Chapter - 6
Conclusions, Recommendations and Scope for Future Research

This final chapter presents the findings and inferences drawn from all the surveys and experiments conducted by the research. It starts with the major contributions of the thesis followed by section wise findings, conclusions and recommendations if any. The chapter also suggests possible extractions of the works for future research.

6.1 Major Contributions of the Thesis

This research has proposed an adaptive agent based e-learning system that determines active or passive (or reflective) learner characteristics through studying the types of learning objects requested by the learners and investigating the history of e-learner profiles. Since learner characteristics are subjective matter, user habits are recorded and analysed from authorised user profiles by adaptive mobile agents alongside the preferences exhibited by the learners for particular types of e-objects (SCOs). Comparisons between the properties of preferred learning objects by a particular learner and the recorded history of that learner (profiles) are tested through Naive Baye’s conditional probability values by the agents. This process executed by the proposed framework is found to be reliable and efficient. This proposed framework has been validated through social studies and thus established. Conclusions drawn out of various experiments and social studies will be useful to researchers of agent based e-learning systems and it will also provide utility values to e-learning system designers.

6.2 Findings and Conclusions of Strategic Studies

6.2.1 On the Methodologies to Determine Strategies

Findings:

Based on the observations of the social survey and by knowing the sample positions, the research could segregate active and passive learners from 58
experimental group respondents. The survey identified 27 (47%) active and 31 (53%) passive learners. The ratio 47/53 matched well with the ratios of active/passive preferred feedbacks computed respectively from the statistical analysis. Reliability was checked through Chronbach’s alpha value. The segregated respondents were interviewed for validating the obtained results using Delphi technique. This second survey also confirmed the hypothesis by one way ANOVA test. This identified experimental group became control group for later surveys and the strategies have been approved as research parameters.

Conclusions:

It is concluded that passive and active learners can be identified and segregated based on their learning preferences of particular instructional styles. Even though preference of learning strategies could vary from time to time and also the duration of time spent on particular learning material designed with particular learning characteristic could also vary; but the active or passive learners will prefer for distinctively different styles of instructional designs.

6.2.2 On Various Strategies

Findings:

1. It is found from the two surveys, that active learners exhibited a higher degree of acceptance of most of the strategies of active learning characteristics but do not overwhelmingly accepted most of the strategies of passive learning characteristics. Passive learners on the other hand exhibited less degree of acceptance on active learning characteristics’ strategies and medium degree of acceptance to most of the passive learning characteristics’ strategies.

2. 14 Strategies with 9 qualitative measures and 5 quantitative metrics have been derived by the research for dealing with active and passive learning characteristics. These strategies have been experimented with Computer Science e-learning contents. These delimitations are due to the restricted applications of adaptive mobile s/w agents.
Conclusions:

1. It is concluded that irrespective of learner characteristics, most of the e-learners will prefer for personal style adopted in the instructional e-materials of Computer Science.

2. Blended e-learners will not strictly demand for thematic or goal oriented representation of the e-contents. They will not demand for video/images more than textual/graphical media in the e-frames of Computer Science e-contents.

3. Active e-learners will prefer for objective driven e-contents in the form of independent sharable objects.

4. Active learners will prefer for i) Global perspective more than specific idea in the e-instructional approaches; ii) Broader philosophy more than specific fundamental procedural steps; iii) Holistic inter-disciplinary content to discipline restricted content; and iv) Activity based than study based instructions.

5. Passive learners will prefer for i) Specific idea more than global perspective in the e-instructional approaches; ii) Fundamental procedural steps more than broader philosophy; iii) Discipline restricted content more than holistic inter-disciplinary content; and iv) Study oriented approaches more than activity based learning.

6. Active learners will indulge in ‘Group study’ than ‘Solo study’ habits. They will attempt to solve a given problem at the first instance itself. They will also prefer for indication of study time and the entire course or lesson should be divided into independent, small self contained modules or objects.

