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The Role of Perceived Autonomy, Supportive Teachers' Behaviors, Situational Interest, and Self-Regulated Learning Strategies on Mathematics Academic Achievement

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Abstract
The present study tested a model highlighting that effects of specified teachers' autonomy supportive behaviors on mathematics are explained by the mediating roles of situational interest and self regulated learning strategies. The participants were 417 fourth year students in the secondary level who beforehand were evaluated to be low in perceived teachers' autonomy supportive behaviors. These participants were exposed into series of mini-lessons utilizing 4A's strategy instruction. The Learning Climate Questionnaire (LCQ), Situational Interest Survey (SIS), Academic Self-Regulation Scale (A-SRL-S), and mathematics test were administered after the students have engaged in the mini-lessons. Using Structural Equations Modeling, results confirmed that situational interest and self-regulated learning strategies explain the effect of autonomy supportive behaviors on mathematics academic achievement. The tested model attained an adequate fit (χ^2 = 376.795, df= 147 or CMIN/df=2.535, RMSEA= 0.061, TLI =0.925, CFI=0.936, and IFI = .937).

Keywords: Autonomy supportive behaviors; situational interest; self-regulated learning strategies; mathematics achievement

Introduction

Autonomy is a universal psychological need that, when satisfied, provides an individual a feeling of independence and identity, but when stifled will result in maladaptive practices. Learners

have high need for autonomy, which is critical for their learning. In this light, teachers' autonomy supportive behaviors should be examined to find whether they provide the necessary autonomy support during mathematics instruction. Autonomy influences situational interest (Tsai et al., 2008), a construct which learners perceive is absent during math instruction. In fact, some authors presumed that students achieved poorly in mathematics because they do not perceive the subject as attractive, interesting, and engaging (De Corte, Verschaffel, & Depaepe, 2008). Autonomy supportive behaviors not only influence students' interest during instruction, it promotes a chain effect on the students' behavior prompting them to use self-regulated learning strategies (Dohn, Madsen, & Malte, 2009). When students perceive the classroom environment as interesting, they engage in activities and match their skills against the challenges set by teachers (Turner et al., 1998). It is this experience of interest which drives learners to adopt and enhance their use of self-regulated learning strategies (Sierens, Vansteenkiste et al., 2009).

Majority of learners have poor study habits resulting in low mathematics achievement, indicating that they need to be trained to use self regulated learning strategies (Camahalan, 2006). The lack of well-defined self regulated learning strategies may also prove lack of interest on their part as learners, and which can be traced from lack of support to their need for autonomy. This scenario provides the reason why the necessity to investigate more teachers' autonomy supportive behaviors. A number of studies have been conducted showing the direct impacts of autonomy supportive behaviors, situational interest and self regulated learning strategies on math achievement (Tsai, Kunter, Ludke, Trautwen, & Ryan, 2008; Hidi & Harakiewicz, 2000), however, no indirect effects of autonomy to math achievement via situational interest and self regulated learning strategies were specifically known.

This study aims to explain how perceived teachers' autonomy supportive behaviors affect math achievement. It provides explanations on the direct and indirect paths between autonomy supportive behaviors, situational interest and SRL which occur in an autonomously supportive learning context.

Teachers Autonomy Supportive Behavior

Self determination theory (SDT) accounts that autonomy pertains to actions that are self-endorsed and are based on self-

integrated values or interests. It is a basic and universal human need and therefore opportunities to experience it is critical to well-being (Ryan & Deci, 2000). SDT argues that people are naturally prone to self-organized actions and that the sense of choice, congruence, and initiative that characterize autonomy are necessary aspects of healthy functioning. SDT strongly points out that if autonomy is not supported, it will have deleterious impact on well-being (Deci, Koestner, & Eyan, 1999). In classrooms, a teacher who is autonomy supportive ascertains learners to be free of internal hindrances and external manipulations, coercion, and gives adequate options to choose from (Adams, 2007). Autonomy is not limited and bounded by culture, whatever the kind of society is, support for autonomy is a fundamental psychological need among adolescents (Chirkov & Ryan, 2001). It is manifested when teachers develop classroom opportunities for students to align their inner resources with their classroom activities (Assor, Kaplan, & Roth, 2002).

