these results do not contradict each other, but which is the more reliable – in the sense of which is generally applicable. The results from experiments one and three have serious question marks over them (see above), but experiment two had the great strength that the sample was large enough to provide a statistically significant difference. It should also be mentioned that, unlike the sample of students in experiment three, the students in experiment two started with little or no background knowledge about logic gates, and showed a significant improvement in their mean level of knowledge after completing the online course. The latter seems intuitively correct!

**Table 1: Levels of significance for the differences in student achievements (level of knowledge Pre and Post-test, and mean scores in the Pre and Post-tests) between matched and non-matched groups in the three experiments**

Test Type	Experiment one 22 students	Experiment Two 64 students	Experiment three 19 students
Level of knowledge before	$P > 0.05$	$P > 0.05$	$P > 0.05$
Level of knowledge after	$P > 0.05$	$P < 0.001$	$P > 0.05$
Pre-Test	*	$P > 0.05$	*
Post-Test	*	$P < 0.001$	*

\*The Test cannot be performed on empty groups.

**On balance, then, it appears that hypothesis one is disproved.**

**Hypothesis 2:** Matching a student's learning style to the sequence in which the course material is delivered will have a significant effect on the student's confidence, interest and comfort levels. Null hypothesis: there will be no significant difference in student ranking of preferred learning sequence.

Table 2 summarises the results of the measured levels of significance for the differences in students' level of confidence in the course material, how well the online course held their interest, and how comfortable they felt while using the online material. As can be seen, experiment one showed no significant difference between the two groups in terms of the students' levels of confidence, interest and comfort. According to this experiment the null hypothesis can be accepted.

Experiment two showed that there was significant difference ( $P < 0.001$ ) between the groups in the level of confidence, interest and comfortable. Group one was, on average, significantly more confident and interested in the course material, and more comfortable with the course material than Group two. According to experiment two the null hypothesis can be rejected.

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Experiment three found a significant difference ( $P < 0.01$ ) between the groups in the level of interest in the course and comfort with the course. Group one was, on average, significantly more interested and comfortable with the course than Group two. According to experiment three the null hypothesis can be rejected.

**Table 2: The comparison the difference in students' level of confident, Interest and comfortable the three experiments.**

<b>Test Type</b>	<b>Experiment one</b>	<b>Experiment Two</b>	<b>Experiment three</b>
Level of confidence	$P > 0.05$	$P < 0.001$	$P > 0.05$
Level of Interest	$P > 0.05$	$P < 0.001$	$P < 0.01$
Level of comfort	*	$P < 0.001$	$P < 0.01$

\*The Test cannot be performed on empty groups.

**Given that experiment two, with its larger sample size, appears the most reliable then, on balance, it appears that hypothesis two is disproved.**

### **8.2. Comparison between Learning Styles:**

This section examines and compares the relative achievements of the four student learning styles (Activist, Pragmatist, Reflector and Theorist). Student achievement was measured by the rankings given for the self-assessed level of knowledge after completing the online course, the level of interest in the course material, the level of confidence in the course material, the level of comfort with the online course, and the marks awarded in the Post-test. In first or third experiments all students answered all the questions in the Post-test correctly and so no valid comparisons can be drawn (especially as in experiment one the Pre- and Post-test were the same). Also in the third experiment the sample was too small to obtain any useful comparisons for the Pragmatist, Reflector and Theorist learning styles.

**Hypothesis 3** Matching a student's learning style to the sequence in which the course material is delivered will offers an equal balance of learning opportunity to all students no matter what their learning style. Null hypothesis: there will be no significant difference in the performance of students with different learning styles, as measured by their achievement in any of the assessments (student ranking their level of knowledge after completing the online course, and Post-test scores).

Table 3 summarises the results obtained from the three experiments. The results from experiment one show that there was no significant difference in student achievement between learners with the same learning style in the two groups. The null hypothesis in this case cannot be rejected.

In experiment two the Activists, Pragmatists and Theorist learners appear to learn significantly better if they use a learning sequence that matches their learning style. There was no significant difference between the achievements of those Reflectors whose course matched their learning style and those reflectors whose course did not match their learning style. This result is most likely due to the small number of Reflectors in

the sample, but the possibility exists that Reflectors are more flexible than other learning styles. According to this result the null hypothesis can be rejected.

In experiment three the sample was too small. The learning style of the Students in this group was only activist. Experiment three showed no significant difference between the learners with the same learning styles in the two groups in students' achievements when using different learning sequences. The null hypothesis in this case cannot be rejected.

**Table 3: The comparison of students' learning achievements in the three experiments according to students' learning styles.**

Learning Style	Test Type	Experiment one	Experiment Two	Experiment three
Activist	Level of knowledge after completing the online course	$P > 0.05$	$P < 0.001$	$P > 0.05$
	Post-test score	*	$P < 0.001$	$P > 0.05$
Pragmatist	Level of knowledge after	$P > 0.05$	$P < 0.01$	*
	Post-test score	*	$P < 0.05$	*
Reflectors	Level of knowledge after	$P > 0.05$	$P > 0.05$	*
	Post-test score	*	$P > 0.05$	*
Theorist	Level of knowledge	$P > 0.05$	$P < 0.05$	*
	Post-test score	*	$P < 0.001$	*

\*The Test cannot be performed on empty groups.

