The Temporal Path Analysis Model of Intrinsic and Extrinsic Motivation in Cooperative Learning Environment

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***Abstract*—The aim of this research is to explore the temporal path analysis model of intrinsic and extrinsic motivations in cooperative learning environment. The participants are grade 7th junior high students (12~14 years old, 15 males, 13 females, 28 junior high school students) and the learning content is about the linear equations in mathematical within cooperative learning environments. This study will discuss the possible factors of intrinsic and extrinsic motivations which may inspire learning motivations in cooperative learning environment. Furthermore, we hope to support some encouraged strategies which were based on path analysis model for teachers to enhance learners' situated learning motivations. Furthermore, we want to find the interactions of intrinsic and extrinsic motivation to show motivational synergy.**

***Index Terms*—intrinsic motivation, extrinsic motivation, situated learning motivation, path analysis model**

I. Introduction

The temporal motivation model is caused by the situated motivations which will influence by different related factors. Situated motivation is the motivations of individual to move himself to do something in some surrounding circumstance. And the sources of learners' temporally situated motivations will cause by parents, classmates, instructors, learning objects, learning attitudes, teaching algorithms, and knowledge representations. However, the motivations of learning processes are not only positive and negative, but also intrinsic and extrinsic to connect and apply the surrounding circumstance. Accordingly, the more analyzable, and interpretable knowledge framework of motivation with meaningful, connectable, and authenticable motivation linkages will lead learning behaviors with enough reciprocal effects among the learners' mental states, instructors' strategies and concrete applications. In this research, we wanted to survey the relationships of intrinsic, extrinsic, and synergy motivation in cooperative learning environment. In grouping and cooperative learning, Zammuner [1] proposed that small groups promoted learning achievements across many curriculum. And Webb and Farivar [2] proposed the problem solving in mathematical tasks in cooperative learning. Furthermore, Gillies [3], [4] proposed the cooperative learning in heterogeneous grouping method will lead to better performance. Moreover, the interactions of dynamic groups will effect individual motivations. In addition, inner and outer group regulations describes the group interactions may lead the learning processes of individuals who are metacognitive, motive, and strategic in cognitive retrieve and reserve processes. In inner and outer group regulation, the derivation of learning processes or learning algorithm are important for learners to motive, encourage, and challenge to look into learning objects to find, locate and discover the specific knowledge and operation. Conversely, instructors and course designers need to locate the ambiguity reasons or error types from learners for motivation retrieve and reserve. However, the motivational reasoning usually combines intrinsic and extrinsic motivation [5], [6] and motivational synergy [7] in relational principles, and operational algorithms of individual learners to interpret and operate the related concepts and skills. However, most of the learning tasks for learners to perform are not easy for inherently interesting or enjoyable autonomy of individual learners. Moreover, an individual learning processes may maintain voluntary or involuntary characteristics for individual to pay active or inactive attentions to learning and teaching processes. Consequently, the learning motivations were motivated, unmotivated, or demotivated should be the essential issues for acknowledging and performing the good teaching and learning performances. Therefore, how to promote more active and voluntary learning motivations in intrinsic or extrinsic will be the essential strategies for successful teaching and learning. The present study focuses on the ways in which a highly structured form of cooperative learning within simple linear equation. At the same time, the empirical study examines whether the path analysis that support the situated motivation (interactions of intrinsic and extrinsic motivation) and show the motivational synergy.

II. Motivations

In practice, we see the different motivations between mathematic comprehension and application during

Manuscript received August 16, 2015; revised December 22, 2015.

