UTILISING EXPERIENTIAL LEARNING TO DELIVER OBJECT ORIENTED PROGRAMMING (OOP)

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ABSTRACT: This work is based on experiential learning theory that integrates "learning by doing" into every step of the learning process. It combines diverse teaching and learning strategies in a single platform to suit different learning styles. The combined strategy is designed to meet the following objectives:
• To enhance student comprehension of the OOP concepts.
• To stimulate deep thinking and enhance students' capabilities in transferring what they have learnt to new situations so that the transfer of learning takes place.
• To develop and foster independent learning in which students develop the ability to discover and reconstruct knowledge by themselves.
This work demonstrates how the new method is applied to one of the sessions in OOP.
KEYWORDS: Independent learning, experiential Learning, enhance comprehension, transfer of learning

1. THE CURRENT SITUATION

The module under consideration is a third year module, taught to students following the ESD (Engineering Systems Design) program. This module is a 10 credit module, during which students will learn the principles of object oriented programming and how to write efficient maintainable programs using the C++ language. The module is taught in a conventional classical way where theory session is separated from the practical session. Many students suffered from difficulties in understanding this module which was reflected on their final results. This work is going to address the reasons behind these issues and investigate a new approach to tackle these problems.

2. DEFINING THE PROBLEM

In order to identify the main issues which hinder the students' understanding, a questionnaire was prepared to collect general information about motivation of the students to take the module, to assess students general knowledge of the basic concepts of programming, and to identify the most common problems experienced during their previous learning. After analysing the questionnaire's response, a direct discussion was held with the students to discuss the main issues. The main issues are summarised as follows:

• Poor prior knowledge of programming techniques.

• Insufficient level of programming in C language which they covered during the first year.

• One-year gap in developing their skills in programming; OOP was given in the third year and no high level programming being taught during the second year.

• Some technical problems did not allow them to exercise with the C compiler.

• Lack of motivation; students had no idea how to link programming using OOP to their studies and real life.

• Homework and continuous assessment were not included within the grading scheme. This discouraged them from attempting regular practical programming activities.

3. THEORIES, LITERATURE AND POSSIBLE SOLUTIONS

Normally, courses are described as either practical or theoretical. Courses which contain both elements tend to be sharply divided (Neary, 2000). An academic lecturer may present theory in a lecture in the classroom whilst a practical supervisor is in charge of the follow-up practical experience in a workshop. It is common for both types of course to have limited success. Learning cannot be achieved with experience only, reflecting on experience is essential (Carrillo, 2002). Reflection will generate concepts and generalisations. With these generalisations, new situations can be tackled effectively. New learning and developed concepts should be also tested in new situations. A link must be made between theory and action by planning for that action, carrying it out, and then reflecting upon it, relating what happens back to the theory. Learning from experience must involve links between the doing and the thinking (Kolb, 1984). It is the direct result of the learners' participation in events. Experiential learning can be achieved as a direct result of the learners' participation in events (Cowan, 1998). Fig. 1 shows the four-stage model of learning by doing (experiential learning) (Petty, 2009).

Learning takes place through the active behavior of the student: it is what he does that he learns, not what the teacher does (Tyler 1949: 63 quoted in Biggs 2003: 25).

'Academic courses which do nothing to link theory into practice through situated cognition and harnessing learning from experience will be sterile" (Beaty 1999:146)

You do not have to look hard to find literature supporting or examining the notion of learning through experience. Biggs makes much of the improved student engagement resulting form greater levels of activity (see Biggs 2003: 4). Here you will also find the often-referenced table below:

Most people learn:

10% of what they read

20% of what they hear

30% of what they see

50% of what they see and hear

70% of what they talk over with others

80% of what they do in real life

95% of what they teach others

(Biggs 2003: 80, attributed to William Glasser 1988)

In 'The Handbook for Teaching and Learning in Higher Education" (Fry, Ketteridge, Marshall 1999) there is both a theoretical context of experiential learning (pp14) as well as a practical overview of possible applications (pp 134) which looks at the areas of work based learning, problem based learning, laboratory exercises and simulations. Fry et al suggest that 'most of the current ideas about student learning, including experiential learning, the use of reflection etc are based in constructivism' (Fry et al 1999: 11). We are reminded here that constructivism tells us we learn by fitting new understanding and knowledge into… …old understanding and knowledge' (Fry et al 1999: 11). We construct our learning from what we already know. This theory leads us back to Biggs and his theories of constructive alignment, (see Biggs 2003: 11) which sit neatly next to his already sited ideas of active and experiential learning.

