PREDICTING LEARNERS USAGE FOR A MARKETABLE E-LEARNING PORTAL

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ABSTRACT

To date, existing e-learning portals focuses on providing various learning materials via online. Such an approach may provide huge benefit to the learners; nevertheless, less value can be obtained by the developers or owners. The knowledge transfer programme provides an insight on how existing e-learning portal can be upgraded. The academia has introduced the industry to a computational modelling that is built upon the behaviour of nature community (i.e bees). The utilization of Artificial Bee Colony algorithm in predicting learners' usage of an e-learning portal provides an indicator to the developers on the portals effectiveness. Such information is then useful in producing a marketable and valuable e-learning portal.

Keywords: e-learning, computational modelling

Sehingga kini, portal e-pembelajaran yang sedia ada memberi tumpuan kepada penyediaan pelbagai bahan pembelajaran melalui atas talian. Pendekatan sedemikian boleh memberikan manfaat yang besar kepada pelajar; Walau bagaimanapun, kurangnya sesuatu nilai adalah dari pemaju atau pemilik. Program pemindahan ilmu memberikan gambaran tentang bagaimana portal e-pembelajaran yang sedia ada boleh dinaik taraf. Ahli akademik telah memperkenalkan kepada industri untuk pemodelan pengiraan yang dibina di atas tingkah laku semula jadi komuniti (iaitu lebah). Penggunaan algoritma Artificial Bee Colony dalam meramalkan penggunaan pelajar daripada sebuah portal e-pembelajaran memberikan petunjuk kepada industri tentang keberkesanan portal. Maklumat tersebut kemudian berguna dalam menghasilkan sebuah portal e-pembelajaran yang boleh dipasarkan dan bernilai tinggi.

Kata kunci: e-pembelajaran, pemodelan pengiraan

INTRODUCTION

The National Higher Education Strategic Plan (PSPTN) highlights the direction of higher education that emphasizes intellectual development and quality human capital in accordance with the country's aspiration to become a prosperous and competitive nation by the year 2020. The government has realized the role of a university to spearhead Research and Development (R&D) and to produce new technologies and innovations. A university is considered a "think tank" for future technological advancement in an ICT literate society. Knowledge and technology created at universities are then transferred into industries to apply as products and services. For the past years, there has been a rapid rise in knowledge transfer from universities to industry players and technology transfers from industries to universities, through skills and knowledge enhancement programmes, research joint ventures, and corporate social responsibilities. This academia-industry partnership is designed to attract industry players to get involved in smart partnership to minimize their operation costs as well as to enhance their business skills and knowledge. This is because public and private universities are expected to contribute to the country's economy and society, especially through the creation of new businesses and educational programmes.

As such, many e-learning portals and websites are developed to meet the demands of globalization. However, although there are various e-learning platforms in the market that can be utilized for education purposes, these platforms are developed for general usage in which all users regardless of their knowledge background are presented with the same materials of the e-learning programmes. Studies have acknowledged that users of different backgrounds may require different approaches in motivating their learning. For example, some students may not prefer direct learning (e.g. answering question through test bank) but are more interested to undergo education programmes or applications that are incorporated via games. It is felt that since industries are capable of providing relevant resources on ICT technologies, there is a need for industries to provide an alternative –learning platform that includes artificial intelligent features which are capable of learning the users' behaviours. Hence, this project intends to provide an e-learning platform that offers various learning programmes that cater to the needs of different learners particularly the rural communities.

LITERATURE REVIEW

Education should offer conditions needed to optimize learning and promote the transfer of knowledge and skills (Smeets, 2004). Many educational studies have acknowledged the positive effects of ICT on educational attainment particularly on students' level of reading comprehension. The help features available in the computer mediated text can influence reading comprehension (Reinking and Schreiner, 1985; Reinking, 1988; Miller et al., 1994) and comprehension increases when manipulation of the text is controlled by the children (Reinking and Schreiner, 1985).Despite the positive effects of computers on learning, other studies have also indicated rather contrasting views towards the use of computer. Researchers claim that ICT may increase inequality in education (Volman, Van Eck, Heemskerk and Kuiper, 2005; Heemskerk, Brink, Volman and Ten Dam, 2005; Gulati, 2008). Heemskerk et al (2005) argues that digital divide exists between the haves and the have-nots and those who do and do not have access to the Internet which will somehow influence their ICT knowledge and skills. Similarly, Volman, Van Eck, Heemskerk and Kuiper (2005) who studied on primary and secondary students from an ethnic minority background in the Netherlands discovered that these minority students considered themselves as less skilled ICT users than pupils from the

majority population. They also found ethnic differences in participating in ICT activities at schools in which pupils from an ethnic minority background used less ICT for gathering information and more for drill and practice than pupils from the ethnic majority. They were unaware of the value of using the Internet and email in developing their higher level of reading and writing skills.

