# Are we Learning by Understanding or by Route-Learning?

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## Abstract

The study assessed the factorial validity of the Revised Study Process Questionnaire – 2 Factor (R-SPQ-2F) by Biggs in order to profile the individual and the mean learning approach of the first year students of Mariano Quinto Alarilla Polytechnic College (MQAPC). Although the total explained variance was 66.9%, not all the factor loadings satisfied the threshold of 0.6 (Hair et al, 2006). Such finding suggests the weak validity of the instrument for the respondents. But in view of its reputation and widespread use to assess the learning approach of students (Biggs et al, 2001), the study still used the instrument to determine the possible relationship of learning approach to numerical literacy (assessed by the Basic Skills Diagnostic Test by J. Epstein), for a found group of strongly deep and strongly surface students. From this group, the correlation analysis indicated a significant high negative correlation ($r = -0.628$, $p < .01$) between the surface and deep scores of students. This is interpreted as - "the more the student goes surface, the less he goes deep and vice versa", aligning perfectly with the Student Approach to Learning Theory (Biggs, 1987). No significant relationships were found between the numerical literacy scores and the surface and deep scores, respectively, although correlation coefficients revealed the patterns - "the more that a student goes deep, the higher is the numerical literacy score and vice versa". With the finding of a significant negative correlation between the deep and surface scores, the t-test, on the other hand, was not found significant (P-value = 0.18) for the hypothesis of difference in the numerical literacy scores between the strongly deep and strongly surface students, respectively. In contrast, the t-test was found significant ($p < .01$) for the hypothesis of difference between the mean surface scores and mean deep scores, respectively, of students in the higher sections. Interestingly, the weak factorial validity and the unsatisfactory numerical literacy scores of the found group of strongly surface students and strongly deep students might be confirmatory that the R-SPQ-2F has a weak validity with a low-achieving group (Zhang and Bernardo, 2000). The qualitative counterpart thru in-depth interviews (van Maanen, 1992) conducted on the found group of strongly surface and deep students, have shown the usability of the R-SPQ-2F to detect these type of learners at both ends of the learning approach scale. Based on these findings, the recommendations were to obtain an instrument for learning approach with a stronger validity, to find a validated instrument to score numerical literacy (initially), to review the current entrance exam which seems to have placed surface students in the higher sections, and more importantly, to pose the question to the entire MQAPC community "Are we achieving by our mere memorization of details or by our understanding of concepts?"

## Introduction

How can the school and teachers help the students learn better? Coming out of high school, how can the students truly learn in college? These were the seed-questions that motivated this study. The focus is the student because it is now more important to know what the

student does than what the teacher does (Shuell, 1986) toward improving the quality of learning.

To help the students learn is to know first how they learn. A generic way of describing how they learn is precisely in terms of the so-called "approaches to learning" (Biggs et al, 2001). Marton & Saljo (1976) originally conceptualized the approaches to learning, consisting of the surface approach and the deep approach. The surface approach, also labeled rehearsal or memorization, is an extrinsic strategy where learning is to remember or memorize facts and details (Entwistle & Ramsden, 1983). As a quantitative conception of learning, the aim of the surface approach is to end the task, likely meeting the minimum requirements. In contrast, the deep approach, also labeled as elaboration or critical thinking, is an intrinsic strategy and learning is thru understanding contexts or seeking meaning (Weinstein & Mayer, 1986). As the qualitative counterpart, the deep approach engages a personal commitment to learning. With the deep approach, the student relates the school module to personal experiences and existing prior knowledge. The behavior of the student engaging the deep approach is usually marked by further reading, discussing with teachers and classmates, thinking about the context even outside the classroom, and with interest. For these reasons, it is expected that students engaging in the deep approach have better academic achievement. The educational aim therefore is to engage the students in college with the deep approach, even as freshmen.

**Research Purpose**

*To factor validate the R-SPQ-2F for MQAPC.*

Related studies showed that the constructs of approaches to learning can be extracted by ,,instruments like the Learning Process Questionnaire (Bernardo, 2003), the Approaches to Study Inventory (Entwistle & Ramsden, 1983) and the Study Process Questionnaire or SPQ (Biggs, 1987). The latest version of the SPQ is the R-SPQ-2F which was recommended suitable for use by teachers primarily in Australia in order to measure learning approaches (Biggs et al, 2001). For Filipinos, the utility of R-SPQ-2F was also tried (Magno, 2009) but its validity has to be explored further. It is therefore necessary to validate R-SPQ-2F first for the respondents before the subsequent analysis.