**Hypothesis 4:** It is expected that students with different learning styles will differ in their confidence with the course material, their level of interest in the course, and their comfort level when using different learning sequences. Null hypothesis: there will be no significant difference in student ranking of preferred learning sequence according to learning style.

In experiment one there was no significant difference between the students with the same learning styles when using different learning sequence, see Table 4. The result showed that the null hypothesis can be accepted.

Experiment two showed that there was a significant difference between Activist learners in their level of interest, confidence and comfort when they used different learning sequence. Activists who used the learning sequence that matched their learning styles did better than those who did not. Pragmatist learners were significantly different in their levels of interest and comfort when using different learning sequences. Pragmatist, learners who used the learning sequence that matched their learning styles did better than those who did not. Theorist learners showed significant differences only in their comfort level when using the online course when using different learning sequence, but this was a relatively small sample. Reflector learners showed no significant difference in their levels of interest, confidence and comfort when using

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different learning sequences, however this was because of the very small number of responses received. On balance, it appears that the null hypothesis can be rejected.

In experiment three the only significant difference was found with Activist learners because there were so few Pragmatists, Reflectors and Theorists no significant results could be obtained. The Activist students were significantly more interested in the course and comfortable with their way of learning if the learning sequence matched their learning. Thus the null hypothesis cannot be accepted, at least with the Activist learning style.

**Table 4: The comparison the difference in students' level of confident, interest and comfortable the two experiments according students learning styles.**

<b>Learning Style</b>	<b>Test Type</b>	<b>Experiment one</b>	<b>Experiment Two</b>	<b>Experiment three</b>
<b>Activist</b>	Interest	$P > 0.05$	$P < 0.01$	$P < 0.01$
	Confidence	$P > 0.05$	$P < 0.01$	$P > 0.05$
	Comfortable	*	$P < 0.05$	$P < 0.01$
<b>Pragmatist</b>	Interest	$P > 0.05$	$P < 0.05$	*
	Confidence	$P > 0.05$	*	*
	Comfortable	*	$P < 0.01$	*
<b>Reflectors</b>	Interest	$P > 0.05$	$P > 0.05$	*
	Confidence	$P > 0.05$	$P > 0.05$	*
	Comfortable	*	$P > 0.05$	*
<b>Theorist</b>	Interest	$P > 0.05$	$P > 0.05$	*
	Confidence	$P > 0.05$	$P > 0.05$	*
	Comfortable	*	$P < 0.05$	*

\*The Test cannot be performed on empty groups.

### **9. Contributions.**

The summarizes the outcomes of this investigation to find whether any correlation existed between student learning styles, the order in which the component parts of the course material was presented, and the learning outcomes as determined by a Post-test score and the students' self assessed level of knowledge of the course material.

This research was intended to investigate the student's online learning environment to first confirm that the environment itself significantly affected learning outcomes and, secondly, to provide useful information for course designers and educators on how they can get the best outcome when using this new high technology learning environment. The specific issue tested was whether, in this learning environment, the sequence of in which the course material was presented to the student had a significant effect on the learning outcomes:

in particular the relative improvement in student test scores, the students' relative interest and confidence in the course material, how comfortable the students felt while studying the course material as a function of whether the order of presentation of the course material matched or did not match the students learning style as defined by Honey and Mumford.

1. The first finding from his research is that it is possible to deliver the course material to be studied in different learning sequences. This is a confirmation of the work of previous researchers [21].
2. The second, finding is that the learning sequence can have a significant effect on student performance. The results show that it is important that the course contents should be presented in a sequence that matches the student's learning style. This confirms the work of [22] "learning outcomes can be improved if designers of hypermedia courseware provide a different sequence and presentation of materials to accommodate individual learning style differences" and [2] "where individual preferences and activities match, learning is more likely. If there is a mismatch you are less likely to learn and will find learning a struggle".
3. A third, important, result is that Activist learners are the student who most prefer to follow the learning contents in a sequence that matches their learning style.
4. Reflectors showed no significant difference between the two groups in any test, almost certainly due to the small sample size, but there is the suggestion that these learners are more flexible and adapt more readily to a delivery pattern.
5. The research confirmed that the differences in student learning styles should be considering when designing online learning system. Another study was argues that when students' learning styles are identified, it is possible to define an appropriate context of learning. This study had confirmed that the differences in student learning styles should be considering when designing online learning system [23].
6. By designing online material instruction according to Kolb learning cycle, the students achieved higher scores compared to students across Kolb learning cycle. Kolb model divided to four learning sessions this can be implemented in online learning and can offer an equal balance of learning opportunity to all students no matter what their learning style.

This kind of designing eLearning material can offer high structured which can be more beneficial to match many learning styles [24].

## 10. Recommendation for Future Research

The researcher recommends to repeat the same experiments with the following changes:

- Replication of this study be conducted within a higher education institution with an increased sample population, the number of students in each learning type/style at least 40 – 20 in each of Group one and two.
- Additional research into modules in other subjects in different academic fields.
- Researchers should use different instruments in determining learning styles and also implement aspects of learning styles into hypermedia systems in order to confirm the important of using the learning sequences, and it effect on students' achievements.

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