In a similar vein, it is being argued that ICT may not benefit those who are resource poor and have limited access to ICT particularly the rural communities. In cases such as Botswana and China rural and poor community continue to be deprived of infrastructure, technologies and skilled teachers (Gulati, 2008). In Botswana, even though the policies identify computer education as necessary to compete in this modern world, they have to face significant challenges including the shortage of teachers and infrastructure (Ojo and Awuah as cited in Gulati, 2008). Similarly in China, a study by Zhang (2007) indicated that despite the availability of technologies in the urban areas, high percentages of people from lower social classes, females, who continue to be marginalized due to their lack of access to adequate learning resources and basic education (as cited in Gulati, 2008)

In the area of prediction, Bahamish and Abdullah (2010) employed ABC to forecast the tertiary structure of C peptide of ribonuclease A. This is done by searching the conformational search space to find the lowest free energy conformation. In the study, the fitness function is indicated by the protein energy function while the torsion angles represent the variables involved. The results obtained showed that ABC is capable to produce promising results compared to the ones produced by for Parallel Simulated Annealing with Genetic Crossover (PSA/GAc). The application of ABC also has been demonstrated in predicting CO_2 emission of Turkey (Kiran, Turanoglu & Ozceylan, 2011). The study employed several socio-economic indicators as input, which includes energy consumption, population and several others. For prediction purposes, the input was used to find the optimal values of the weighting parameters. The experimental process involved three forms of ABC prediction model, namely ABC-Linear, ABC-Exponential and ABC-Quadratic. Final results obtained indicated that ABC-Linear performs the best by producing better fit solution to the problem under study.

Current research topics include the extension of ABC to optimize of hybrid functions; to provide solution to integer programming and engineering design problems (Rao et al., 2008; Singh, 2009; Karaboga, 2009); to provide the solution to combinatorial (Pan et al, 2010) and multi-objective optimization problems (Omkar et al, 2010) and to provide solution to clustering (Karaboga and Ozturk, 2010), neural network training (Karaboga and Ozturk, 2009) and image processing (Xu and Duan, 2010) problems.

In light of the development of ICT in Eastern schools, Zhang (2007) suggests a number of challenges that Eastern educators need to deal with, including "a) diffusing ICT to the practices of all teachers in all schools in both developed and underdeveloped regions; b) developing partnerships between schools, research institutions, public organizations, and business sectors to build cost-effective ICT and create pedagogical-sound soft ware resources; c) reshaping professional communities that are willing to experiment with new ideas and technologies, in service of reflective and continual improvement; and d) orchestrating ICT into systemic efforts for school change" (p. 311-312). Taking Zhang's suggestions into consideration, this project undertakes the opportunity to share Artificial Intelligence approaches in developing an e-learning portal. In particular, we proposed a forecasting model that is built based on a recent nature-inspired algorithm, which is the Artificial Bee Colony (ABC) (Karaboga, 2005).

METHODOLOGY

The objectives of this paper are as follows:

1. To identify the benefits gained from the university and the industry through this knowledge transfer project
2. To examine the industry, the users and the graduate intern's views of the knowledge transfer project

The project employed both quantitative and qualitative methods such as survey, interview and experiment in designing the user centric model. In order to produce a relevant user-centric model, the key focus is on building the users profile. The profiles were employed as input data in the experimental stage. In Stage 1, a prototype of an e-learning platform developed by I-Sys has been utilized by a target group of students between the ages of 10-12 years old. In total 122 students were enrolled in this project and they were selected from various areas in Semenanjung Malaysia. This includes four selected Telecentres in Peninsular Malaysia which covered [1] Pusat Akses Internet Komuniti Masjid As-Syakirin, Oran, Perlis; [2] Pusat Internet Desa Bandar Tenggara, Johor; [3] Medan Info Desa Sg Lalang, Selangor; [4] Karnival Jalur Lebar Kuala Nerang and Selected school in Kedah [5] Sek. Keb. Bandar Baru Sintok. Briefings were given to the PID managers, teachers, parents and students by the Industry's representative Pn. Zainazad, the Graduate Intern, and the researchers from University Utara Malaysia. Table 1 below shows the students' profile by location.