*To profile the individual and class mean learning approach*

If valid, the R-SPQ-2F will be used to profile first the individual learning approach of the students. The learning approach profile will enable teachers and administrators to understand how students engage school tasks, and thus be able to help them. Secondly, each class can also be profiled for the mean learning approach. The R-SPQ-2F scores are a function of both how the student engages in the task and how the teacher structures the teaching context (Biggs et al, 2001). The mean learning approach therefore will reflect the nature of the relationship between the students and the teaching context. In fact, the mean of the approaches of the students in a class gives an index of the quality of teaching in that class (Biggs, 1987). A high surface mean score would reflect a classroom environment that promotes rehearsal and memorization while a high deep mean score would reflect critical thinking and learning by understanding. The surface approach, when found rampant, should be discouraged because it is the "fall-back position when you don't have a good knowledge-base" (Driscoll, 2005).

The students have to be informed of their learning profile. It is educationally important that students know how they strategize their learning. Teaching methods should encourage students to be informed of their learning approach to help them reflect critically and realistically on what they are doing in order to control future learning (Driscoll, 2005). According to Dr. Auxencia Limjap (DLSU-SED), the "teaching style should be aligned to the learning processes of the students and the individual needs of students should be addressed".

*To determine the relationship between learning approaches and numerical literacy.*

Earlier correlation analysis revealed that the deep-level approach were associated with academic success in Filipino schools (Watkins, 1984; Watkins & Astilla, 1982). In this study, academic success will be viewed thru the lens of their numerical literacy, as the latter is an important component of the school curriculum.

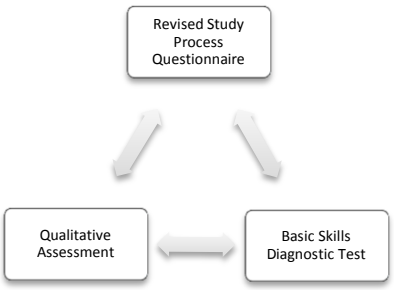
*To determine whether the numerical literacy scores differ between surface learners and deep learners*

It has been observed that students who endorse a surface approach see themselves as performing poorly, as compared with others in their class, and express a high degree of dissatisfaction with their performance. The opposite is true of deep students who see themselves as good performers (Driscoll, 2005). In connection, the study also wishes to test if there is a significant difference in the performance between the two groups of learners in terms of numerical literacy scores.

*To qualitatively validate the R-SPQ-2F*

Qualitative approach in research is a valuable lens in surfacing the multiple layers of meaning embedded in human phenomena (de Guzman, 2007). The image of reality could be better captured when both quantitative and qualitative approaches are combined. Figure 1 shows a triangulation of the instruments used in this study to assess the relationships between the numerical literacy and learning approaches of the freshmen.

Figure 1 Triangulation of Instruments




**Method**

*Participants*

The participants in this study comprised of 161 freshmen of MQAPC. There were 41 students from Engineering Technological Course, 37 students from BS Hospitality Management and 83 students from BSE English. All participants were administered the two instruments – one for learning approach, the other for numerical literacy. Testing was done in the last two weeks of school to make certain that topics were all covered.

*Instrument*

Assessment of approaches to learning

The Revised Study Process Questionnaire – 2 Factor (R-SPQ-2F) is the improved version of the 3- factor structure Study Process Questionnaire or SPQ (Biggs, 1987) that has 3 constructs: surface, deep, and achieving main scales with subscales: motive and strategy. Through a factor analytic study, the R-SPQ-2F eventuated into 2 factors, the deep and the surface approach, each with motive and strategy subscales (Biggs et al, 2001).

The R-SPQ-2F was recommended suitable for use by teachers in evaluating the learning approaches of their students. Composed of 10 items for each approach, items were presented as statements to which students were to respond on a 5-point Likert scale ranging from 'always true of me' to 'only rarely true of me'. The 'always' response was assigned a score of 5, while the 'rarely' response was assigned a score of 1. The Cronbach alpha values for the deep and surface approaches were 0.73 and 0.64, respectively. (Biggs et al, 2001). A summary of the description (Bernardo, 2003) of the two approaches are summarized in Table 1.