Studies documented positive effects of autonomy on academic achievement. Autonomy enhancing instructional behaviors directly affect students' cognitive and behavioral engagement with academic tasks (Assor, Kaplan, & Roth, 2002). During mathematics instruction, students who perceive teachers to be autonomy supportive of their learning obtained higher academic performance (Tsai et al., 2008; Wilsons & Simons, 2002). In a study of 135 sixth-grade and 91 ninth-grade regular education students in Southern California, stepwise regression analyses indicated that teachers' autonomy support among others, predict mathematics performance (Wong, Weist & Cusick, 2002).

Evidences proved that autonomy supportive teaching behaviors trigger development of situational interest (Stefanou, Perencevich, DiCintio, & Turner, 2004; Assor, Kaplan, & Roth, 2002; Reeve & Jang, 2006; Grolnick, Ryan, & Deci, 1991). Studies conducted on 261, 7th grade students in Germany found that autonomy supportive behaviors predicted students' situational interest in math (Tsai, et al, 2008). Positive feelings, valuing tasks, and engagement characterize high situational interest. Similarly, a study conducted among 95 sophomore students at Dutch University found that variance in students' situational interest was generated due to their satisfaction in terms of psychological need in which one is autonomy (Boekaerts & Minnaert, 2006).

Teachers' autonomy supportive behaviors can stimulate students to adopt self-regulatory learning strategies. In a study on regulatory fit, students displayed equally autonomously regulated learning strategies when they perceived the environment to be autonomously supportive, but, demonstrated maladaptive strategies when the learning climate was perceived to be controlling (Pierro, et al., 2009). In a particular study of 526 Belgian students, teachers' autonomy support was found to be positively correlated with students' self-regulated learning. These findings were in line with Self-Regulated Learning Theory stating that these processes are assumed to be influenced by environmental stimuli (Zimmerman, 1989). A study further suggests that if teachers want their students to evaluate themselves, to plan their study activities, and to think about themselves as learners, they are expected to provide instruction and expectations in an autonomy-supportive way (Pierro, et. al, 2009).

Situational Interest

Interest as a psychological construct is of two types: the individual or personal type and situational interest. Situational interest is characterized by positive emotions and heightened concentration. It is spontaneous, environmentally activated, assumed to be transitory, context specific, and is provoked by external and situational stimuli rather than by individual variables (Hidi & Renninger, 2006). Once elicited, situational interest facilitates cognitive functioning and learning (Hidi, 1990). It can be initiated by something in the environment, and is more amenable to change (Schraw & Lehman, 2001).

Development of interest usually goes into phases, such as triggered-situational interest, maintained-situational interest feelings and maintained situational interest values. Triggered-situational interest (Trig-SI) usually comes out at the onset of individual's association with the environmental stimuli, and is similar to "catch". It refers specifically to *initiating* interest (Hidi & Harackiewicz, 2000; Hidi & Renninger, 2006). Maintained-situational interest feeling (MSI-F) develops due to the extent wherein the material itself was enjoyable and engaging. Lastly, maintained-situational interest-values (MSI-V) develops based on whether the material was viewed as important and valuable (Linnenbrink-Garcia, Durik, Conley, Barron, Tauer, Karabenick, & Harackiewicz, 2010).

Situational interest is relevant to learning. It may best contribute to the beginning stages of knowledge acquisition (Hidi, 1990). The triggered situational interest serves as a "spark" which would ignite student's curiosity to learn more and engage in mathematical concepts, facts, ideas, processes and principles being presented. More engagement in challenging tasks, experiences of positive affect, enjoyment in dealing with difficult tasks and seeing the tasks as significant are evidences of interested students that lead more to higher achievement in math (Harakiewicz, Barron, Durik, Tauer, and Linnenbrink-Garcia, 2008).

Situational interest affects students' use of learning strategies (Schiefele, 1991). It energizes learners to adopt self-regulated learning strategies (Sorić & Palekčić, 2009). Results of a study revealed **t**hat the level of interest or enjoyment in math is a significant predictor of students' reports of strategy use which accounted for 14% of the variance **(**Cleary & Chen, 2009). Another findings proved that when situational interest is enhanced, it promoted the use of self-regulated learning strategies specifically when the instructional setting is less structured (Dohn, Madsen, and Malte, 2009).

Self-Regulated Learning Strategies

Self-regulated learning strategies are activities or actions which students use to perform well and obtain successful academic outcomes (Zimmerman, 1989). They can be understood as an organized, conscious, and intentional whole of what the student does to efficiently accomplish a learning objective in a given social context (Gargallo, Suárez-Rodriguez, & Pérez-Perez, 2009). These strategies are used by independent learners to control their learning, focus in their studies, plan and study (Magno, 2009; 2011a). Generally, it is through self–regulated learning in which students activate and sustain their cognitions and behaviors and systematically orient themselves toward the attainment of their learning goals (Zimmerman, 1989).