Table 1: Number of Subscriptions By Location

Location	Number of Subscriptions
Phase 1	
Pusat Akses Internet Komuniti Masjid As-Syakirin, Kg Oran, Perlis	15
Pusat Internet Desa Bandar Tenggara I & II, Johor	24
Medan Info Desa Sg Lalang, Selangor	13
Karnival Jalur Lebar Kuala Nerang	10
Phase 2	
Sekolah Kebangsaan Bandar Baru Sintok	60
Total	122

The prototype is a learning portal created as a one-stop learning centre which integrates learning management system, content and applications from reputable content providers. It offers students to utilize learning objects, online questions banks, education games, community tools and few other facilities. The students were asked to utilize the prototype for a period of 6 months. During the utilization period, all activities (in the e-learning portal) performed by the students were automatically stored in personal log book. Prior to that, students' demographic profiles were also collected via questionnaire. In Stage 2, information on both the students profile and logged activities was used to design a model that predicts the user's commitment in utilizing learning portal. Such information is important in developing a prediction model as Artificial Intelligence approach which was based on pattern learning that utilizes historical data in predicting the future outcome. In the experimental design, 90% of the data was used for training (that is to develop the model) while the balance was utilized as a testing dataset. While in Stage 3, the experiment is carried out using LS-SVMlab Toolbox (Pelkmans et al., 2002) and is executed using MATLAB platform on Intel® Core™ i3-2330M processor, CPU @ 2.20GHz with 6.00 GB of RAM, in 64-bit Windows 7 operating system. Finally interviews were conducted

with a representative from the industry and the graduate intern to identify the benefits gained. In this paper, we will highlight the findings gained by the industry particularly in relation to ABC as a prediction model and the industry's perspectives of the project.

RESULTS AND DISCUSSION

- *ABC as Prediction Model*

In this project, the Artificial Bee Colony was utilized as the prediction algorithm. Prior to conducting the experiment, the value for control parameters of ABC was set, where the value for source number(SN), limit was set to 125 and maximum iteration was set to 100, SN*Dimension and 300 respectively. The equation of commitment prediction for ABC was adopted from Bahamish, Abdullah and Abdul Salam (2009) and defined as follows:

$$\mathbf{Commit(i) = (\alpha \times FC) + (\beta \times FI) + (\gamma \times COwn) + (\delta \times IConnect_S) + (\varepsilon \times IConnect_H) + £}$$

Where Commit(i) is users commitment in using e-learning portal and the α, β, γ, δ and ε are the coefficients for FC, FI, COwn, $IConnect_S$ and $IConnect_H$ respectively while the £ is the intercept coefficient. The output produced by ABC is the coefficient values for the utilized variables. Table 2 shows the best values produced by ABC that can minimize the error between prediction (output) and actual value of student commitment.

Table 2: Values of variables

ALPHA (α)	BETA (β)	GAMMA (γ)	DELTA (δ)	EPSILON (ε)	ZETA(£)
0.1476	-0.1094	0.2227	-0.7937	0.5153	0.6317

Based on the Table 2, the best values produced by ABC that can minimize the error between prediction (output) and actual value of student commitment. It showed that ABC is able to perform better in parameter tuning which finally resulted in higher prediction accuracy. Thus, it is concluded that ABC can be considered as suitable tool for prediction of time series data under study.

In the present study, these features were used for prediction model construction. Table 3 illustrates the actual and predicted values by ABC logarithm based on the sample data taken from 6 students.

Table 3: Actual vs. Predicted Values by ABC

	FC	FI	COwn	$IConnect_S$	$IConnect_H$	Prediction (in hrs)	Actual Commitment (in hrs)	Differences
Student 1	3	2	1	2	1	0.006 (0.36 mnt)	0.050 (3 mnt)	0.044 (2.64 mnt)
Student 2	3	2	1	2	1	0.006 (0.36 mnt)	0.000 (0 mnt)	0.006 (0.36 mnt)
Student 3	2	2	1	1	1	0.652 (39.12 mnt)	1.317 (79.02 mnt)	0.664 (39.84 mnt)