Table 1
Description of Learning Approaches and Sample Items for the R-SPQ-2F

| Scale | Description | Sample item |
|---|---|---|
| **Surface Approach** | | |
| **Surface Motive** | Motivation is functional; goal is to gain credentials at minimum allowable standard. | "My aim is to pass the course while doing as little work as possible"; "I see no point in learning material which is not likely to be in the examination." |
| **Surface Strategy** | Reproduction of minimum requirements using rote learning strategies. | "I only study seriously what's given out in class or in the course outlines"; "I learn some things by rote, going over and over them until I know them by heart even if I do not understand them." |
| **Deep Approach** | | |
| **Deep Motive** | Motivation is true interest and mastery in subject area. | "I find that at times studying gives me a feeling of deep personal satisfaction"; "I come to most classes with questions in mind I want answering." |
| **Deep Strategy** | Meaningful understanding of material through deep reading, synthesis and organization of ideas. | "I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied"; "I make a point at looking at most suggested readings that go with the lectures." |

When scoring the questionnaire responses, the statements 1, 2, 5, 6, 9, 10, 13, 14, 17 and 18 were added to obtain the deep approach score of a student. The responses for the rest of the statements were added to obtain his surface approach score. For the deep motive subscale, statements 1, 5, 9, 13, and 17 were added; deep strategy – statements 2,6,10,14, an 18; surface motive – statements 3,7,11,15, an 19; and surface strategy – 4, 8, 12, 16, and 20.

Assessment of numerical literacy

The numerical literacy scores were obtained using the Basic Skills Diagnostic Test (BSDT). The BSDT is a free-response 24-item conceptual diagnostic guide on basic mathematics understanding. It has been field-tested in different colleges in US and Canada. The items were selected from lengthy experience in laboratory mathematics program that was designed to bring students from basic levels to the college level (http://www.flaguide.org/tools/diagnostic/basic_skills_diagnostic.php). The content was also face validated by an expert. A description of the BSDT is shown in Table 2.

Table 2
Topics and Sample Items in the Basic Skills Diagnostic Test

| | Item No. | Sample Item |
|---|---|---|
| **Basic Pre-Algebra** | | |
| Operation on fractions | 1 , 2, 3 | Put the following in order from smallest to largest: 0.4, 5/3, 1.007, 8/9, 2. |
| Decimals | 4, 5, 11 | Divide .738 by .9. |
| Area and volume | 6, 12 | What is the area of the figure? |
| Proportional reasoning | 7,8,9,10,13 | If I can walk 1/20 of a mile in one minute, how long will it take me at that rate to walk 20 miles? |
| **Basic Algebra** | | |
| Concept of a variable | 14, 15 | If a peanut costs 79 cents a pound and cashews cost 93 cents a pound, how much do I pay in total for x pounds of peanuts and y pounds of cashews? |
| Simplifying expressions | 16,17,18 | Simplify as much as possible: $3(2^n) + 2(2^n)$. |
| Linear equations | 21, 22, 23 | Simplify as much as possible: $\frac{x^3+y^3}{x+y}$. |
| **Intermediate Algebra** | | |
| Concept of a function | 20 | If $f(x) = x^2 + 4$, what is $f(z+1)$? |
| Graph of a function | 24 | Sketch the graph of $x \cdot f(x) = 12$ |
| Concept of logarithm | 19 | Make a reasonable estimate: $\log_{10}500$. |

## Data Analysis

Factor Analysis is a statistical tool for structure detection, identifying factors that explain the pattern of correlations within the data. The responses to the R-SPQ-2F were factor analyzed in order to extract the underlying approaches that lead the students respond as they did.

The Pearson Product Moment Correlation Coefficient r was used to quantify the degree of the possible relationship that numerical literacy may have with learning approach. The significance of the correlation found was tested at 1% significance level.

T-test for independent means (assuming unequal variances) was used to determine if there is a difference in the mean surface and mean deep scale score in each class. If t-test is found significant, the learning approach with a higher observed mean score would be the mean learning approach of the class.
The descriptive measures, mean and standard, were used to describe the numerical literacy scores. Each item of the 24-item BSDT was scored 1 point each. Scores were not converted to percentages.

