Pertanika J. Soc. Sci. & Hum. 25 (S): 83 - 92 (2017)

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

# Product-Orientated Learning Efficacy among Technical Students

**Mansor, M.*** **and Madar, A. R.**

*Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia*

## ABSTRACT

The appropriateness of learning methods used contributes to performance improvement and interest in the topic, Electromagnetism, among technical students with different cognitive styles. Learning is a process in which students obtain new information and knowledge. For effective learning and to achieve academic excellence, students need to know the proper learning methods. This study identifies appropriate learning methods for technical students in order to improve the achievement of technical students of different of cognitive and to enhance their interest as presented in Witkin's Theory. This research studies a couple of learning groups engaged in product-orientation learning and conventional learning. The sample comprises 70 students from Malaysian polytechnics to determine their cognitive styles through the Group Embedded Figures Test. A pre-test, post-test and a questionnaire were used in quasi-experimental research to obtain data concerning the students' performance and their interest in learning. The results show that product-orientated learning yields the best scoring of students' performance and interest increment compared to other methods. We conclude that learning methods should ensure students' needs positively correlate with their achievements and interest. Based on the advantages of the product and its effectiveness in aiding student comprehension, this product is seen to be an appropriate learning method for technical students in Malaysian polytechnics

*Keywords:* Cognitive styles, learning method, product-orientated learning

ARTICLE INFO

*Article history:*
Received: 01 November 2016
Accepted: 15 March 2017

*E-mail addresses*:
jlk8056@gmail.com (Mansor, M.),
rizalm@uthm.edu.my (Madar, A. R.)
* Corresponding author

ISSN: 0128-7702 

## INTRODUCTION

Technical and Vocational Education Training (TVET) provides education for technical students and is responsible for producing highly skilled graduates. In order to achieve this goal, technical and vocational institutions have implemented various methods involving multiple parties. Although the methods have been established and carried out, the students' academic performance and skills still seem to be deteriorating. This deterioration has contributed to shortcomings in fulfilling the requirements of industries that require highly skilled talent. Several research studies have been conducted to identify this performance decline among local polytechnic students (Emran & Hamid, 2014; Che Kob, Abdulah, Kamis, Hanapi, & Ridzuan, 2016; Marlina, Azilla, & Adila, 2013). The investigations revealed that not all learning methods employed affected student achievements (Godwin, 2013). Many learning methods have been studied and it has been suggested that they be used for technical and vocational students. Nevertheless, the results of these investigations found, surprisingly, that students are still applying conventional learning as a learning method (Crouch, Fagen, Callan, & Mazur, 2004; Ragan, Frezza, & Cannell, 2009). However, these studies did not focus on the appropriateness of the learning methods used by the students to improve the quality of their learning and achievements.

Product-orientated learning, which is one of the learning methods, helps students to learn more clearly. This method provides more details about content and theory (Salas & Ellis, 2006). The researchers also claimed, by comparing to previous research, that this method could help students to interact directly with the content through a product or object that was applied during the lecture. According to Metros and Bennett (2002), this learning method aims to transform the delivery of the curriculum learning design in an effort to improve the quality of higher learning institutions.

Conventional learning only provides limited learning materials, while learning-orientated products can be used repeatedly and students may learn the latest technology (Wiley, 2009) from using them. By using learning technologies, students can apply the technology used in the real world of industry. In addition, it may make students realise the difference between knowledge and application (Cheng & Wang, 2013). For an effective student learning approach, students should be actively involved in operating the products. It is an important aspect in the world of learning as it helps students reinforce theoretical knowledge and problem solving whether for complex problems or real problems (Tick, 2007). When students know what they have learnt, learning is more interesting and efficient and the students are motivated to continue. Salas and Ellis (2006) explained that product-orientated learning is able to drive students to explore the information obtained through the method of problem solving. In addition, Lin, Tseng, Weng and Su (2009) noted in their study that this method enables students to learn and prioritise knowledge and information they need, thus improving their understanding towards teaching and learning.

Previous studies emphasised some aspects of product-orientated learning, also called learning materials. These learning materials consist of the actual material used when learning takes place to give exposure to the students about real concepts and actual materials used in industry. Farrokhnia and Esmailpour (2010), who studied the effectiveness of learning through experiments using real materials and virtual and comprehensive study, found that the application of real materials compared to simulation helped students to improve their understanding of electricity as electricity is an abstract concept that is difficult to be grasped only through theory (Kolloffel & Jong, 2013). Therefore, it can be summarised from these studies that product-orientated learning is suitable for technical and vocational education, in which real-world applications as well as concepts must be mastered. The researchers then added that although technical students in particular referred to textbooks to learn their field, this traditional method of learning was limited in facilitating understanding. These students should use and apply real materials and procedures so that the information obtained is used precisely and completely.

