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THE INFLUENCE OF CONTEXT, INPUT AND PROCESS ASPECTS ON ASSESSMENT OF SCIENCE PRACTICAL WORK ACHIEVEMENT

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The purpose of this study was to examine the influence of context, input and process aspects on Assessment of Science Practical Work (ASPW) achievement among the form 4 students in Sabah. A total of 447 Form 4 students from all over Sabah were selected by using stratified sampling technique. Non-experimental quantitative research and survey method was used to collect data. Instruments used to collect data comprised Context Aspect Survey (CAS), Input Aspect Survey (IAS) and Process Aspect Survey (PAS), whereas result of ASPW was provided by the science Form 4 teachers who assessed the students using a standardized achievement indicator rubric provided by the Malaysian Examination Board. The Statistical Package for Social Sciences' (SPSS) for Windows version 20.0, QUEST item analysis software, and Smart Partial Least Square (SmartPLS) version 2.0 software were used to analyze collected data. The findings showed that for the assessment of context, input and process aspect, the level of assessment was high (3.41-4.20) whereas the min of ASPW achievement according to the skills was at excellent level (8 or 9, Grade A). There was significant correlation and influence between context and input and between input and process. However, there was no significant correlation and influence between process and product. The result of paths analysis revealed that context, input and process aspects of ASPW do not correlate with the ASPW achievement. The findings of this study bring some implications especially the need to revise the process aspect, to ensure the input aspect fulfills the ASPW, and to consider other factors which are able to fulfill student's requirement.

Keyword: Assessment of Science Practical Work (ASPW), Context, Input and Process Aspects

Introduction

Science curriculum emphasizes the cultivation of scientific value, the acquisition of knowledge and skills in science, developing scientific thinking that can appreciate science and its application in everyday life. Since the implementation of the Integrated Secondary School Curriculum, pure science subjects assessed in Paper I, II and III while the Integrated Science is assessed in Paper I and II only. Cognitive domain of science subjects assessed by Paper I and II while the abilities of students in the mastery of science process skills are assessed through Paper III. However, there was no paper that can assess manipulative skills and scientific value. Continuation of the government's determination was further emphasized in the 9th Malaysia Plan (9MP) through human capital development agenda in producing the best energy source, trained, commensurate and adequate skilled worker. Students characterized human capital desired should have has a strong identity, competent superior, noble, knowledgeable and highly skilled, critical and creative thinking,

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and the ability to act in according to rational, demonstrate problem-solving skills and the ability to create new opportunities, resilient and capable of dealing with the global environment. Nowsaday, Assessment of Science Practical Work (ASPW) is still performed despite Paper III was proposed in the examination for Biology, Physics and Chemistry subjects. Therefore, the implementation of the ASPW that has been implemented for ten years until 2013, researchers feel the study of the influence of context, input and process aspects on the students' achievement among the Form 4 students in Sabah was fair highlighted for program improvement. The researcher also felt the needs to examine the effect of its endogenous variables (context, input and process) towards its exogenous variables (product) since its implementation.

Methodology

Quantitative research method was used in this research to collect information from the number of respondents with multistage sampling method. According to Shaughnessy and Zechmeister (1977 in Mohammad Yusuf, 2001), quantitative research refers to research findings generated by using statistical analysis. Quantitative research used the research design such as an experimental research and surveys (Mohammad Yusuf, 2001). Baker (1999) stated that quantitative research findings can be summarized in the form of numbers using statistical analysis. The main goal in this study sample survey method is to collect variables information from the population studied. According to Graziano and Raulin (2010), the main goal of a survey is to learn about the ideas, knowledge, feelings, opinions, behavior and attitude of self- report for the target population. In this study, the researchers made a survey of the perceptions of context, input and process aspects on assessment of science practical work achievement (product) among the Form 4 students in the state of Sabah. In addition, the direct and indirect relationships between exogenous variables with endogenous variables were examined using structural equation modeling approach (Structural Equation Modelling, SEM). Details of this study viewed from the aspect of the relationship and the significant influence of perceptual aspects of context, input and process towards the achievement of ASPW product. Researchers designed three set of questionnaires to fulfill the purpose of obtaining the perception of exogenous variables where as the endogenous variables (student achievement) was obtained from the science teachers who have evaluated their own students using instruments and assessment rubrics which was standardized by the Malaysian Examination Board for all the schools in Malaysia. Data were analyzed using inferential statistic using Statistical Packages for Social Sciences (SPSS) for Windows version 20.0 and SmartPLS version 2.0. The study was conducted at a total of 139 secondary schools in Sabah. The size of the sample is determined according to the formula published by Krejcie and Morgan (1970) and power analysis (Miles & Shevlin, 2001). Krejcie and