Student 4	1	4	1	1	1	0.286 (17.16 mnt)	3.733 (223.98 mnt)	3.447 (206.82 mnt)
Student 5	2	2	1	1	1	0.652 (39.12 mnt)	0.000 (0 mnt)	0.652 (39.12 mnt)

As indicated in Table 3, Student 1 used computer a few times a month and has been using internet between one to four years. In addition, he / she used the Internet at school between four to six times a week. Based on the data obtained, the expectation that Student 1would use Schoolbox portal was 0.36 minutes. However, the actual commitment of students using the portal was 3 minutes. A total of 2.64 minutes difference was found between the predictive values with the actual value. Hence, no significant difference of the predicted value was found. For student 3, the actual commitment of this student using the portal was 79.02 minutes. From data obtained, the frequency of using the computer was a few times a week this student used the computer at school between one to three times a week and the expectation that student 3's commitment in using Schoolbox portal was 39.12 minutes. The value for the difference was 39.84 minutes. This indicates a significant difference from the predicted value of 39.84 minutes.

Benefits gained by the Industry

To date, this project has succeeded to realize knowledge transfer between the two parties; Universiti Utara Malaysia and I-Sys Sdn. Bhd. Both parties have gained some benefits in terms of E-learning initiatives, IT Solutions, Internship programmes and knowledge on Artificial Intelligence. In this section, we highlight the related knowledge and benefits gained from University-Industry Collaboration based on the interview.

- *Knowledge on Artificial Intelligence*

Firstly, this project managed to transfer the knowledge on Artificial Intelligence and its approaches. Artificial intelligence (AI) is a field of computer science that explores computational models of problem solving, where the problems to be solved are of the complexity of problems solved by human beings. Intelligence can have many faces: solving problems, pattern recognition, classification, learning, induction, deduction, optimization, surviving in an environment, language processing, planning, and knowledge. This project includes one of the nature-inspired algorithm in AI, namely the Artificial Bee Colony (ABC) algorithm for problem solving.

- *Business Profit*

The profit gained by I-SYS Sdn. Bhd. grew 100% in the enrolment numbers. Figure 1 illustrates the enrolment statistics by primary school students. This can be demonstrated in phase 1, whereby a total of 62 people enrolled in this Schoolbox portal. Then, in phase 2, the number of students increased by over 60 people and bringing the total number of 122 students.

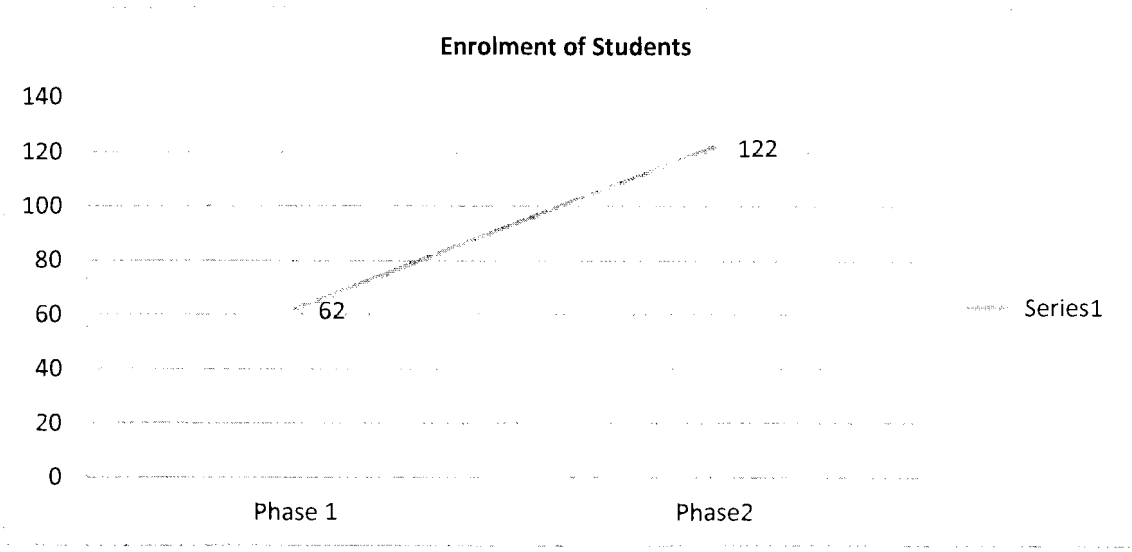

Figure 1: Enrolment Statistics of Students

Figure 2 illustrates the enrolment fee statistics of students. Based on the figure, RM15000 was obtained from student registration fees in phase 1. While in phase 2, the fee increased to RM 30000. This shows an increase of 100% in the enrolment fee.