In his book 'Freedom to Learn' (Rogers 1994) Carl Rodgers succinctly summarises the positive aspects of experiential learning by first considering its antithesis as the rather difficult task of trying to memorise nonsense syllables such as 'baz, ent, nep, arl, lud' (Rogers 1994: 35). Of course with no meaning attached the 'learning that takes place is "from the neck up". It does not involve feelings or personal memories; it has no relevance for the whole person.' (Rogers 1994: 35). By contrast he then goes on to reference Marshall McLuhan who considers the example of a five-year-old child who is moved to a foreign country and allowed to play freely for hours with her new companions. The child, he suggests, will learn the new language in a few months and will acquire the proper accent. (Rogers 1994: 36).

One model of experiential learning particularly relevant to this teaching intervention is the Kolb learning cycle. Kolb, according to Fry et al is credited with the most popular theory of learning from experience. The Kolb learning cycle is relevant here in two ways. Firstly, the teaching intervention as defined by the PGCthE, is based on the notion of action research (or perhaps action reflection would be an equally appropriate term) and the Kolb model illustrates this cycle. The other relevance of the Kolb model is that it helps us to identify what is possibly missing from the OOP learning activities described above.

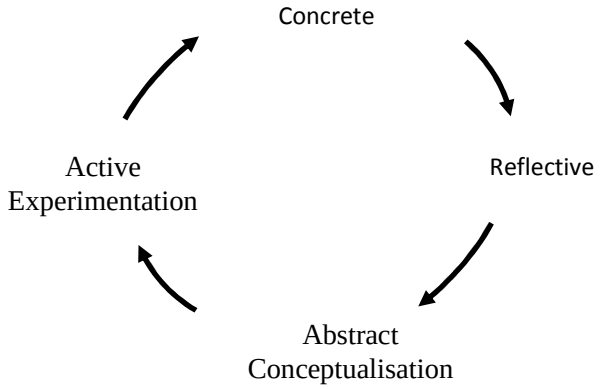

Figure 1. The Experiential Cycle

Fry et al offer a useful clarification of the terms used in the learning cycle. Concrete experience is defined as learners 'involved fully and freely in new experiences' (Fry et al 1999: 14). They must then have the time and space to reflect on these experiences (reflective observation) such that they can 'take ownership of their ideas and integrate them into sound logical theories (abstract conceptualization)' (Fry et al 1999: 14). Finally these theories must be tried and tested possibly to an end of problem solving or the like (active experimentation) and this in turn provides the material for a new concrete experience. Phil Race, when considering the Kolb model in the 'Lecturers Toolkit' (Race 1998), suggests the parallel terms of 'doing', 'feedback', 'digesting' and 'wanting / needing' as replacements for concrete experience, reflective observation, abstract conceptualisation and active experimentation respectively (Race 1998: 10) Fry et al also note that the reflective observation phase of the cycle 'will be strongly influenced by feedback from others' (Fry et al 1999: 14). Interestingly, Race questions the usefulness of these stages of experiential learning being placed in a cycle. He proposes the model be considered without arrows implying a direction or sequence of events and even suggests the stages as appearing like 'ripples on a pond' (Race 1998: 11) with wanting and needing at the centre and feedback on the outside (see Race 1998: 11). His rational for this is as follows:

-It is important to keep on wanting while doing

-It is useful to seek feedback while doing as well as after doing

-It is useful to be continuing to seek feedback while digesting

-It is useful to be continuing the doing while receiving feedback and while digesting

-It is important to digest both the experience of doing and the feedback that is received

(Race 1998: 11)

However you choose to approach or navigate your way around this model for experiential learning it is clear that the value inherent in concrete experience needs to be unlocked through reflective observation and feedback. The digesting and conceptualising of this reflection then becomes a need to experiment. Identifying these stages in this teaching intervention would align my initial concrete teaching experience as facilitating some learning activities for a second year group in Music Technology and Composition, my reflection on this experience then identified a passive environment around what should be an active task, and this was considered a potentially problematic situation. The digesting and conceptualising of this situation includes this review of theories of experiential learning, and the active experimentation will be addressed in the next part of the paper as 'actions and experiments'.