Academic Self Regulated Learning Scale (A-SRL-S) identified self regulated learning strategies which include memory, goal setting, self-evaluation, seeking assistance, environmental structuring, learning responsibility, and organizing.

Self-regulatory learning strategies predict academic success. They are proven as the best predictor of standardized achievement test scores (Zimmerman & Martinez-Pons, 1986). Higher level of use of

self-regulated learning strategies results to better academic achievement (Soric' & Palekcic', 2009). The same results were shown in the study that all seven self-regulation strategies significantly predicted college students grade at the end of the term or semester (Magno, 2011a). Specifically, another study found that self regulated learning activities such as self-evaluation, monitoring, planning, goal setting positively affected mathematics achievement (Arzal, 2011).

Conceptual Framework

A conceptual framework was formulated which shows the direct and indirect effects of teachers' autonomy supportive behaviors, situational interest and self-regulated learning strategies on math achievement. This model shows the probability of the existence of indirect effects of teachers' autonomy supportive behaviors to impact math achievement by affecting first the students' situational interest, or their self regulated learning strategies. These indirect effects visualize how the influence is carried over to math achievement. The study may expose the probability of the mediating roles of situational interest and self regulated strategies in an autonomously supportive learning context.

The first indirect path presumed to exist in this study as the result of logically linking the constructs during model formulation is that students' perception of teachers' autonomy supportive behaviors could trigger development of situational interest (Stefanou, Perencevich, DiCintio, & Turner, 2004; Reeve & Jang, 2006; Grolnick, Ryan & Deci, 1991) and as a consequence, math performance improved (Hidi & Harakeiwicz, 2000; Harakeiwicz, Barron, Durik, Tauer, & Linnenbrink-Garcia, 2008). Situational interest serves as the construct through which effects of autonomy supportive behaviors would be carried over to math achievement. This indirect effect is expected to assume a certain magnitude which could explain how changes in autonomy affect situational interest, which in turn may affect math achievement.

When students perceive teachers to be autonomy supportive, they are stimulated to self-regulate (Grinsven & Tillema, 2006). More autonomy supports will be encoded as favorable experiences and thus prompt them to match their skills, to effectively engage in self-regulated learning strategies, and improve academic performance (Sierens et al., 2009). In addition, students who perceive teachers in

mathematics to be generally good at scaffolding their learning also engage more in self-regulated learning strategies. Teachers who explain the purposes and relevance of the tasks as well as link present concepts and prior knowledge facilitate students to put more meaning in and value their learning, resulting in more use of self-regulated learning strategies. Hence, increasing autonomy supports increases the use of a variety of learning strategies (Grinsven & Tillema, 2006), and in effect, the frequency of use of SRL consequently improves students' achievement (Zimmerman & Martinez-Pons, 1986; Soric' & Palekcic', 2009; Camahalan, 2006; Arzal, 2011).

Autonomy supportive behaviors influence students' use of self regulated learning strategies through situational interest. The model explains that students can be prompted to adopt self-regulated learning strategies when at that particular context, they experience situational interest. The model describes that autonomy supportive behaviors can at the same time induce learners to adopt self-regulated learning strategies by ensuring the presence of situational interest. Situational interest in this path serves as the construct through which autonomy supportive behaviors carry over its effect on self regulated learning strategies.

The formulated conceptual model identified the path indicating that students situational interest can influence math achievement through the presence of self-regulated learning strategies. This relationship shows that when students use more self-regulated learning strategies, situational interest impacts best mathematics achievement. It proposed a strategic way on how situational interest effects to math achievement could be maximized.

Teachers' autonomy supportive behaviors can trigger students to generate situational interest and make them adopt SRL strategies which would improve math achievement. During mathematics instruction, although students may perceive the lessons as difficult, instructions would appear as interesting and challenging through teachers supporting their autonomy. When teachers understand their feelings and show confidence on them, students continue to persevere in difficult tasks. Experiencing situational interest in classroom settings, positive influence on students' self-regulated learning strategies results, and mathematics achievement are also attained (Schiefele, 1991; Soric' & Palekcic', 2009).