In-depth interview (van Maanen, 1992) was used to collaborate with the quantitative validation of the R-SPQ-2F for the respondents. The interviews were recorded (with the interviewee's consent), transcribed and cleansed from "transfer errors" through corrective listening (Flick et al, 2004). Themes were then extracted as the interviews were reviewed. Conceptual themes were identified and specific statements coded as supportive evidence (Flick et al, 2004).

## Results

*Factor Analysis of the R-SPQ-2F*

Factor analysis was conducted on the 20 items with Varimax Rotation. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for analysis (KMO = .669). Bartlett's test of sphericity ($X^2$ = 696.85, p < .001) indicated that correlations between items were sufficiently large. Table 3 shows the factor loadings after rotation. Interestingly, all the statements corresponding to the deep approach scale sided with factor 1. Thus factor 1 must be the deep construct. Similarly, except for surface motive statements 1 and 3, all the statements corresponding to the surface approach scale sided with factor 2. Thus factor 2 must be the surface construct. The factor loadings were all greater than 0.3 except for surface motive statements 1 and 3. In strict sense, for factor loadings to be significant, values must exceed the threshold of 0.6 (Hair et al, 2006). In view, the study found out that the R-SPQ-2F does not have strong factor validity for the data, in spite of its recommended suitability (Biggs et al, 2001). The factor loadings (Varimax with Keiser Rotation Method) are summarized in Table 3.

*Assessment of the class mean learning approach*

The t-tests for the hypothesis of difference between the deep mean scale scores and surface mean scale scores were all found significant, some were even found highly significant (BSE 1A mean ›› deep =11.64, surface=14.35, p < .01; BSE 1B mean ›› deep =11.61, surface=13.96, p < .05; HRM 1A mean ›› deep =12.47, surface=16.60, p < .01; COET 1A mean ›› deep =12.82, surface=17.0, p < .05) in the higher sections. The significant t-test suggested that more likely, students in these sections endorsed the surface learning approach more than the deep approach in tackling school work. It seemed that the surface approach was also more likely to be responsible in placing the students to the higher freshmen sections. Such finding evoked the question – "Could it be that the entrance exam of MQAPC endorsed the surface?" Past research indicated that high surface approach scores are associated positively with efficient reproduction of facts and details (Biggs, 1987). "Could it be that the entrance exam measures only the ability to recall facts and not the ability to understand and analyze?" In addition, the significant t-test also suggested that more likely, it is still the surface approach which played dominantly in the higher sections even up to the end of the freshman year. (The mean scores for the deep and surface scales for all sections are summarized in Table 4).

Table 3
Rotated Factor Matrix for the 20 items of the R-SPQ-2F

| Item/Statement | Component | |
|---|---|---|
| | 1 | 2 |

| | | |
|---|---|---|
| Deep Motive1 | .648 | |
| Deep Strategy1 | .362 | |
| Surface Motive1 | | |
| Surface Strategy1 | | .338 |
| Deep Motive2 | .712 | |
| Deep Strategy2 | .695 | |
| Surface Motive2 | | .692 |
| Surface Strategy2 | | .472 |
| Deep Motive3 | .594 | |
| Deep Strategy3 | .617 | |
| Surface Motive3 | | |
| Surface Strategy3 | | .451 |
| Deep Motive4 | .637 | |
| Deep Strategy4 | .491 | |
| Surface Motive4 | | .560 |
| Surface Strategy4 | | .654 |
| Deep Motive5 | .501 | |
| Deep Strategy5 | .494 | |
| Surface Motive5 | | .584 |
| Surface Strategy5 | .342 | .391 |

Factor Loadings less than 0.3 omitted.