Relating the Kolb learning cycle and related issues to the particular teaching scenario in OOPs technology outlined above as the 'problem' we see immediately that the reflective observation stage is not made as explicit or explored as much as it could be. It may be that students are, in fact, going through the full cycle of doing, reflecting, digesting and experimenting but it is very difficult to know if they are, and if so where they are in the cycle at any particular time. There is clearly a missed opportunity here for offering and receiving feedback, an element that we have seen is so important in reflective observation. Feedback from peers particularly would seem appropriate when we consider McLuhan's scenario of the five year old child learning a new language so efficiently through play with friends, and when we consider Biggs'

statistic that we learn as much as 70% of what we talk over with others. It is clear that a teaching intervention in some way needs to support and develop reflective observation. This should, in turn, support the abstract conceptualisation and active experimentation stages of the learning cycle.

4. IMPLEMENTING THE EXPERIENTIAL LEARNING CYCLE

For each phase of the experiential learning cycle there are practical learning and teaching methods which are described as follow:

A. Planning for experience

The methods of this phase are aimed to prepare learners prior to experiences for example through action planning and the negotiation of learning contracts.

B. Increasing awareness of experience

During this phase methods are aimed to heighten learners' awareness of their experiences so that they notice more and have more material upon which to reflect afterwards (e.g. through the use of log books).

C. Reviewing and reflecting upon experience

This phase is concerned with the learning points that can be drawn out through structured reflection on the learning experiences (through the use of video recordings and self-assessment).

D. Providing substitute experiences

This phase is concerned with ways of providing classroom-based experiences as substitutes for work or other experience (through the use of role-plays).

5. THE CLASSICAL PRACTICAL APPROACH IN TEACHING OOP

A classical practical session is carried out throughout the following stages:

1. Basic principles are demonstrated by the tutor.

2. Students attempt to write a program implementing the principles of OOP, under supervision.

3. Feedback and comments from the tutor are given to the students who finished their programs.

The main problems with this approach, as observed, are:

• Lack of attention during the demonstration.

• It takes relatively a long time to write a program, some of them fail to write a complete program.

• Despite the full explanation at the beginning of the session, the tutor has to repeat the same notes again and again.

• Most of the written programs have poor standards.

• Students give no reflection about the quality of their programs. They leave it to the tutor to identify the weakness and strength of their programs.

6. THE NEW PRACTICAL APPROACH USING EXPERIENTIAL LEARNING

According to the experiential learning theory the reasons behind the problems in the classical method are as follows:

• Students have not planned for their work and have not established the way to judge their work.

• No reflection and assessment done by the students.

• No opportunity to go round the learning cycle a second time to correct mistakes.

• Students have no active role and responsibility in the learning process.

In order to tackle the above-mentioned issues, the following approach was introduced:

1. Background

Students were asked to develop a database program using the principles of OOP. During the first phase the tutor started to demonstrate the basic principles of a database system, he described the different functions of the database management program and the different files required for the application. The concepts of OOP and how to apply them in developing the program were also explained. At the end of this phase students were split in groups, three or less in each group.

2. Assessment Criteria

The second phase was related to the assessment criteria of the program. The main players were the students with the help of the tutor. The main criteria were set and defined as follows:

In relation to the program;

• The program should be modular.

• The program should function properly.

• The principles of OOP must be implemented.

In relation to the documentation;

• Algorithms should be well described.

• Proper UML diagrams should be provided.

• A testing procedure should be included.

3. Writing Program

The third phase was writing the program. The students were in need for the tutor to give them help in debugging the program.

4. Evaluation

During the fourth phase students started to check their programs against the six assessment criteria defined in phase two and short reports with their reflections were submitted with their programs.

5. Discussion

In the fifth phase, a discussion was held between the tutor and the students to investigate the different methods for improving their programs and check their level of understanding. If level was not achieved, new tasks and new program modifications were agreed and another cycle might begin starting at phase three, if understanding is acceptable, then the assignment is fulfilled and the learning cycle will end.

The total amount of time allowed for the assignment was seven weeks. Fig. 2 shows the flow of the different phases within the session.