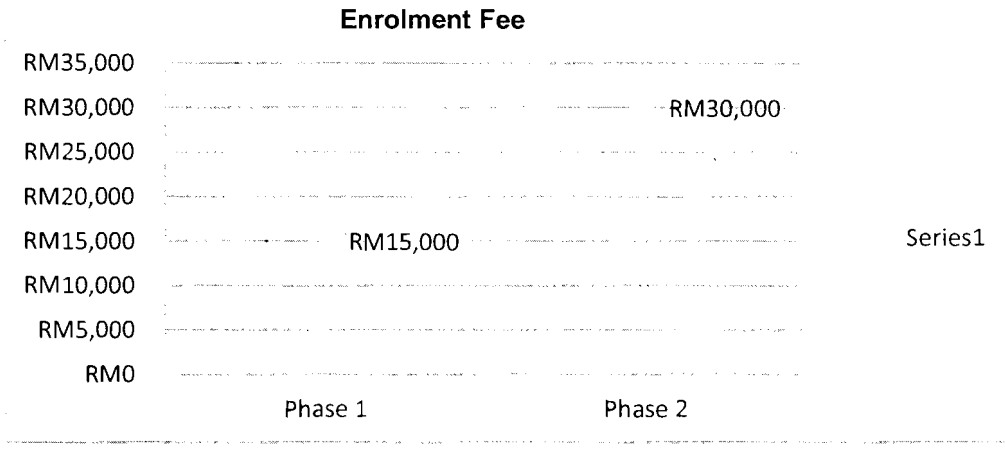

Figure 2: Statistic Enrolment Fee of Students

Zainazad explained that the project has helped her company to increase their product's subscription. More students from the rural areas benefitted from it and the government's aim to increase accessibility to technology and to reduce the digital divide among urban-rural people are achieved.

> *110 rural students have benefitted from the program with free subscription. Their parents can now take part in their children's learning activities and monitor their progress as the system can produce performances reports.* *(Zainazad, Interview)*

Even though this project has allowed free subscription of the Schoolbox e-learning portal for 122 students, the existing results indicated that there was only minimal commitment and

participation from the students. They maximized the usage only during the researchers' visit to the school. Figure 3 shows the number of Schoolbox portal usage by the students.

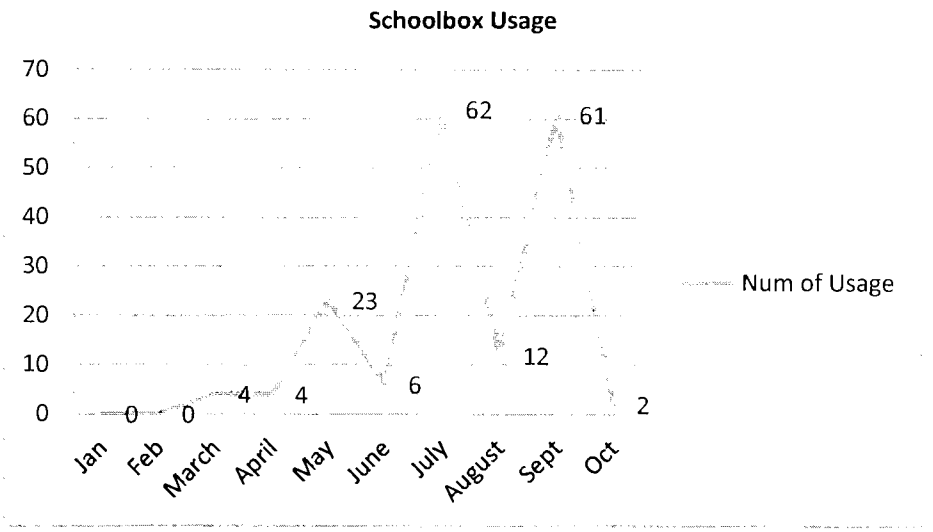

Figure 3: Number of Schoolbox Portal Usage

- *Product Improvement*

Zainazad reported that this joint project between University-Industry helped to improve their product which is called 'School Box'.

> *The product features are enhanced as few more new features are added based on the feedback and suggestion from the end users and the academicians. This has enabled us upgrade our product and ensure that we are capable and confident to enter the mass market (Zainazad's Interview)*

She added that the feedback received from the university enhanced the quality and the features of her product.