Table 4. T-Test Result

| Section | BSE 1 A | | BSE 1B | | BSE 1C | | HRM 1A | | HRM 1 B | | EET 1 | | COET 1 A | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Deep | Surface | Deep | Surface | Deep | Surface | Deep | Surface | Deep | Surface | Deep | Surface | Deep | Surface |
| Mean | 11.64 | 14.35 | 11.61 | 13.96 | 13.9 | 14.45 | 12.47 | 16.60 | 13.5 | 15.95 | 12.59 | 14.5 | 12.82 | 17.00 |
| **N** | 28 | 28 | 23 | 26 | 20 | 20 | 15 | 15 | 20 | 20 | 22 | 22 | 17 | 17 |
| **P-Value** | **.004**** | | **0.04*** | | **0.56** | | **.004**** | | **0.05** | | **0.06** | | **0.04*** | |

** - highly significant * -significant

*Assessment of the relationship between numerical literacy and learning approach*

Only the scores of 16 students who each had either a very high surface score (8 students) or a very high deep score (8 students), were used to correlate the R-SPQ-2F with the BSDT scores

in order to arrive at meaningful conclusions. The correlation analysis showed that surface scores have a high negative relationship with the deep scores correlation ($r = -0.628$, $p < 0.01$), and that this magnitude is highly significant. This means that the more the student goes surface, the less he goes deep and vice versa. This finding confirms well the theorized contrast between the two constructs (Biggs, 1987).

A moderately small negative correlation between surface scores ($r = -0.438$, P-value =.089) and numerical literacy scores was found but not significant. This means that higher numerical literacy scores were more frequently observed with lower surface scores and vice versa but such pattern was not statistically significant. In contrast, the moderately small positive correlation between deep scores and numerical literacy scores ($r = 0.337$, P-value = .201) shows that higher numerical literacy scores were more frequently observed with higher deep surface scores but this pattern was not also statistically significant. (The result of the correlation analysis is summarized in Table 5).

Table 5
Correlation Analysis of the R-SPQ-2F and the BSDT scores

| **Correlations** | | | | |
|---|---|---|---|---|
| | | Deep | Surface | BSDT |
| Deep | Pearson Correlation | | -.628** | .337 |
| | Sig. (2-tailed) | | .009 | .201 |
| | N | 16 | 16 | 16 |
| Surface | Pearson Correlation | -.628** | | -.438 |
| | Sig. (2-tailed) | .009 | | .089 |
| | N | 16 | 16 | 16 |
| BSDT | Pearson Correlation | .337 | -.438 | |
| | Sig. (2-tailed) | .201 | .089 | |
| | N | 16 | 16 | 16 |
| ** - $p < 0.01$. | | | | |

*T-test result for the difference in the mean numerical literacy scores between the strongly deep and strongly surface students*

Only the BSDT scores of the 16 students as mentioned were used to align with the scope of the correlation analysis. The deep group had a higher mean BSDT score (Mean = 6.83 points) than the surface group (Mean = 3.50 points) with more variation for the deep group (S.D. = 5.91 points) than for the surface (S.D. = 2.78 points), but this observed difference was not statistically significant (P-value = 0.18). For both groups, the mean BSDT scores were below satisfactory levels, 24 points being the highest mark. (The results of the t-test are summarized in Table 6).

Table 6
t-Test Result for the Difference in Mean BSDT Scores Between Surface and Deep Students

| | | *Deep* | *Surface* |
|---|---|---|---|
| Mean BSDT score | | 6.83 | 3.50 |
| Standard Deviation | | 5.91 | 2.78 |
| Observations | | 8 | 8 |
| P- Value | 0.18 | *not significant* | |

*Qualitative Validation of R-SPQ-2F*

With factor analysis, a strong validity of the R-SPQ-2F was not quantitatively established for the data but the high negative correlation ($r = -0.628$, $p < .01$) of the R-SPQ-2F scores between the surface and deep students in the above-mentioned group lead to a qualitative investigation. Quantitative results are substantiated by qualitative tools in order that the study would have more meaningful results.

On these statements - "studying gives me a deep feeling of satisfaction", "I come to class with questions in mind", "I am not interested in my course, that's why I do just the minimum", "my aim is to pass the course while doing as little work as possible", "I do not find my work interesting so I keep my work to the minimum", "I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied, "I feel that virtually any topic can be highly interesting once I get into it", "I work hard at my studies because I find the material interesting," the answers solicited sounded the same for the surface and deep students. For both type of learners, a feeling of deep satisfaction in studying and a general interest in their course were generally mentioned.