Teachers' autonomy supportive behaviors stimulating students' inner resources to develop situational interest, and utilize SRL

strategies are embodied in Self Determination Theory. This organismic-dialectical theory views human being as proactive organisms but their natural or intrinsic functioning can be either facilitated or impeded by the social context (Deci & Ryan, 1985; 1991). These tendencies do not operate automatically, instead require ongoing social nutriments and supports (Ryan & Deci, 2000). This theory explains that individuals have high need for autonomy aside from competence and relatedness. Once all the necessary nutriments are provided continuously such as teachers' autonomy support, the most volitional and high quality forms of motivation and engagement result. The output would be persistence and creativity leading to higher performance. Thus, SDT serves as the bases for explaining relationships and connections as well as outcomes between perceived teachers' autonomy supportive behaviors, situational interest, and self regulated learning strategies.

Statement of the Problem

The main purpose of this study was to examine and explore how autonomy supportive behaviors affect mathematics achievement. It tried to examine how this construct behaves in the presence of situational interest and self-regulated learning strategies, concepts which have great roles in students' attainment of knowledge especially inside the classrooms.

Specifically, this study sought answers to the following research questions:

Direct Effects:

1. Do teachers' autonomy supportive behaviors directly increase students' achievement in mathematics?
2. Do teachers' autonomy supportive behaviors increase students' situational interest?
3. Do teachers' autonomy supportive behaviors stimulate students' adoption of self-regulated learning strategies?
4. Does situational interest directly increase students' achievement in mathematics?
5. Does situational interest directly improve student's use of SRL strategies?
6. Do self-regulation strategies directly increase students' achievement in Mathematics?

Indirect Effects:

7. When situational interest is optimal, how do autonomy supportive behaviors influence students' academic performance in mathematics?
8. When students' level of use of self-regulated learning strategies is high, how do autonomy supportive behaviors encourage learners to attain satisfactory academic performance in mathematics?
9. When situational interest is optimal, how do autonomy supportive behaviors advance learners to use self-regulated learning strategies?
10. When students' level of use of self-regulated learning strategies is high, how do situational interest affect academic performance in mathematics?
11. In general, how do autonomy supportive behaviors, situational interest and self-regulated learning strategies impact mathematics achievement?

Hypothesis

The following hypotheses were tested in this study;

Direct Effects

Hypothesis 1: Teachers' autonomy supportive behaviors directly improve students' academic achievement in mathematics.
Hypothesis 2: Teachers' autonomy supportive behaviors during mathematics instruction increase students' development of situational interest.
Hypothesis 3: Autonomy supportive behaviors instigate students to adopt self-regulated learning strategies in mathematics.
Hypotheses 4: When students' situational interest during mathematics lessons is high, learners adopt more and deeper level of self-regulated learning strategies.
Hypothesis 5: When students' situational interest is high, academic achievement in mathematics is expected to improve.
Hypothesis 6: Students adoption of self-regulated learning strategies will result to an improved achievement in mathematics.

Indirect effects:

Hypothesis 7: When situational interest is high, autonomy supportive teachers' behaviors promote students to attain better academic performance in mathematics.
Hypothesis 8: When students adopt more self-regulated learning strategies, autonomy supportive teachers' behaviors increase their academic achievement in math.
Hypothesis 9: When students' situational interest is high, autonomy supportive behaviors would encourage learners to adopt self-regulated learning strategies.
Hypothesis 10: When students' level of use of self-regulated learning strategies in mathematics is high, increased levels of situational interest sustain them to achieve better.
Hypothesis 11: In general, when autonomy supportive behaviors, situational interest and use of SRL strategies are experienced at high levels, students' mathematics achievement is improved.

Method

Research Design

A learning context was structured and maintained where teachers' autonomy supportive behaviors were ensured to exist and were held constant so as to affect student's development of situational interest, use of self-regulated learning strategies, and improve mathematics academic achievement. The explanatory, cross-sectional design was utilized and analysis of data were made across variables of autonomy supportive behaviors, situational interest, self-regulated learning strategies, and math achievement. Finally, Structural Equation Modeling (SEM) tested fitness of the proposed model to the data.

Participants and Procedure

A permission to conduct a research with the fourth year students as the participants was secured from authorities of Manggahan High School, Division of Pasig City, Philippines and proposed plans for gathering data were discussed.