Salas and Ellis (2006) recommended the use of 'web-based' learning products for technical and vocational students as a means of enhancing comprehension of difficult theories and applications. However, students were not able to use and feel the actual materials. This method was suitable as an introduction or preparation for using the actual materials. Lucas (2014), who studied the pedagogy of vocational students, found that for effective and deep learning, students needed three key aspects to be present: opportunity to use actual materials during learning, guidance from an expert and proper symbols.

These studies suggested that the researchers were focussed on learning methods for technical and vocational students in order to improve their academic performance, but failed to fully consider the characteristics of the students. Students' characteristics are an important aspect in learning strategies as they indicate the students' ability to manage learning (Pithers, 2006). Therefore, this study aimed to investigate the learning methods that are considered product-orientated. It focussed on the characteristics of students from different orientations i.e. field independent (FI) and field dependent (FD) in cognitive styles and the learning method that best suited them. The research questions were as follows:

(a) Is there a significant difference in the level of achievement and increment of polytechnic students' interest between the treatment group and the control group among students with different cognitive styles who are field independent (FI)?

(b) Is there a significant difference in the level of achievement and increment of polytechnic students' interest between the treatment group and the control group among students with different cognitive styles who are field dependent (FD)?

The results obtained indicated the importance of learning methods in improving students' achievement and interest in learning among technical and vocational students.

## METHOD

### Participants

The participants comprised 70 first-semester students enrolled in the Diploma in Electronic Engineering (Communication) programme in Malaysian polytechnics. Thirty-three students from Sultan Abdul Halim Polytechnic were placed in the treatment group, while the other 37, from Tuanku Syed Sirajuddin Polytechnic, were placed in the control group. All qualified participants were considered as being on the same level. These students were chosen as they were stakeholders. All were studying Electrical Technology. The actual number of students enrolled in this programme is large but only 70 participated in the experiment.

### Materials

Students in the treatment group were led through product-orientated learning on the topic, Electromagnetism, which is one of the topics studied in the Electrical Technology course. Four sub-topics were chosen namely, magnetic field, magnetic inductance, Faraday's Law and Fleming's Right-Hand Law. An activity from each sub-topic was run. The students were provided with a lab sheet to guide them through the activities.

### Procedure

The 70 participants were assigned into two groups: a control group (Tuanku Syed Sirajuddin Polytechnic students) and a treatment group (Sultan Abdul Halim Polytechnic students). The control group applied the traditional method in learning the modules, while the treatment group applied product-orientated learning. Before the lecture, both groups were tested on their cognitive ability using the Group Embedded Figure Test (GEFT), which required the students to answer a set of questions. The test was conducted to determine the students' cognitive styles i.e. if they were field independent (FI) or field dependent (FD). The test contained three parts, which the students had to complete in 20 minutes. They were also required to answer a pre-test question to identify background knowledge of the topic, Electromagnetism. The test took both the cognitive and affective domains into consideration. The whole procedure took about one hour and 30 minutes. Next, they were required to answer questionnaires to determine their interest before the study began.

The study period took eight weeks to complete. After that, the students were again required to answer a post-test question to determine their level of knowledge on the topic that was learnt. Then, they were once again asked to answer a questionnaire to find out whether there was an increment in interest after the methods were applied.

## DATA ANALYSIS

The Statistical Package for the Social Sciences (SPSS) software was used to analyse the findings. MANCOVA was used to find the differences in student achievement and interest in FI and FD between the control group and the treatment group. All the statistical tests performed had a significant value of *x*=0.05.

## RESULTS

Table 1 shows the interaction effect of the two groups of students, the treatment group and the control group against their cognitive styles. The Pre-Achievement and Pre-Interest scores show the pre-test and initial interest scores, respectively, before learning took place. The Post-Achievement and Post-Interest scores indicate the post-test and increase in student interest, respectively, after learning had been completed.