On these statements - "I learn some things by rote, going over and over them until I know them by heart even if I don't understand them", "I find I can get by in most assessments by memorizing key sections rather than trying to understand them", "I find the best way to pass examinations is to try to remember answers to likely questions", the answers solicited became noticeably different for a strongly surface and for a strongly deep student, respectively. Except for two exceptions, surface students mentioned that the most effective way to prepare for exams is by memorizing the lecture. Interestingly, common traits suddenly emerged, which were not specifically stated as R-SPQ-2F items. The surface students have concentrated their studying to their notebooks and depended heavily on the teacher. Some surface interviewees revealed that they even knew the exact spot where information was written. At least two students cited having memorized pages of lecture without even understanding so that what was memorized did not really stay. At least one student mentioned that she never failed an exam by just memorizing. The surface group generally bounded their learning to teacher input and to the margins of their notebook.

On the contrary, the deep group said that they were fond of reading and that they habitually referred to supplements. On the statements, "I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes", "I make a point of looking at most of the suggested readings that go with the lectures", "I find most new topics interesting and often spend extra time trying to obtain more information about them," the answers solicited indicated that deep students patronized the library while surface students generally did not. In general, deep students studied most of the time by reading, while the surface students studied just for exams.

There were also exceptions, but such were few. Some responses did not agree with the expected contrast between surface and deep approaches. At most two students said that they studied more "by understanding" and less by "memorizing". But when probed, at least one student mentioned that he habitually used key words and past examinations for likely questions. Such may indicate that he was appropriately identified as surface by the R-SPQ-2F though he insisted on learning more "by understanding". (The summarized data of the interview is shown in Table 7.)

Another qualitative venue examined was the quality of the BSDT answer sheets, comparing the two groups. A rough inspection showed the pattern that more frequently would an essentially deep student scribble solutions than would a surface student, as theorized (Biggs, 1987). The student who got the highest score came also from the deep group.

**Conclusions and Recommendations**

This study sought to help enhance the quality of the learning climate in MQAPC by investigating on the learning process of the freshmen (initially) amidst the other host of factors such as teaching and assessment methods, classroom, and etc. The possible relationship of learning approaches with numerical literacy, a vital curriculum component, was also explored. Two instruments were used, the Revised Study Process Questionnaire (R-SPQ-2F) which aimed to profile students as deep or surface learners (Biggs et al, 2001) and the Basic Skills Diagnostic Test which aimed to assess basic understanding in mathematics.

The weak factor validity of the R-SPQ-2F was substantiated by the low factor loadings of the rotated factor matrix, thus, the instrument was found inadequate to profile the learning approaches for the respondents, in spite of its international reputation. Interestingly, such findings were congruent to earlier factor analytic studies of the LPQ with Filipino students (Watkins & Astilla, 1982). In light of previous unsuitability of the LPQ with Filipino students, R-SPQ-2F was still considered in this study because it is an updated version of the LPQ (Biggs et al, 2001). More recent factor analysis with the LPQ revealed that it has consistent factor structures with female Filipino students (Watkins et al., 1986). The validity of the LPQ was eventually established to assess learning approaches but only for higher achieving Filipinos (Zhang and Bernardo, 2000) and not for lower achieving ones. Therefore, could it be that the unsatisfactory mean BSDT scores of the respondents was a reflection of their level of achievement? Could it be that R-SPQ-2F was unsuitable for the respondents the way the low-achieving Filipino students did in the LPQ of Zhang and Bernardo (2000)? Such a sad predicament could not be verified at present by this study and is recommended as future research.