doi: 10.18178/ijlt.2.2.133-139

mathematical teaching and learning processes. And the situated motivation will be generated via the interactions among parents, classmates, instructors, learning objects, learning attitudes, teaching algorithms, knowledge representations, and learning atmospheres during the specific period. Meanwhile, the learning motivations are not merely positive or negative, but also intrinsic or extrinsic. The factors were defined by Deci and Ryan [6] which included the intrinsic and extrinsic motivations. Many researches [8]-[12] pay attention to motivational traits, motivational states, and motivation toward to the task. Moreover, Zimmerman & Martinez-Pons [13] proposed that how teacher can promote self-regulated learning [14] will be a critical criterion to school success in teaching and learning. However, the motivations will be distinct in different interactions by specific person, culture and environment. Furthermore, In Self-Determination Theory (SDT), Deci & Ryan [6] distinguished different types of motivations via the different reasons or goals to be specific behaviors and actions. And Amabile [15] proposed a model of motivational synergy which presented the intrinsic and extrinsic motivation may interact the outcomes from work and environment. And work preference inventory (1994) is to detect the tendency of individual's intrinsic and extrinsic motivation of adults and students. In addition, Amabile [16] mentioned that organizational changes can fluctuate motivation enormously. Consequently, working and learning motivation is not stable in different atmosphere and organization. Accordingly, temporary motivational states can be effected by social couture or environment. Furthermore, motivator-hygiene theory [11] (includes motivator and hygiene factors. The motivator factor involves responsibility, autonomy, and satisfaction. And the hygiene factor involves pay, reward, security, and working condition. The autonomy, self-control, self-monitor, self-discipline, and self-efficacy are implied to support the learners to reach specific objectives with self-generate thinking, feeling, acting, monitoring, and evaluating processes. Individual's specific feedback, commitment, control, and confidence are interacted each other in self-regulation which can be used to clarify goals and reduce or remove uncertainty in task [17]. Furthermore, Pintrich [18] proposes four assumptions of self-regulation learning models as the followings: 1) active and constructive assumption; 2) potential for control assumption; 3) goal, criterion, or standard assumption; 4) activities are mediators between personal and contextual characteristics and actual achievement or performance. And the cognitive evaluation theory proposes when fulfills the basic psychology needs, competence and autonomy may motivates intrinsic motivation to active participants in the learning process [6], [19]-[21]. The researches [22], [23] shows that more autonomy supportive was built, the more intrinsic motivation would be created. The intrinsic motivation perspective asserts that learners can potentially monitor, control, and regulate certain aspects of their own cognition, motivation, and behavior with curious, preferring challenges, and making independent mastery attempts. In work preference inventory, the self-report instrument includes four constructs (extrinsic compensation, extrinsic outward, intrinsic enjoyment, and intrinsic challenge) were adopted to detect motivations in cooperative learning environment. Meanwhile, the group-regulation and self-regulation may be the instructional mechanism to promote the learning and teaching performance. The intrinsic motivation, which refers to doing something or work because it is inherently interesting or enjoyable form doing work. And extrinsic motivation, which refers to doing something or work because it leads to a separable rewards which were not coming from work. The self-regulation learning perspective takes a much more inclusive perspectives on student learning which include cognitive, affective, and social contextual factors [24]. Accordingly, we need to know the ways to build an environment that are likely to satisfy individual's motivations for competence. And how to construct a structure for learning with autonomy support with self-regulation. In cooperative learning environment, the social support relationships will be embedded for learners to go further easily and autonomously. Furthermore, most of good performances of teaching and learning outcomes are based on the suitable information management and communication during the teaching and learning processes. Individuals and groups may share their learning processes and goals each other to communicate their knowledge, information, and skills. To be or not to be motivated is an essential issue for teaching strategies and environment setting to be adapted. The more learning motivation can be occurred, the more autonomy learning behaviors may be achieved to lead better learning performance with individual's potential and intentional purposes. Typically, the teaching or learning interaction and communication are intended to motivate or reinforce individual's learning processes for reaching the specific teaching or learning behaviors. Furthermore, the different teaching and learning strategies to be adapted in specific educational curriculum will be interacted to lead to different motivations and performances. Consequently, learning is situated, teaching and learning processes will intentionally and potentially be occurred and interacted by capabilities, motivations, relationships, and interactions among learners, instructors, learning objects and environment settings. Consequently, it will be the essential issues to detect and know the possible factors of intrinsic and extrinsic motivations which may inspire learning motivations in cooperative learning environment.

III. Cooperative Learning Design

The five essential criteria of cooperation are 1) positive interdependence, 2) individual accountability, 3) face-to-face promotive interaction, 4) social skills, and 5) group processing [25]. And the five types of cooperative learning are Student Teams Achievement Divisions

(STAD), teams, games tournaments, jigsaw, team accelerated instruction, and cooperative integrated reading and composition [26]. These strategies can be used to enhance student learning. The participants were 28 junior high school students who were novel learners in learning linear equations. The learners were divided into seven groups in heterogeneous grouping. Every group has one leader (within the top seven grades of class and the highest score of the group) and sub-leader (within the top fourteen grades of class and the top two of the group) for guiding and teaching the third and fourth classmates. The positions of groups were arrange in special ways of single and class group. Fig. 1 shows the position of single group. The design was 2×2 square. The inner group design was the first learner (leader) to cooperate with the third learner and the second learner (sub-leader) to cooperate with the fourth learner.