Table 1
*Score of Field Independent and Field Dependent Cognitive Styles Students' Achievement and Interest*

| Source | Dependent Variable | df | MS | F | P |
|---|---|---|---|---|---|
| Pre-Achievement | Post-Achievement | 1 | 2324.365 | 149.261 | 0.000 |
| | Post-Interest | 1 | 0.004 | 0.251 | 0.618 |
| Pre-Interest | Post-Achievement | 1 | 2.156 | 0.138 | 0.711 |
| | Post-Interest | 1 | 3.986 | 252.778 | 0.000 |
| Group | Post-Achievement | 1 | 10.128 | 0.650 | 0.423 |
| | Post-Interest | 1 | 0.018 | 1.129 | 0.292 |
| Cognitive Style | Post-Achievement | 1 | 3217.825 | 206.635 | 0.000 |
| | Post-Interest | 1 | 4.902 | 310.836 | 0.000 |
| Group * Cognitive Style | Post-Achievement | 1 | 14.044 | 0.902 | 0.346 |
| | Post-Interest | 1 | 0.016 | 1.002 | 0.321 |
| Error | | 64 | 15.573 | 149.261 | |

Significant at $p<0.05$

The Group* Cognitive of Post-Achievement and Post-Interest shows that the $F(1,64)=0.902$, $p>0.05$ and $F(1,64)=1.002$, $p>0.05$, which indicate that both groups obtained the same score. Therefore, the results show that there were no statistically significant difference between the two variables, achievement and interest of students. The reading of these values shows that there was no statistically significant difference in student achievement and interest before and after the learning process.

Table 2, however, shows that there was a difference between the two learning methods.

Table 2
*Comparison of Mean Scores for Student Achievement and Interest in Field Independent and Field Dependent Cognitive Styles*

| Dependent Variable | Independent Variable | Group | N | Mean Score (Before) | Mean Score (After) | SD |
|---|---|---|---|---|---|---|
| Post-Achievement | Field Independent | Treatment | 6 | 28.91 | 84.92 | 7.41226 |
| | | Control | 15 | 23.1 | 60.33 | 5.94218 |
| | Field Dependent | Treatment | 27 | 26.61 | 82.13 | 7.92342 |
| | | Control | 22 | 22.02 | 57 | 6.61708 |
| Post-Interest | Field Independent | Treatment | 6 | 2.26 | 3.35 | 0.24410 |
| | | Control | 15 | 2.47 | 2.82 | 0.26645 |
| | Field Dependent | Treatment | 27 | 2.41 | 3.51 | 3.51741 |
| | | Control | 22 | 2.46 | 2.88 | 0.31745 |

Table 2 scores clearly show that there was a statistical difference between the mean scores of the two groups and the students' cognitive styles. The mean score for student achievement in FI among the treatment and control groups were, respectively, increased from 28.91 to 84.92 and from 23.01 to 60.33. The mean score for student achievement for FD among the treatment and control groups, also increased, respectively, from 26.61 to 82.13 and from 33.02 to 57. At the same time, the mean score for student interest in FI among the treatment and control groups, also increased, respectively, from 2.26 to 3.35 and from 2.47 to 2.82. The FD among the treatment and control groups increased from 2.41 to 3.51 and from 2.46 to 2.88, respectively. All the readings indicated that there were differences in student achievement and interest before and after learning.

Students' grade scores are based on the standard set by the Polytechnic Higher Education Ministry of Malaysia, and this standard was also adhered to in this study; under this standard, the score 80-100 is 'excellent', 65-79 is 'distinction', 40-64 is 'pass' and 30 or lower is 'fail'. The score for the students' interest was based on a 4-point Likert scale, where 1='Strongly disagree', 2='Somewhat agree', 3='Agree' and 4='Strongly agree'. The post-test results on the topic, Electromagnetism, showed that the students who used product-orientated learning received the score, 'excellent'. They also showed an increase in interest.

## DISCUSSION

The results showed that students of both cognitive styles who used the product-orientated learning method did better that those who use conventional learning methods. They scored 'excellent' and showed an increase in interest. Product-orientated learning was able to stimulate their interest to explore the topics in greater depth, unlike for the students who applied conventional learning. It is quite a challenge developing compatible learning product that can be used effectively by students of different cognitive styles. However, the product-orientation method proved in this instance well suited to do just this.

According to Witkin, Moore, Goodenough and Cox (1977), who studied the field-dependent and field-independent cognitive styles, field independent as a feature is more prominent than field dependent especially among technical, vocational and engineering students. However, the product-orientation learning method enabled both groups to obtain the score, 'excellent' without bias. This method allowed the students to grasp a complex topic in their studies.