Table 7 Data Display of the Interview

| | | | | | |
|---|---|---|---|---|---|
| Deep Proto 1 | | | | | |
| I really have to understand the material before I can memorize. | | I am fond of reading, and I always go to the library to read. | | If I can't understand the lesson, I will really try to read to understand it | |
| Deep Proto 2 | | | | | |
| I can understand things better if it's the teacher who explains. | I learn better by memorization than by understanding. | If a material is not included, I don't give a lot for it. | If a material interests me, I will read further on. | When I was in high school, I only memorized likely answers but the teacher gave a different set that is why I don't do that anymore. | |
| Deep Proto 3 | | | | | |
| I always test myself If I have really understood. | There are times I need to memorize but many times, I study by understanding. | I only study the lectures I have written. | I study even topics that are not covered in exams because I feel have to learn them. | I study by understanding and not by memorizing. | I do not do further reading if the material does not interest me. |
| Deep Proto 4 | | | | | |
| I always read books and study all the time. | I study the lectures and then go to the library to read more. | If I don't understand something , I don't stop until I get the answers I need. | | I read other books to make me understand something. | |
| I read lots of books for a particular topic. | I get irritated if there's something I don't understand. | I study both by memorizing and by understanding. | | I want the teacher to be strict so that I will have to study more. | Depending on the exam, if I know I only have to memorize, that's what I do.. |
| Deep Proto 5 | | | | | |
| I sometimes challenge myself by setting goals and then I try to achieve it. | I only study what is required choosing only what is interesting. | I don't memorize. | I don't stop asking questions until I am satisfied with the answers. | | I only give much effort to subjects where I think I might fail. |

| | | | |
|---|---|---|---|
| I study on the spot, I just read before the exam. | I believe that If you know the topic already, you will just get confused if you study it repeatedly. | If there's a new topic, that's the time I study in order to know it before the teacher talks about it. | I don't study much if I know the subject already . |
| Deep Proto 6 | | | |
| I really enjoy studying. | At times, I sleep until midnight to study, or sleep early then wake up at dawn. | I always go to the library to understand the topics more. | I read the course syllabus and then go to the library to read about it. |
| If there is an interesting topic, I read more about it. | When I read my lectures thrice, I know already where it is written in my notebook. | I see materials not included in the exam as additional knowledge that's why I still study them. | I don't like enumeration type of questions, I like teachers who give practical exams. |
| Surface Proto 1 | | | |
| Sometimes, I just study to pass the subject but sometimes it depend on what the teacher does. | I feel I need to memorize when studying. Because If I memorize right away, it feels like a lot of things have been covered already. | If I don't memorize, I tend to forget. Sometime ago, I only memorized without understanding it, I didn't fail the exam. | I always memorize. I have not yet taken an exam without having memorized something. I have never failed. |
| If it's time to study, I study, but on my free time, I don't study. | I seldom go to the library. | If I find the topic interesting, I give time to it. | Memorization helps me more in exams. |
| Surface Proto 2 | | | |
| When I have memorized the topic, then I will be able to understand. | | I can memorize pages of lectures even without having to understand it. It is like a God-given talent. | |

| | | | | |
|---|---|---|---|---|
| Surface Proto 3 | | | | |
| I review when there is an exam, but if there is no exam, I just take it easy. | I don't study anymore topic that I know would not be included in the exam. | But if a topic is interesting, I still study it even if its n tint he exam. | I study by understanding and not merely memorizing things. | I study depending on the topic, If I find it interesting, I really study it by reading the lectures. |
| Surface Proto 4 | | | | |
| I study by writing what the teacher say and then study it. | I seldom go to the library because I just study using my notebook. | I write a reviewer and the order of the topic to prepare for an exam. | I depend on memorization. To make sure I pass an exam, I memorize even the order of the topics. But if I am in rush, I just read. | I find it difficult to understand that's why I just memorize. In solving equations, I just memorize the steps. |
| Surface Proto 5 | | | | |
| If I do not understand the lecture, I just memorize it. | What I memorize do not really stay in my head, I forget it easily. | I want to study my lectures more than books. I memorize my notebook where my lectures are written. | I only study what is important. Memorization works best for me. | I would only study further when I am interested with the topic, but if its math, I really try to understand it. |
| Surface Proto 6 | | | | |
| I am not easily satisfied by what the teacher says so I read further. | Even if a topic would not be given as exam, I still study it for reference. | Sometimes I go to the library, so that I have something to share during discussions. | I study by understanding because I find it difficult to memorize. | I always study with key words. With key words, things will easily flash back to my memory. |
| Sometimes, I use passed examinations for likely question items. | I usually cram for exams. | There are questions in passed exams that may be likely to come out, I try to remember them. | I study by understanding. | At time that I don't understand the topic, I just make my own conclusions. |

On the brighter side, the R-SPQ-2F helped in the selection of a group of students who were strongly surface and strongly deep, respectively. The significant high negative correlation proved the divergence of the surface and deep approach, that is, the more that a student goes deep, the less that he goes surface. The moderate negative correlation of the numerical literacy scores with the surface scores was not significant as well as its moderate positive correlation with the deep scores. Had a significant correlation been achieved, concerns on numerical literacy could be addressed through intervening with the learning approach which is a modifiable affective component of the learning process. Interestingly, the findings of the study were congruent to earlier relationships where the use of the deep approach was not found to be particularly associated with high or low verbal ability (Biggs, 1987).