The Learning Climate Questionnaire (LCQ) was administered and those students whose means were below 3.5 in the LCQ were

selected as participants. This is to ensure a context low in autonomy supportive behaviors. Only 417 out of the original number of 423, (58.04% males, mean age=15.38 years old) were able to complete the scales. Aside from having low levels of perceived autonomy supportive teachers' behaviors (*M*=3.23, disagree to strongly disagree to items of LCQ), the participants have varied socioeconomic background, with more than half (56.17%) of them having family monthly income lower than Php10,000.

Instruments

Learning Climate Questionnaire (LCQ). This is the short version scale that measures the degree to which the students perceive their teachers as supporting their autonomy. Items were adapted from the Learning Climate Questionnaire developed by Tsai et al., (2008), (e.g., "*I felt that my teacher provided me choice and options*"). The scale has good internal consistency, Cronbach's alpha=*0.983*. Responses were given on a 7-point Likert type scale. Goodness of fit indices supported unidimensionality (CMIN/df=4.7; NFI=.96; IFI=.97 and TLI=.95).

Situational Interest Survey (SIS). This 12- item Likert type scale was developed by Lenninbrink-Garcia, Durik, Conley, Barron, Tauer, Karabenick, and Harackiewicz (2010) and is made up of three factors (triggered situational interest, maintained situational interest-feelings, and maintained situational interest-values). All indices of reliability of item scores were good. The subscales measured situational interest in Math domain; Triggered-SI consisted of 4 items; α.= .813 (e.g. "*My math teacher is exciting*"), maintained-SI-feelings have 4 items; α.= . 850 (e.g. "*I am excited about what we are learning in math"*) and maintained-SI-values consists of 4 items; α.= . 811 (e. g. *The things we are studying in math are important to me"*). Responses were given on a 6-point Likert scale that ranged from 1 (*disagree strongly*) to 6 (*agree strongly*).

Academic–SRL-Scale (A-SRL-S). This is a self-report 55-item scale consisting of 7 subscales that measures self-regulated learning strategies in academic settings (Magno, 2010) and is made up of seven factors. The sub-scales have high internal consistency: Memory Strategies (α.= .881); Goal setting strategies (α.= .677); Self Evaluation (α.= .848); Seeking assistance strategies (α.= .704) Environmental structuring (α.= .742), Learning responsibility strategies

(α.= .714); and Organization strategies (α =.725). Responses are given on a 4-point Likert scale and ranged from 1 (never) to 4 (always).

Math Test. This is a 35-item test used to measure students' competencies in Mathematics 4 on the topic, "Graphing Quadratic Function". The test items were aligned to curriculum standards, checked by experts, and TOS has been prepared, thus attained content validity. The discrimination and difficulty indices were determined using the Classical Test Theory (CCT).. The reliability was established by determining its Cronbach's alpha (Table 1) (alpha=.712 $p<.05$).

Data Collection

Collection of data went through 3 phases; Phase 1 is orientation, training, and seminar-workshop for teachers. The existence of an autonomy supportive learning context, situational interest and utilization of self regulated learning strategies was ensured in this phase. It included development of lesson plan, preparation of the modules and training design for teachers and conduct of the orientation, training and seminar workshop for math teachers. Phase 2 involved conducting and monitoring the 5-day series of mini lessons which exposed the participants under highly autonomous supportive teachers while phase 3 was the administration of the instruments. The scales were distributed at the end of each period while mathematics test was administered on the following week after the mini lessons.

Data Analyses

Two tests were done initially, to satisfy the assumptions of multivariate and SEM analyses; the directionality and data related assumptions. Temporal precedence and unidirectionality were ascertained. Tests for normality and homoscedasticity of the data were carried out. Normality was induced and homoscedasticity was diagnosed. Descriptive statistics and reliability estimates of each scale were calculated. Bivariate correlations were done and SEM with Maximum Likelihood Technique was utilized to estimate the coefficients between parameters to answer the research questions and hypotheses posed in the beginning of this study. Parameter estimates between latent variables indicating direct and indirect effects and coefficients of their corresponding indicators were analyzed with the

technique. This was followed by assessment of model fit (Joreskog & Sorbom, 1989). Interpretations and recommendations by Schermelleh-Engel, Moosbrugger, & Müller (2003) were applied.

Results

The model tested the directionality related assumptions specified in the hypothesis. Autonomy supportive behaviors, an exogenous variable, has arrows pointing to situational interest, self regulated learning strategies and math achievement which are the endogenous variables or the downstream variables. The latent constructs have arrows pointing to their respective manifest variables characterizing a reflective model. Disturbance and error terms have no covariance symbols connecting them. The model is recursive; theories and previous findings served as the bases for the specification.