> *Feedback received from the end users and academic team has enabled us to enhance the features of the product to offer better services to the end users (Zainazad's Interview)*

Furthermore, she explained that the company managed to reduce the time in terms of users and the market survey.

> *Since the program has provided us a platform for us to test our product with a group of users, it has significantly reduced our time in terms of user and market surveys. With the testing group, we are able to receive feedbacks and suggestions to further improve our product.The customer service set-up for the program are able to provide better services as the project has given us the opportunity to service the end users and improve our processes (Zainazad's Interview)*

- *Better Understanding of the End Users*

She claimed that the company gained better understanding of the users such as parents and the school children as well as their needs. Thus improve customer services in the company.

The program has enabled our employees to experience first- hand on dealing with end users especially parents and school children.We are able to set and arrange our teams based on the job specialisations as we are more aware of the needs and requirements of the end users. The relationship between customers are better and more manageable now than before the program started as we are dealing with actual end users with actual issues...
The program definitely is a good experience for the customer service team. Since we are working with actual customers, we are able to better anticipate issues and expectations..
Various roadshows conducted by the company and UUM has provided valuable experience for our employees. *(Zainazad, Interview)*

- *University-Industry Partnership*

Zainazad mentioned that team work culture was fostered between the two parties involved. Both learned new technologies and knowledge from each other.

The program has inculcated the teamwork culture between the company and the academicians as both parties have given full cooperation to ensure that the program is a success.

The intern assigned for the project has assisted us in understanding the concept and methodology of artificial intelligence (AI), particularly the ABC model and how AI can be implemented in SchoolBox. However, we find that the intern's knowledge of the algorithm is only at theoretical level. *(Zainazad, Interview)*

The goal of the project is to transfer knowledge on intelligent user-centric e-learning platform between academia and industry. The objectives of the project are: i) to identify the benefits gained from the university and the industry through this knowledge transfer project; ii) to examine the industry, the users and the graduate intern's views of the knowledge transfer project; and finally, iii) to identify issues and concerns voiced by the participants of the project.Our findings indicated that the ABC Prediction Model can be used as a tool to predict students' commitment when using the E-learning portal. Even though the data gathered in this study was limited, we managed to examine the students' interests and commitment based on their actual time spent on the portal. Throughout this project, we realized that most of the rural students particularly from the PID centres, who subscribed to the E-learning portal did not have easy access to it due to the distance from their homes to those centres. In addition, lack of monitoring and commitment from the PID managers and students somehow contributed to the problems in implementing the project. Students were not using the free portal subscribed for them despite the free access provided. This finding is supported by earlier studies conducted in many parts of the world including Botswana and China (Gulati, 2008; Zhang, 2007) which indicated many challenges in dealing with rural communities despite the availability of technologies provided for them. If this continues people from lower social classes will continue to be marginalized due to their lack of access to adequate learning resources and basic education (Gulati, 2008). Digital divide between the haves and the have-nots and those who do and do not have access to the Internet in these areas will still exist and essentially will influence their ICT knowledge and skills.

However, during the second phase of the data collection, with constant monitoring from the researchers, we managed to gain some data set for the analysis. However, the data obtained during this project was still quite limited. The results indicated that students' commitment in using E-learning portal was low. Perhaps if the project was conducted in the urban areas, the findings would have been different. It is felt that constant monitoring from the teachers, parents,

PID officers and the researchers are needed to ensure the success of any ICT project involving rural communities.

Despite the pitfalls, this project brought about many benefits to the parties involved: the university, the industry and the rural community. The Industry benefitted in terms of their business profits through an increase in the subscription rate of the E-learning portal and product improvement of the Schoolbox. They also developed a better understanding of the end-users through the road shows organised by the university and finally, established the university-industry partnership and the teamwork culture between the parties.

SUMMARY

In summary, the Ministry's goals through this Knowledge Transfer Project to improve the level of education in certain areas and to enhance economic gains for the industry as well as for the academia to adopt the latest knowledge and technology from the industry in teaching, learning, research and consultancy are achieved. However, low commitment and lack of supervision are found to create challenges in rural community project like this one. Apart from that, another issue raised by the Industry was the lack of commercialization funding to launch the portal to the mass market after undergoing modifications and improvement. In conclusion, it is hoped that more initiatives are provided by the Ministry to further enhance the knowledge transfer of university-industry-community partnerships.

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