Figure 1. The positions and relationships of inner group design

This inner group design is to reduce the difference between the cooperative learners for cooperative interactions. Beyond the cooperative learning, the differential abilities of interactive learners will be the essential factors for communication and cooperation. Furthermore, owing to the more cognitive differences between the cooperative learners, the more patience and misunderstanding may be happened in their cooperation and communication. Consequently, the inner design (diminish differences design, L_1 with L_3 and L_2 with L_4) of cooperative group is not only for more passion, patience, cooperation, and interaction within inner group and hope to promote more active and voluntary of learning intrinsic or extrinsic motivations from individual themselves. Moreover, communication is vital for developing mathematical ideas, for challenging misconceptions and improving the skills of reasoning. The educational processes are a series of information communications and interactions among instructors, learners, and objectives via suitable instructional strategies and environmental settings. Fig. 2 illustrates the locations (outer group) of seven groups. The outer group design is change the original square like position to a butterfly like position in traditional classroom. This outer group design is to enlarge the space among the competition groups for competitive interactions. Furthermore, this outer design is not only for more challenge, recognition, evaluation and competition among all groups and hope to promote more active thinking and cooperation with intrinsic or extrinsic learning motivations form group competition autonomously and voluntarily. The competitions involved individual and group activities. Firstly, every group has number 1 to number 4 competitors to compare another groups. Secondly, each member of inner group has different scores to get the points for their group. The member_1, group leader, can get one point for their group while the member_1 give the right answer or presentation to all classmate. And the member_4, the lowest learning performer of the group, can get four points for their group while the member_4 give the right representation or right answers for all classmates. The member_2 and member_3 will get three and two points for their group separately. As mentioned above, the group members may have more willing, patient, and passion to guide and instruct the low achievement members to concentrate, comprehend, and apply the leaning contents in order to get more points for their group.

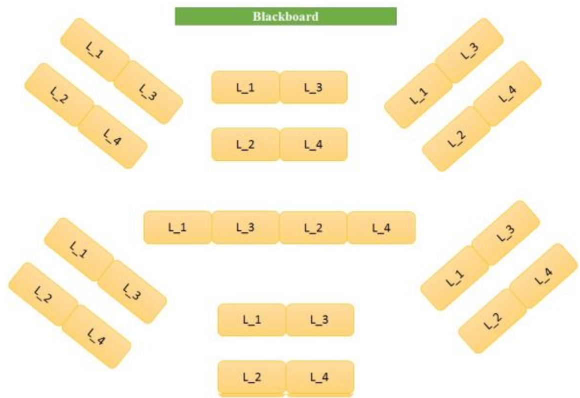

Figure 2. The positions and relationships of outer group design

Moreover, in cognitive domain, the low achievement members will get more supports for comprehension and application during learning processes. Furthermore, in affective domain, the low achievement members will be encourage to attend the learning and competitive activities under the inner group inspiration and outer group balance competitors. The balance competitor means that answer reports of other group members are usually as the same member number to answer or present the problems. In teenagers, the learning behaviors will be effected by their classmates easily. The correlations of learning stress, performance, and individual autonomy are significant difference with classmate stress [27]. We may infer that the more work hard classmate existed, the more individual stress may be happened. It means that individual learner may feel stress while the classmates (especially, the same level classmates) work hard or maintain the good performances in classroom. However, the suitable learning stress will be the possible ways to encourage learners to work hard and pay more attentions to enhance their learning processes autonomously. In teaching view, the inner group interactions maintained the possible ways to give more supports, directions, and instructions from cooperative members. And the outer group interactions maintained the competition ways to compare, evaluate, and analysis the different group presentations for synthesis, recognition, and identification the mathematical concept thinking and problem solving. Accordingly, the mechanisms of inner and outer group interactions will be the important teaching and learning resources which were generated by learner themselves. The cooperative learning groups were set to a specific position for individual, instructor, and group interactions.

IV. The Tempoial Model

The temporal model of motivation may communicate intrinsic and extrinsic motivations in cooperative learning environment. In cooperative learning environment the social relationships and social interactions will be the essential factors to generate and originate the teaching and learning atmosphere. And the social relationships and social interactions come from multiple channels which are learner with instructor, learner with learners, individual with group, and group with groups to communicate cognition and metacognition of learner, group, and instructor. Furthermore, in ground theory, individual learner may learn, accommodate, and assimilate his comprehension and cognition to build and modify individual's knowledge. Moreover, the social relationships and social interactions need to give opportunities for learners to interpret, construct, and interact their metacognition and cognition via the cognitive and interactive learning behaviors. In cognitive and interactive learning behaviors, the comprehension of individual learners may not only be the passive processes which learner receives information from instructors or texts, but also be the active processes which learner interacts information with inner and outer groups. Moreover, the Individual Cognition and Interpretation Framework (ICIF) [28] are not always plentiful, stable, or obvious enough for individual learners to active and achieve their comprehension and application tasks. Furthermore, the cognitive evolution is an essential cognition process for individual to make progress. However, individual's comprehension and application are not merely to recover and recognize the original concepts of instructors or texts, but also to interpret, create, and construct meanings of concepts out of instructors and texts. Fig. 3 illustrates the bi-direction interactions between instructor and learner. The bi-direction interactions between instructor and learner are not easily identified by well-defined programs, real teaching/learning actions and the detectable/reachable interaction processes between instructors, learners and concept frameworks.