Levene's test was similarly done to find for the homogeneity of variances across teachers' autonomy supportive behaviors, results are shown in Table 1.

Table 1
Levene's Test for Homogeneity of Variance Across Autonomy Supportive Learning Behaviors

Variables	Levene's Statistic	df 1	df 2	p
(1) Triggered-Situational Interest	1.909	27	385	.005
(2) Maintained Situational Interest - Feelings	1.645	27	385	.024
(3) Maintained Situational Interest-Values	1.421	27	385	.082
(4) Memory	1.504	27	385	.053
(5) Goal Setting	1.477	27	385	.061
(6) Self evaluation	2.050	27	385	.002
(7) Seeking Assistance	.988	27	385	.484
(8) Environmental Structuring	1.034	27	385	.420
(9) Learning Responsibility	.975	27	385	.502
(10) Organizing	1.156	27	385	.272
(11) Competence 1	2.233	27	385	.001
(12) Competence 2	.961	27	385	.524
(13) Competence 3	2.293	27	385	.000

The obtained Levene's statistics reflected that majority of the variables are non significant ($p>.05$) indicating that the variances of

these variables across autonomy supportive behaviors are homogenous, thus, decision to proceed to the major analysis was warranted.

Table 2
Means, Standard Deviations, Confidence Intervals, Cronbach's alpha of Autonomy Supportive Teaching Behaviors, Situational Interest, Self-regulated Learning Strategies and Mathematics Academic Achievement (N=417)

Variables	M	SD	Minimum	Maximum	Confidence Interval	Cronbach's Alpha
Autonomy Supportive Behaviors	5.39	1.02	2.02	7.0	.013	.983
Triggered-Situational Interest	4.65	.92	1.67	6.0	.002	.813
Maintained Situational Interest-Feelings	4.74	.86	1.50	6.0	.002	.850
Maintained Situational Interest- Values	4.93	.85	1.00	6.0	.002	.811
Memory	2.71	.61	1.40	4.0	.002	.831
Goal Setting	2.90	.61	1.00	4.0	.002	.677
Self Evaluation	2.96	.50	1.67	4.0	.002	.848
Seeking Assistance	2.85	.48	1.50	4.0	.001	.704
Environmental Structuring	3.14	.57	2.00	4.0	.002	.740
Learning Responsibility	3.04	.54	1.40	4.0	.002	.714
Organizing	3.06	.51	1.50	4.0	.002	.725
Competence 1	8.06	2.82	0	10	.008	.813
Competence 2	11.43	4.64	0	20	.014	.852
Competence 3	1.49	1.71	0	5	.005	.840

Table 2 shows that the participants perceived their teachers to be autonomy supportive of their learning. Similarly, they have developed and possessed different forms of situational interest and have utilized to certain levels self-regulated learning strategies. It is also shown that they acquired certain competencies on the three dimensions of math achievement. The standard deviations reflect that there was no abnormal spread of the data.

Reliability estimates for the scales ranged from alpha=0.68-0.98 indicating that items have acceptable to excellent internal consistency.

Truncated estimates for the path coefficients during SEM analysis are avoided (Kline, 2011, p. 123).

Confirmatory factor analysis validated the factors for each latent variables while bivariate correlations between dimensions are found to be linear. The correlations among and between the dimensions or factors of situational interest, self-regulated learning strategies, and mathematics achievement were tested at p=. 01 and p = .05 (2-tailed level of significance). Table 3 showed that the bivariate correlations are positive and are higher between indicators of the same construct supporting convergent validity. The positive correlations between dimensions support linearity and are significant indicating the certainty that regression weights of considerable estimates can be calculated, a realization of another assumption for SEM.