Morgan (1970) suggested a sample of 354 Form 4 students is more than sufficient. The size of the sample used in this study was 447 respondents. Since the State is divided into several divisions, District Education Office, Urban and Rural Secondary School, Form 4 classes in urban and rural areas, therefore stratified random sampling method is more appropriate to use. In this study, the instruments used to obtain quantitative data are as follows: (i) Context Assessment Questionnaire (CAQ), (ii) Input Assessment Questionnaire (IAQ), (iii) Process Assessment Questionnaire (PAQ) and (iv) Assessment of Science Practical Work result (ASPWR). Hopkins (1997) emphasized the advantages of using questionnaires depends on whether the items were precisely specific, easily administered, very relevant for comparative study and suitable for obtaining information and feedback. In this study the questionnaire using an ordinal scale that rates the subject on several dimensions and order: 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure Agree or Disagree, 4 = Agree and 5 = Strongly Agree. Mohd. Majid (1990) stated that an instrument will have high content validity if the device can measure all content and content areas studied effectively. In order to demonstrate the content validity of a set of test scores, one must show that the behaviours demonstrated in testing constitute a representative sample of behaviours to be exhibited in a desired performance domain. Thus, content validity can be considered has to do with the legality and validity of the teaching curriculum that items in a test should have the ability to measure learning objectives (Crocker & Algina, 1986). Researcher used Guion opinion that suggested five conditions that must be met before an instrument is said to have content validity (Brown *et. al.* 1983). Comments and opinions from five content experts on ASPW has been accepted and considered for content validity analysis. Statistical methods of factor analysis in SPSS version 20.0 was used to determine the validity of the construct. Researchers also used the Quest analysis based on Rasch Model to determine the validity of the construct. Based on the data obtained from the factor analysis, the number of items to form an idea can be determined (Sidek, 2000). The findings of the pilot study using SPSS version 20.0 reliability analysis found that every item has a value of .90 or above. Table 1 showed the coefficient of reliability aspects of context, input and process data after taking into account the reduction in the factor analysis done previously.

TABLE 1: STATISTICAL RELIABILITY ASPECTS OF CONTEXT, INPUT AND PROCESS

Aspects	*No. of Item*	*Cronbach's Alpha*
Context	52	.955
Input	35	.909
Process	35	.943
Total	122	.972

Quest analysis of internal consistency values refer to the Cronbach alpha. Table 2 showed the mean scores, standard deviation and the internal consistency of the

instruments of context, input and process in a pilot study prior to implementing the data reduction factor analysis. All the internal consistency showed a high reliability value approaches to the value of 1. Thus CAQ, IAQ, and PAQ have high reliability value.

TABLE 2: ANALYSIS QUEST MEAN SCORES, STANDARD DEVIATION AND INTERNAL CONSISTENCY RATE

Student's Perception	*N*	*L*	*Probability Level*	*Mean test score*	*Standard deviation*	*Internal Consistency*
Context	344	57	.50	162.52	22.41	.96
Input	344	41	.50	117.75	16.04	.91
Process	344	41	.50	113.22	17.34	.94

Tables and Charts

Assessment of Science Practical Work (ASPW) Level of Agreement for Context, Input and Process Aspects

TABLE 3: RESULTS OF STATISTICS DESCRIPTION FOR CONTEXT, INPUT AND PROCESS ASPECTS OF ASPW

		Context	*Input*	*Process*
N	Valid	447	447	447
	Missing	0	0	0
Mean	4.17	3.99	4.07	
Std. Error of Mean		.0188	.0221	.0209
Std. Deviation		.3984	.4680	.4429
Variance		.159	.219	.196
Range	2.02	2.36	2.46	
Minimum		2.98	2.64	2.54
Maximum		5.00	5.00	5.00

Table 3 showed the mean for the level of agreement of respondents mostly on level 4. The level of agreement of ASPW for 447 respondents from the aspect of context, input and process showed that the degree of agreement on the level of 'High' (3:41 to 4:20) as shown by the mean values in Table 3. The rating context from the survey was at the level of 'High' from the factors such as the extent to which the needs of the experiment, experiment planning skills, scientific attitudes, situations and needs are taken into account, the need of ASPW, skills for data recording, data interpretation skills, the skills of collecting data, identifying skills of objectives, hypotheses and variables and the skills to use material or apparatus.