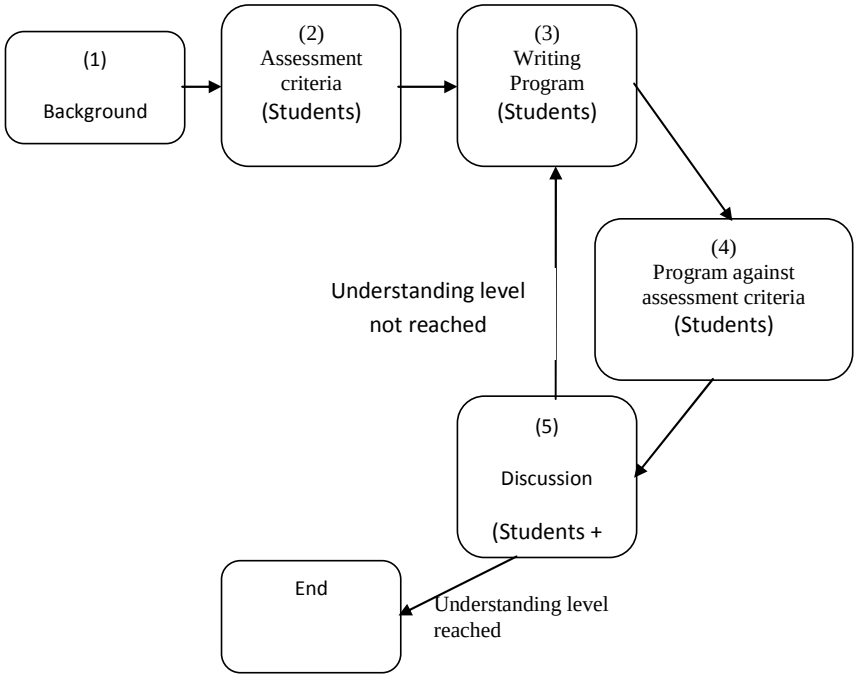

Figure 2. The flow of the different phases within the session

The main features of this session in terms of experiential learning theory can be summarised as follows:

The students started with the theory (Conceptualisation), then they developed an assessment criteria and related theory to practice (Experimentation), followed by writing and running a program (Experience), then analysing and assessing the outcome of their programs (Reflection). Based on their assessment, new ideas will come out (Conceptualisation), and a new cycle will start over until the required level of understanding is achieved.

7. ASSESSMENT

The assessment of this intervention is based on questionnaire and observations. The questionnaire included the following few questions:

• I enjoyed doing the assignment.

Disagree ◄ 1 2 3 4 5 ► Agree

Result = 4.1

• The assignment helped me in better understanding the OOP concepts.

Disagree ◄ 1 2 3 4 5 ► Agree

Result = 4.4

• I got a good support from the tutor during the assignment

Disagree ◄ 1 2 3 4 5 ► Agree

Result = 4.5

• I found discussions with my peers helpful

Disagree ◄ 1 2 3 4 5 ► Agree

Result = 3.9

• The allocated time for the assignment was proper

Disagree ◄ 1 2 3 4 5 ► Agree

Result = 4.4

• Self assessment is helpful to develop my learning process

Disagree ◄ 1 2 3 4 5 ► Agree

Result = 4.0

• Any suggestions to improve the assignment!

Some students came up with suggestions, mostly regarding the resources, asking for more reference books to be available in the library and how to get a free compiler to work on their assignment at home.

The tutor's observations are summarised as follow:

• The students were more engaged with the demonstration during the lecture.

• The students started to take an active role in the learning process.

• The students started to make their own plans for learning.

• They started to reflect and make their self-assessment.

• They started to seek and learn new tools to debug their programs.

• More time for the tutor with less stress.

• The cyclic nature of the learning process created a better comprehension and understanding.

• Promoting responsibility improved their attendance.

• Students responded positively according to the questionnaire which followed the intervention.

8. CONCLUSIONS

This session has significantly changed the way how the assignments in OOP will be planned in the future. From the results mentioned in the last section, there is an achievement with regard to students' understanding which was reflected on the quality of programs submitted during the assignment and the level they approached within the assignment period. On the other side, the lecturer is not under high pressure, since students are working, planning together taking responsibility of

their understanding and the lecturer is there for guidance and supervision, not fully busy explaining and repeating the same material again and again to different groups. The self assessment practice practised by the students during the assessment phase motivated them to watch their level of understanding and make learning more attractive. This practice could be expanded and applied not even in OOP but in other subjects as well.

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