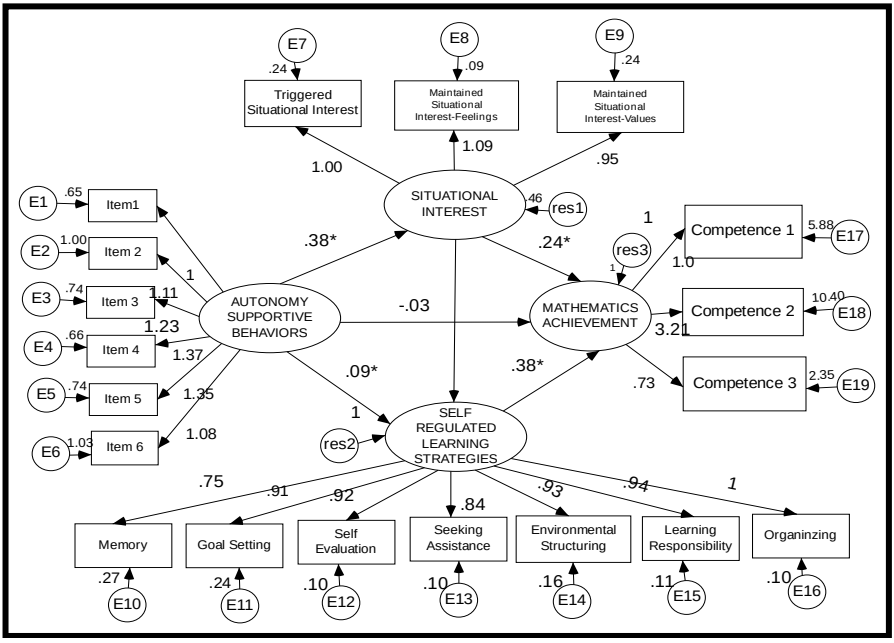

Figure 1. Effects of Autonomy Supportive Behaviors on Mathematics Achievement via Situational Interest and Self Regulated Learning Strategies

In the figure, teachers' autonomy supportive behaviors' direct effect on mathematics achievement (parameter estimate =-.03) is not significant, hence there is no supporting evidence as whether to confirm or not Hypothesis 1. However, the direct effects of the rest of the variables on each other and on math achievement are all positive, significant, and high, indicating that Hypothesis 2 to Hypothesis 6 are supported. Based on these direct effects, results implied that for every 1 unit increase in perceived teachers' autonomy support, there is a corresponding 38% increase in students' situational interest (p<.001) and 9% increase in self regulated learning strategies (p<.05), respectively. On the other hand, situational interest significantly and directly affected students' SRL strategies (parameter estimate= 0.15, p<.001) and Math achievement (parameter estimate= 0.24, p<.05), thus supporting Hypothesis 4 and Hypothesis 5, respectively. It implied that for every 1 unit increase in situational interest, a corresponding 15% and 24% increase resulted in self-regulated learning strategies and math achievement, respectively. Lastly, a direct effect of self-regulated learning strategies on math achievement is likewise significant, (estimate=.38, p <.001), supporting Hypothesis 6 and indicating that for every 1 unit increase in self regulated learning strategies, a corresponding 38% increase is carried over to math achievement.

The hypothesis on the existence of indirect effects of autonomy on math achievement via situational interest and SRL, as well as the indirect effect of autonomy on SRL via situational interest, and situational interest on math achievement via SRL are all supported by the results. Evidences for indirect causal relationships can be interpreted through the products of indirect effects (Kenny, 2008). Thus, following this statement, as shown in Figure 1, it is implied that during increased levels of situational interest, autonomy supportive behaviors impact positively math achievement (indirect effect, .38 x .24 = .091), supporting Hypothesis 7 and implying further that for every unit increase in autonomy, 9.1% is carried over to math achievement, through situational interest. This indicates that situational interest served as the presumed mediator, which explains the effect of autonomy to math achievement. This also implies that autonomy supportive behaviors impact math achievement through increased situational interest.

On the other hand, the indirect effect of autonomy to math achievement via SRL strategies (indirect effect, .09 x.38=.0342)

supported Hypothesis 8. The results implied that when students are prompted to use available SRL strategies due to autonomy supportive behaviors, an effect of 3.42% is carried over to math achievement. In addition, as reflected in the model, at high levels of situational interest, autonomy supportive behaviors correspondingly would affect SRL (indirect effect=.057), supporting Hypothesis 9. This indicates that a 5.7% effect is carried over to SRL via situational interest for every unit increase in autonomy support. The findings suggest that the use of SRL strategies can also be significantly improved by autonomy supportive behaviors by increasing the levels of situational interest. In addition, as manifested in Figure 1, situational interest impacts math achievement via SRL (indirect effect= .057), supporting hypothesis 10. This connotes that through increased self-regulated learning strategies, the 5.7% effect of situational interest is carried over to math achievement.