The results showed that the perception of respondents in terms of the context was at the stage of 'High' to the goals of the program, which has existed in an effort to meet customer needs for the program. Thus, the perception of respondents in the context was the need to re- evaluate the need to do science experiment, the

experiment planning skills, scientific attitudes, situations and needs are taken into account, the need of ASPW, data recording skills, skills of interpreting data, skills of collecting data, skills of identifying objectives, hypotheses and variable and the skills of using materials or apparatus based on the student's perspective. Therefore, the context assessment focused on the rationale for identifying program objectives, defining the relevant environment, explaining the intentions and the actual situation of the environment, identifying unmet needs and opportunities that are not being used.

This study has also obtained the perception of respondents in terms of input of resources available for ASPW program in helping to achieve the objectives of the program especially in evaluating the allocation of time, an opportunity to improve, methods of teaching and learning, laboratory facilities, teaching strategies and learning, encouragement, support and cooperation, the approach to teaching and learning facilities and equipment. The findings showed that the respondents' perception was at the level of 'High' (3:41 to 4:20) to input aspect of ASPW.

Survey perception on the aspects of ASPW process can be divided into factors such as attitude and interest, the assessment of ASPW process, ASPW briefing, feedback of assignment/portfolio, file or portfolio of ASPW, implementation and tasks of the revised criteria. The findings showed that the survey perception of the process aspects was at the stage of 'High' (3:41 to 4:20) to factors inherent in the process aspect of ASPW. Thus, the answer to the first research question was the degree of consensus in terms of context, input and process based on the perception of ASPW of the Form 4 students in Sabah state was on the level of 'High' (3:41 to 4:20).

Level of Product Achievement based on ASPW Skills

Table 4 showed the results of the statistical description of the measures of central tendency and dispersion measures for ASPW product or student's performance in ASPW. There were five elements that assessed the performance skills of the students in ASPW such as the planning of experiments (E1), experimenting (E2) skills,

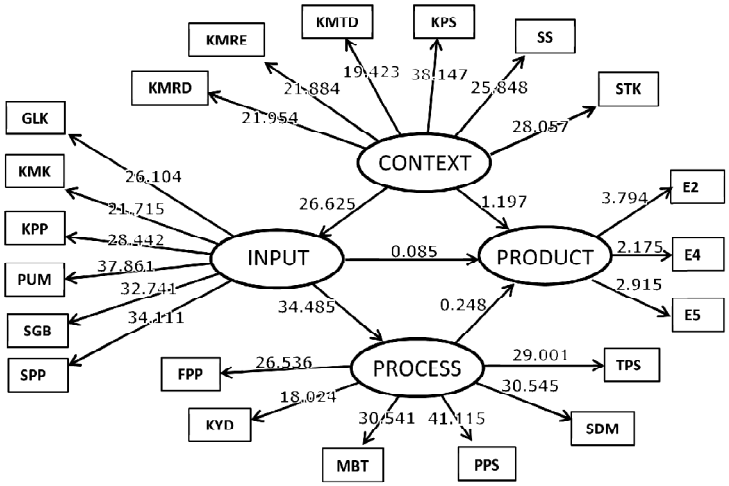
TABLE 4: MEASURES OF CENTRAL TENDENCY RESULTS AND MEASURES OF DISPERSION OF ASPW PRODUCT

		E1	*E2*	*E3*	*E4*	*E5*
N	Valid	447	447	447	447	447
	Missing	0	0	0	0	0
Mean		8.07	8.05	8.13	8.06	8.13
Std. Error of Mean		.0351	.0370	.0332	.0318	.0292
Std. Deviation		.7422	.7825	.7023	.6727	.6183
Variance		.551	.612	.493	.453	.382
Range		3.00	3.00	3.00	3.00	3.00
Minimum		6.00	6.00	6.00	6.00	6.00
Maximum		9.00	9.00	9.00	9.00	9.00

collecting and recording data (E3), the skills of interpreting data and drawing conclusions (E4) and the achievement of scientific attitudes and values (E5). The result showed that the mean level of achievement in all the ASPW products in E1, E2, E3, E4 and E5 were at an excellent level (8 or 9, Grade A).