7. Passive learners will indulge in ‘Solo studies’ rather than group studies. They would like to consume plenty of time to study a given problem first before attempting to solve the problem. They will not like restricting instructional time with limit, rather will like to consume their own time in learning. Passive learners want the entire e-course or complete lesson in one single bundled lot explaining the matter in a sequential fashion.
6.2.3 On the Measuring Tools of Strategies

Literature Supports and Findings:

With strong literature supports, two parameters namely 1. μ, the ratio of any current strategic value at any instance of the current usage and the threshold documented value and 2. ‘M’ which is represented by a natural logarithmic function, a metric using μ has been defined and determined during experiments for every instance of measure. It is found that this ‘M’ could either numerically converge to a value of ‘e’ the natural exponential number, or 0.0 depending upon how a particular learner (either active or passive) under observation behaved in a particular learning situation (strategy). An algorithm which applied Naive Baye’s conditional probability, computed these μ and M values for any instance and found whether the values of M either converged to ‘e’ or 0.0.

Conclusions:

It is concluded that strategic ratios and natural logarithmic function value that used the ratios, can be reliably applied to determine whether a learner through his continued usage of particular characteristic (strategy) e-contents belongs to that particular learning characteristic or not.

6.3 Conclusions Drawn from First Set of Experiments

Findings:

1. It is found that quantitative strategies can identify the learning characteristics of a lesson, when tagged with threshold strategic values.
2. It is found from the experiments that the surveyed learner characteristics and the hypothesised learner characteristics matched well with each other in most of the qualitative strategies when seen in an overall perspective. It is thus found that learner preferences have revealed the respective learning characteristics.
3. Quantitative and qualitative strategies were measured using ratios of strategic values and M values of logarithmic function using strategic values.

4. Quantitative strategies are found to be easily identifiable. Qualitative strategies showed a clear picture of learning characteristics.

5. Despite its easiness in specifying quantitative strategies, the performance of qualitative strategies closely represented appropriate learning characteristics than the quantitative strategies.

6. Active learners were found to be stronger in choosing active based instructions, while passive learners in general chose both active as well as passive learning materials.

**Conclusions:**

It is concluded that as and when lessons progress, either the active representation or the passive representation when increase, the other will decrease. It is also concluded that the deviation between strategies will vary from lesson to lesson. It is concluded that the deviations in strategies will increase with respect to mixed types of active and passive representations.

**6.4 Conclusions Drawn from Second Set of Experiments**

**Findings:**

1. Errors were found to be minimized with agent based s/w approaches.
2. All jobs were computed either with time slices or OS dependent processing in the single system approach without agents.
3. Errors were found to be minimized with agent based approach in determining preferred SCOs.
4. Agents skipped processes once Naive Baye’s value reached threshold value.
5. Size ratios of processes increased in the case of non agent based approach.
6. Virtually non-agent based processing time was governed by user retention time.
7. Most of the processing in single system wasted processing time in streaming the buffer which was less in the case of agent based systems, even though it was difficult to measure streaming time.

8. It is found that segregating the mobile agents into conditional objects (like ‘factual’ / ‘procedural’ / ‘solution’) as proposed by the research work and also demonstrated by the experiments, will largely reduce the computational overheads in generating unnecessary mobile agent processes in e-Learning environment.

Conclusions:

1. Adaptive mobile s/w agents when adopted in e-learning environment will increase the reliability in determining learner characteristics and make the system efficient.
2. It is concluded that Naive Baye’s conditional probability values will be accurate in predicting the required ratios of conditional mobile agent numbers for newer trial runs.

Recommendations:

1. It is recommended to implement s/w agents in e-learning environment, under independent server that will generate agents, while separate servers could be deployed for e-learners, and maintain separate SANS for storing classified SCOs of different learning styles.

6.5 Suggestions for Future Extension of Research

1. The agents adopted Naive Baye’s conditional probability for either active or passive learning characteristics. This research may be extended for trying out Cauchy’s probability distribution for multiple learner characteristics under system’s approach.
2. This work may be extended for determining security aspects, by trying out Poison’s probability values.
3. This work may be extended with non-problematic, non-engineering/science subject of e-contents.