Having resourcefully identified the strongly deep and strongly surface students, the study then sought to test if there is a significant difference between their numerical literacy scores. If the t-test is found significant, a learning approach can take more credit for a higher numerical literacy score. The deep group had a higher mean score than the surface group but the observed mean difference was not significant. This met expectations since the earlier correlation between the BSDT and the R-SPQ-2F scores was found not statistically significant.

T-test was also used to determine the mean learning approach in each freshmen class. It was found out that the mean learning approach of the higher sections was significantly surface. Could it be that the freshmen were put into the higher sections by a surface-level entrance test? Such predicament cannot be verified at this time by this study and evaluation of the entrance test is recommended as future undertaking. The significant t-test evoked the question, "Could it be that the surface approach still played dominantly in the higher sections even up to the end of the freshman year?"

If students in the higher sections are found surface, this may suggest that the entrance exam assessed the efficient reproduction of facts. High surface approach scores are associated positively with efficient of reproduction of facts and details, but negatively with qualitative complexity of performance (Biggs, 1987). Not on purpose, the BSDT is a deep-level type of test. Could it be that the unsatisfactory mean numerical literacy score of the selected group of students was a reflection of a freshmen populace that is generally surface? Could it be that surface approach was used more by freshmen in learning mathematics? Further exploration is recommended.

The qualitative validation thru in-depth interviews of the surface and deep students who were identified by the R-SPQ-2F greatly substantiated the marked difference between the surface and deep with very few exceptions. Surface students mentioned that they studied mostly by memorizing their lectures and skipping visits to the library. On the contrary, deep students mentioned that they studied mostly by understanding and the library was a favorite habit. Both the surface and deep students revealed that if the topic is interesting, they read and engaged themselves further. Thus, the surface approach can be discouraged by making classrooms interesting. The deep strategy is used only when the student is intrinsically interested in the material (Biggs, 1987).

The generic aim of good teaching is precisely to encourage students to adopt a deep approach and to discourage the use of a surface approach (Biggs, 1999). However the question is, can a student who endorses surface be taught to go deep? Yes. The SAL theory states that student is not permanently a surface learner or a deep learner (Biggs, 1987). Learning approach is different from a learning style. The former, having an affective component, is a strategy that can be adopted based on the motive. It is therefore modifiable. The latter, being purely cognitive, is a permanent personality trait that is displayed in a range of tasks and develops independently of schooling. So, if the deep approach is seen as better, why don't the students engage them. It is because students' strategy depends on their motives – what do I want out of this? Motives tend to determine strategies – How do I propose going about getting there (Pintrich, 1984)? The learning structure or context that the school provides can induce surface learning or deep . A student who would normally go deep would be encourage to go deep by context that encourages memorization or rote-learning and where assessment can be passed thru accurate retention of details. Teaching and assessment methods often encourage a surface approach when they are not aligned to the aims of teaching the subject .

The presence of a surface approach therefore signals that something is wrong in our assessment methods. On the other hand, a student who have habitually go surface could be helped to try the deep approach by a context that encourages understanding. Thus, the approaches that prevail tell us something about the quality of the teaching environment. The R-SPQ-2F can be useful in evaluating the teaching environment and is often more sensitive when reworded for a particular subject (Biggs, 1987).

The challenge now for MQAPC is to provide a learning context that requires the deep approach and to use assessments that measure understanding of concepts and not mere recall of information. As it is important to determine the individual and mean learning approach profile of students, it is recommended to find an instrument with a stronger validity. It is also recommended to review the current entrance exam which had placed surface students to the higher sections. A validated instrument for numerical literacy should also be used for a related study. Finally, part of the challenge is to enhance the numerical literacy of the freshmen given the prevalence of the surface approach among them as the question – "Are we achieving by our mere memorization of details or by our understanding of concepts?", still linger.

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