Field-dependent students enjoy interaction, while field-independent students tend to be intrapersonal learners. This method, therefore, favours field-independent students as it gives them the opportunity to interact during learning. This helps them improve their memory and comprehension. Ragan, Frezza, and Cannell (2009) and Salamun (2004) found that learning materials gave an opportunity for students to engage directly with learning, enabling them to form involvement actively. Atif (2013) believed that the use of this learning method helps students work together to solve a problem. In this study, it helped field-independent students to cultivate the habit of working in a group, which is a practice they would have to do in real-life work situations.

In this study, product-orientated learning triggered active learning through interaction among the two different groups of students, and this facilitated comprehension, leading to improvement in their performance. When students are actively involved in their learning process and especially with the guidance of their lecturers, they learn well and effectively (Ganefri & Hidayat, 2015); this is probably due to the friendly and personal learning environment that is created.

Field-independent students are analytical thinkers, whereas field-dependent students are global thinkers. Electromagnetism is a challenging for both groups; Salamun (2004) found that the product-orientated learning could improve comprehension of this challenging topic for both groups, helping them understand the complex theories introduced and solve related problems. Not only that, it also improved their academic achievement and thinking process, enabling them to understand complex concepts and solve complex problems. As technical and vocational students, they often encountered complex learning content, so this method would be useful to them. Field-dependent students prefer a casual learning environment, while field-independent students prefer a formal learning environment. However, product-orientated learning offered an environment that was casual yet competitive. This aspect was vital to the students as they need to be adept at critical thinking to compete in a world of sophisticated technology.

Since this learning method was student-centred, meaning it encouraged more discussion rather than lectures, field-dependent students were comfortable. However, field-independent students faced some problems and would have preferred to learn independently. Nevertheless, this product-orientated learning method allowed both groups to learn independently, while encouraging discussion in order to reinforce comprehension so as not to distort information. Discussion also helped to consolidate the knowledge they had acquired.

In the context of strengthening learning, field-dependent students require more reinforcement. They also require objectives to be defined, whereas field-independent students are able to do this themselves. Field-dependent students, therefore, require learning materials to help them understand content better. However, product-orientation learning also helps field-independent students to learn better and understand more easily. Cheung and Slavin (2013) described the use of learning aids such as hardware and materials, and stated that the product-orientated learning method can strengthen students' cognitive style and improve their achievement. Although this method required some time for the students to grasp, in the end, it was a better way of learning. Working with real materials allowed the students to acquire knowledge directly and provided them with valuable information and concepts. This prevented misconception.

Cheung and Slavin (2013) stated that using learning materials in practical lessons helped students to strengthen their comprehension of theories. However, this was an impediment for field-dependent students. Product-orientated learning attracted both student groups to be fully involved in the learning process. It also prevented boredom, which can set in when learning is mostly through reading textbooks or listening to lectures. Thus, this is a better method than the conventional method.

## CONCLUSION

This study investigated the appropriateness of learning methods for technical students with different cognitive styles. Malaysian polytechnics rely on textbooks during lectures. For complex topics like Electromagnetism this is not suitable as these topics contain concepts that are difficult to grasp. The results of this study showed that product-orientated learning was helpful for students in learning complex topics. Thus, this learning method is recommended for use in Malaysian polytechnics. Fuglseth and Gronhaug (2003) stated that the performance of field-dependent and field-independent students will improve if they apply appropriate teaching and learning methods. As this method used real materials, it also requires the use of physical manipulation and the tactile sense as students will be required to work with tools and equipment. Using actual products also aids learner comprehension, long-term recall and transfer, level of thoughts and other elements pertinent to hands-on work. We recommend that this method be used in technical and vocational institutions to improve student achievement and interest. Future research could consider related psychomotor processes that are vital in technical and vocational education.

## ACKNOWLEDGEMENT

The authors would like to thank Universiti Tun Hussein Onn Malaysia's (UTHM), Office for Research, Innovation, Commercialisation and Consultancy Management (ORICC) and the Malaysian Ministry of High Education (MOHE) for supporting this Fundamental Research Grant Scheme Vote No. 1500.

## REFERENCES

Atif, Y. (2013). Conversational learning integration in technology enhanced classrooms. *Computers in Human Behavior, 29*(2), 416–423. doi: 10.1016/j.chb.2012.07.026

Che Kob, C. G., Abdulah, M. S., Kamis, A., Hanapi, Z., & Rus, R. C. (2016). Amalan gaya pembelajaran pelajar cemerlang di Politeknik Seberang Perai: Kajian pelajar Malaysia berdasarkan Model Felder Silvermen. *Malaysian Journal of Society and Space, 3*(3), 181–191.