Model Path Analysis (Structural Model)

Implementation of bootstrapping analysis for the determination of the coefficients as outer weights, outer loadings, and the significance of the path coefficients can be implemented through t-test analysis. Figure 1 showed the result of the analysis after the implementation of bootstrapping. β coefficient trajectory of the model structure (structural model of relationship) between exogenous variables such as context, input and process with endogenous variables, namely product were reported in Table 5. Context, Input and Process aspects have a weak negative correlation with the product of ASPW. The process aspect has higher β followed by input and context aspects. These three exogenous variables explained only 1.4% of the variance of the endogenous variables of the product. Therefore, the analysis for model invention cannot be continued because the null hypotheses were not successfully rejected. This indicates exogenous variables such as context, input and process aspects were not a good predictor for the endogenous variable based on the value and significance of β trajectory.



Key:

KMRD-Recording data skills
KMRE-Experiment planning skills
KMTD-Skills to interpret data
KPS-The Needs of ASPW
SS-Scientific Attitude
STK-Situation and Needs
GLK-Encouragement
KMK-Laboratory facilities
KPP-Teaching and Learning Methods
PUM-Opportunity to improve
SGB-Support and Cooperation
SPP-Teaching and Learning Strategies
FPP-Assessment File
KYD-The revised criteria
MBT-Assignment Feedback
PPS-Process of ASPW
SDM-Attitudes and Interests
TPS-Briefing of ASPW

Figure 1: Findings Analysis after Boothstrapping Implementation

However, the path coefficient of β in the model structure (structural model of relationship) between exogenous variables, namely between the input and the context, and between the input and the process showed that the null hypotheses were successfully rejected. These findings showed that there was a significant relationship between the input and the context aspect and between the inputs to the process aspect of ASPW.

TABLE 5: VALUE OF EXOGENOUS VARIABLES PATH COEFFICIENT

Hypotheses		*β*	*se**	*t-value*	*p-value (2 tailed)*	*Result*
Ho1	Context -> Product	-0.103	0.078	1.197	0.232	Not Significant
Ho2	Input -> Product	-0.005	0.095	0.085	0.932	Not Significant
Ho3	Process -> Product	-0.017	0.099	0.248	0.804	Not Significant
Ho4	Context -> Input	0.684	0.026	26.623	0.001***	Significant
Ho5	Input-> Process	0.746	0.022	34.485	0.001***	Significant

Note: * p<0.10 (1.65); ** p<0.05 (1.96); *** p<0.01 (2.57)
se* estimated bootstrap standard error

Results

The researchers concluded the findings of the perception of Form 4 students in Sabah was at the stage of approval 'High' (3:41 to 4:20) of the aspects of context, input and process of ASPW where as the ASPW products for each element was at an excellent level (8 or 9, Grade A). The study also found that context, input and process aspects did not have a relationship based on the trajectory of the â coefficient which was less than zero with the aspects of the product. The first, second and third null hypothesis were not successfully rejected. The study found a significant relationship between the context and the input aspects and between the input and the process aspects. Therefore, the fourth and fifth null hypothesis is successfully rejected. Because there was no relationship between context, input and process aspects with the product of ASPW, therefore there was no effect between context, input and process aspects to the product of ASPW. Furthermore, the direct effects model proposed structure to predict the product of ASPW was also rejected.

Discussion

This finding is supported by contextual learning theory asserting learning method that combines content with the daily experiences of individuals, society and the working environment (PPK, 2001). This is explained in the Theory of Contextual Learning that aspects of the concrete context as involving hands-on and minds-on. Wellington (1989) stated that science process skills are higher intellectually as compared with the mastery of facts and scientific principles. Therefore, students need to learn not only facts but dominated the science process skills to enhance their analytical thinking skills and to be more successful in solving a problem

(Tobin and Capie 1982). This findings can support why respondents had high perceptions in terms of context as likely to exist among students who are more easily dominated the science process skills through practical work than mastery of facts and scientific principles intellectually. Alawa (2005) stated that the shortage of materials and equipment in schools becomes a deterrent to some practical activities to be implemented. The findings are supported by the study done by Bigge and Shermis (1999), who expressed their opinion that Skinner behavior is controlled by two functions of different environments. The findings also fulfilled Spady's opinion (1993), in which the achievement of learning outcomes is more important than the time taken to achieve it.