The calculated total effects=.74, presaging that a 74% increase is attained in math achievement by the influence of autonomy supportive behaviors through situational interest and self-regulated learning strategies supporting hypothesis 11. The resulting goodness of fit indexes evaluated that the model is supported by the data. Since absolute fitness of test, χ^2 =376.795,df=147, or CMIN/df=2.535, p<.000 is significant, other indices were examined; Root Mean Square Error of Approximation (RMSEA) = 0.061; Tucker Lewis Index (TLI) = 0.925; Comparative Fit Index (CFI) = 0.936 and Incremental Fit Index (IFI)= .937. Majority of these indices are within the acceptable range which indicates that the model fits the sample well. The data also met the required assumptions for the SEM and multivariate analysis, hence a strong argument is made that the model cannot be rejected and is as good as true.

Discussion

The model, which describes how perceived teachers' autonomy supportive behaviors improve mathematics achievement is the present study's major contribution to empirical research. The developed model hypothesized that similar with previous findings, mathematics achievement is predicted by the direct effects of autonomy supportive behaviors, situational interest and self-regulated learning strategies, and emphasized, which is unique in this study, the indirect effects or

associations between these variables can provide more meaningful pathways to explain mathematics achievement.

The tested model explains that the effects of teachers' autonomy supportive behaviors to math achievement was plausibly mediated by situational interest and self regulated learning strategies as shown by the significant magnitudes of these two constructs to math achievement. With their inclusion in the causal process, an indirect effect of autonomy supportive behaviors is carried over to math achievement. This confirmed the seemingly facilitating roles of situational interest and self-regulated learning strategies in transmitting the positive influences of teachers' autonomy supportive behaviors to mathematics achievement whenever they are present. It suggests that when teachers are more autonomy supportive, students' interests are triggered which serves as the "spark" that ignites the learner's curiosity to know more thus engage in all activities (Hidi & Harakiewicz, 2000). When students engage more they experience positive affect, enjoy even more in difficult tasks and see the tasks as meaningful and valuable. The more that they interact with other learners and with the materials during activities, there is hands on, hearts on, and minds on, characterizing a learner centered curriculum (Ocampo, 2008). In this context, to sustain their satisfaction, learners are led to self regulate their actions. With the continuous and increased support from the outside source, which in this situation, the teachers' autonomy supportive behaviors, students maintain the feelings of interestingness in the 3 dimensions, resulting in more use of self regulated learning strategies. The learners acquired more tools in the form of SRL strategies which aid them in learning; consequently, they are able to achieve the competencies required of them. This context finally led to higher achievement in math (Harakiewicz, Barron, Durik, Tauer, & Linnenbrink-Garcia, 2008). Although the direct effect of teachers' autonomy supportive behaviors which leads to better mathematics achievement (Tsai et al, 2006; Assor, Kaplan, & Roth, 2002; and Wilsons & Simons, 2002) was not provided with evidence for confirmation in this study, however, how teachers' autonomy affects math achievement is clearly manifested. These outcomes confirmed the similar influences to math achievement, obtained in the study conducted by Hidi & Harakiewicz (2000), Schraw, Flowerday, and Lehman (2001) and Dohn, Madsen, and Malte (2009). On the other hand, when students utilize SRL often as the result of interestingness

of the learning context, they are aided in facing and overcoming challenges in math instruction, enabling them to analyze, process, comprehend, do mathematical computations with accuracy thereby attaining the competencies expected of them, and finally improve mathematics achievement. These results were also found in the studies conducted by Soric' and Palekcic' (2009), Camahalan (2006), and Arzal (2011). However, it should be reiterated that positive effects of situational interest and self regulated learning strategies on math achievement become significant only when the learning context is autonomy supportive. These triadic relationships which are not yet explicated well in the research arena affords valuable findings that support self-determination theory (Deci & Ryan, 2000), stating that positive outcomes are possible when necessary social nutriments from the outside are provided. Teachers' autonomy supportive behaviors supply the necessary "nutriments" needed for the development and improvement of situational interest making learners to self-regulate their learning strategies, become self determined and consequently attain higher mathematics achievement. These behaviors provide the necessary encouragements for learners to overcome their fears, be one in the group, and/or recognize their potentials which lead to more development of situational interest and adoption of more self-regulated learning strategies. This explains why the urgent need to support autonomy of our learners.

Teachers' autonomy supportive behaviors effect on math achievement is explained best by the development of situational interest and SRL strategies among learners. Findings of this study fit well the Self Determination Theory (Deci & Ryan, 1985; 1991; 2010) and has wider range of application in the field of education.

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