Cheng, K. W. E., & Wang, W. (2013). Environmental object based method for electrical engineering subjects to enhance learning and teaching, 3(2). doi: 10.7763/IJIET.2013.V3.257

Cheung, A. C. K., & Slavin, R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review, 9*, 88–113. doi: 10.1016/j.edurev.2013.01.001

Crouch, C., Fagen, A. P., Callan, J. P., & Mazur, E. (2004). Classroom demonstrations: Learning tools or entertainment. *American Journal of Physics, 72*(6), 835. doi: 10.1119/1.1707018

Emran, N. F., & Hamid, H. (2014). Gaya pembelajaran pelajar semester pendek 2014 untuk topik "Capital Allowance" kursus PA502 Taxation 1. Retrieved from the Sistem Pengurusan Penyelidikan dan Inovasi Online Politeknik Tuanku Sultanah Bahiyah website: ecrim.ptsb.edu.my/file/20141106092008.pdf

Farrokhnia, M. R., & Esmailpour, A. (2010). A study on the impact of real, virtual and comprehensive experimenting on students' conceptual understanding of DC electric circuits and their skills in undergraduate electricity. *Procedia Social and Behavioral Sciences 2, 2*(2), 5474–5482. doi: 10.1016/j.sbspro.2010.03.893

Fuglseth, A. M., & Gronhaug, K. (2003). A tool kit for measurement of organisational learning : Methodological requirements and an illustrative. *Journal of Universal Computer Science, 9*(12), 1487–1499.

Godwin, A. (2013). Influence of learning styles and teaching strategies on students' achievement in biology. *Voice of Research, 1*(4), 5–13.

Hidayat, H. (2015). Production based learning: An instructional design model in the context of vocational education and training ( VET ). *Procedia - Social and Behavioral Sciences, 204* (2014 November), 206–211. doi: 10.1016/j.sbspro.2015.08.142

Kolloffel, B., & Jong, T. de. (2013). Conceptual understanding of electrical circuits in secondary vocational engineering education: Combining traditional instruction with inquiry learning in a virtual lab. *Journal of Engineering Education, 102*(3), 375–393.

Lin, H.-Y., Tseng, S.-S., Weng, J.-F., & Su, J.-M. (2009). Design and implementation of an object oriented learning activity system. *Educational Technology and Society, 12*(3), 248–265.

Lucas, B. (2014). *Vovcational pedagogy: What it is, why it matters and what we can do about it*. United States of America: City & Guilds.

Marlina, S., Azilla, N., & Adila, N. (2013). "System approach" dalam pengajaran pembezaan untuk kursus matematik kejuruteraan 2, di Jabatan Matematik, Sains dan Komputer, Politeknik Sultan Azlan Shah. In *E-Prosiding Seminar Pendidikan Matematik, Sains dan Komputer Peringkat Kebangsaan* (pp. 57–68). Malaysia: Politeknik Merlimau Melaka. Retrieved from www.pmm.edu.my/jmsk/images/doc/e-proceeding.pdf

Metros, S. E., & Bennett, K. (2002). *Learning objects in higher education*. United States of America: ECAR.

Pithers, R. T. (2006). Cognitive learning style : A review of the field dependent-field independent approach. *Journal of Vocational Education and Training, 54*(1), 117–129. doi: 10.1080/13636820200200191

Ragan, E. D., Frezza, S., & Cannell, J. (2009). Product-based learning in software engineering education. *Proceedings of the 39th IEEE International Conference,* San Antonio, Texas: *Frontiers in Education Conference*. Retrieved from http://dl.acm.org/citation.cfm?id=1733663.1733790

Salamun, B. E. (2004). *The integration of technology into the science classroom: A case study of two senior high schools at Surabaya, Indonesia*. New Mexico State University.

Salas, K. De, & Ellis, L. (2006). The development and implementation of learning objects in a higher education setting drivers for the adoption of flexible methods at the University of Tasmania. Interdisciplinary *Journal of Knowledge and Learning Objects, 2*, 1–21.

Tick, A. (2007). Application of problem-based learning in classroom activities and multimedia. In *5th Slovakian-Hungarian Joint Symposium on Applied Machine Intelligence and Informatics* (pp. 363–375). Slovakia: Obuda University. Retrieved from http://uni-obuda.hu/conferences/sami2007/36_Andrea.pdf

Wiley, D. A. (2009). *Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy*. United States of America: Utah State University.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. *Review of Educational Research, 47*(1), 1–64. doi: 10.3102/00346543047001001