Evaluation process conducted for the purpose as stated in the evaluation of Stufflebeam model (2000, in Posavac & Carey, 2003), namely to provide information on how the program was conducted. These findings coincide with Baskar's study (2009) that measure the effectiveness of the implementation of ASPW using 4-point Likert scale (1 = Very Bad, 2 = Good, 3 = Good, 4 = Very Good). His findings indicated that the effectiveness of the implementation of ASPW in student achievement is at a good level (mean=3.58, standard deviation=0.59). The findings in the process aspect of ASPW also supported by the findings of Klainin's study (1984), which affirmed if the experiment is conducted in a group of students who are not many, students can actually engage in the science practical. Overall, the implementation of laboratory activities carried out by teachers are at a good level at which the highest frequency of once a week (Zarina, 2005). This outstanding achievement is in line with the students' perceptions of ASPW. The finding showed that the students were proficient in the five elements assessed. This finding is supported by Baskar's study (2009) in measuring the level of effectiveness of the implementation of ASPW using the 4-point Likert scale who found that the level of understanding of scientific concepts (mean = 3.97, standard deviation = 0.47) was good. This is likely to meet the results obtained by Kang and Wallace (2005) who found that teachers assume lab activities as a means to generate experimental results that are consistent with the basic scientific knowledge, in other words, that this activity is aimed at verifying the existing scientific knowledge. Wellington (1989) found that the mastery of the science process skills is much higher in intellectual aspect as compared with the mastery of facts and scientific principles. Therefore, students need to learn not only facts but dominated the science process skills to enhance their analytical thinking skills and to be more successful in problem solving (Tobin & Capie, 1982). The findings of this research are also supported by the studies done by Kim and Chin (2011) who found that the science practical work in Korea believed that students can work and think actively during the execution of activities using the inquiry approach. Experimentation learning is faster applied in the learning process as students conducted their own investigations to obtain information through a real substance (Ogunniyi 1983; Yusup 1997; Berg

2003, in the study of Nurzatulshima *et al*. 2009). Students will go through the process of identifying problems, designing solutions strategy, gathering information, analyzing information and to obtain results and making conclusion. The findings can also be supported by the theories of behaviorism in psychology approach by Skinner (1989 in Bigge & Shermis, 1999) that supports learning are the result of operant conditioning. This corresponds to the findings of this study found no correlation between the process aspects and with the ASPW product aspects (β = -0030, t= 0.137, p > 0.10). However, these findings contradict with the findings in Baskar's study (2009). According to Stufflebeam, Madaus and Kellaghan (2000), the evaluation input assess program strategies and work plans are related with the operating expenses. Thus, according to the evaluation concept of context and input, it can be said the findings show the requirements, problems, assets and opportunities within the scope of ASPW environment which has a strong and significant relationship with the program strategy, planning and work related operating expenses (facility) of ASPW. According to Stufflebeam, Madaus and Kellaghan (2000), the evaluation input is a precursor to failure or success and track the effectiveness of changes in equity. Thus, based on their opinion it can be said input factors in ASPW is very relevant to the subject of factors in ASPW process that have been implemented over the years. The findings of input components have a strong and significant relationship with the components of the process that has been discussed above. Rodziah (2004) found that there is a correlation between laboratory infrastructures with student achievement in science process skills. According to the CIPP Model by Stufflebeam Madaus and Kellaghan (2000), it is expected that there is a relationship between the process aspects with the product as both should complement each other to meet the goals and objectives of a program. However, the findings contradict this concept.

Conclusion

Overall, the study found that there was no direct relationship and influence between exogenous and endogenous variables. However, there is a significant relationship between context and input and between input and the process of ASPW. This finding seems to reflect what is being implemented in ASPW at school now has no relationship with the student achievement in ASPW even though the findings of student's achievement in ASPW are at an excellent level. This scenario gives the impression that it is about time that MOE and MBA should review the implementation of ASPW that have been conducted in schools.

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