Figure 3. The learners discussed and communicated in classroom

Moreover, many instructors are both anxious and puzzled as they tried to make sense of the learning phenomena during invisible learning processes which become a black box that was not the real subjects can be insight and exploration. Fig. 4 illustrates the bi-directions of relationships and interactions with neighborhood classmates and individual learner in inner group. The diminish differences design, Learner_1 with Learner _3 and Learner _2 with Learner _4 of cooperative group is not only for more passion and patience to cooperate and interact each other and hope to promote more active and voluntary from individual themselves. And the interactions between Learner_1 with Learner _2 and Learner _3 with Learner _4 may maintain the promotion ways of individual understanding for individual themselves.

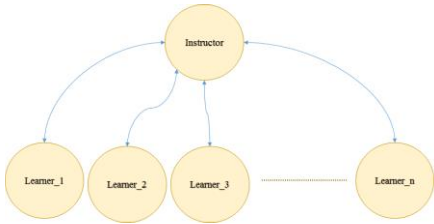

Figure 4. The bi-directions of relationships and interactions with instructor and learners

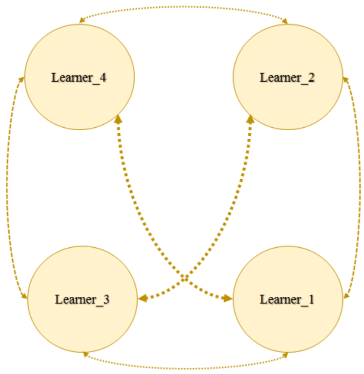

Figure 5. The bi-directions of relationships and interactions with neighborhood classmates and individual learner in inner group

Mathematical problem solving, pattern discovering, question formulating, and answer describing are complex behaviors for learners to make sense, perform and enact these comprehensions and applications which were based on individuals' cognitive schemas and prior knowledge. The social relationships and social interactions support the ways to mediate the bi-direction communications between individuals and learning objectives to reduce the cognition depletion during learning processes. Fig. 5 illustrates the bi-directions of relationships and interactions with groups and individual learners within inner group.

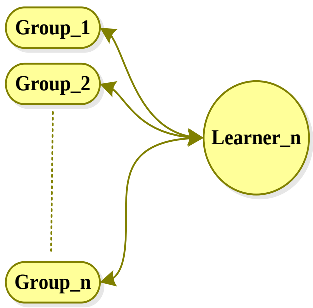

Figure 6. The bi-directions of relationships and interactions with groups and individual learner

Meanwhile, individual learner may build knowledge, comprehension, application, and evaluation through the cross comparisons, simulations, modifications, and reconstructions among the interactions and communications. Fig. 6 illustrates the bi-directions of relationships and interactions with groups and specific individual learner. Fig. 7 illustrates the bi-directions of relationships and interactions with groups and specific groups. Consequently, the social relationships and social interactions of learning and teaching processes are a series variations and selections of knowledge evolutions and concept formations by learners, groups, and instructors.

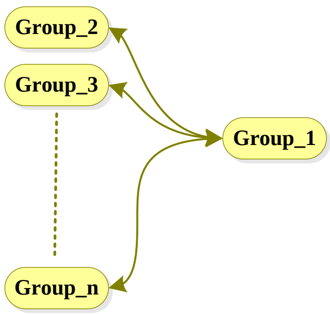

Figure 7. The bi-directions of relationships and interactions with groups to specific group

TABLE I. The Values of Cronbach's Alpha, AVE ((Average Variance Extracted), Composite Reliability, R Square, Communality, and Discriminability of Measurement Model

Construct / Values	Extrinsic Compensation	Extrinsic Outward	Intrinsic Enjoyment	Intrinsic Challenge
Cronbach's Alpha	0.8484	0.8707	0.8705	0.8289
AVE	0.6879	0.6134	0.7233	0.5514
Composite Reliability	0.898	0.9039	0.9123	0.878
R Square	0.573	0.727	0.7415	
Communality	0.6879	0.6134	0.7233	0.5514
Discriminability	0.8294	0.7832	0.8504	0.7426

V. Result and Conclusion

In cooperative learning, situated learning motivation will be constructed and effected by task content, individual cognition, metacognition, key person, sharable knowledge, or environmental condition. And the situated learning motivations may positive or negative to effect on learning and teaching processes. The positive effects or interdependence are that they are likely to enhance perceived competence, skill, and intrinsic motivation. The situated cognition is that people's knowledge is embedded in the activity, context, and culture. And the work preference inventory (Amabile, 1993), the self-report instrument includes four constructs 1) extrinsic compensation, 2) extrinsic outward, 3) intrinsic enjoyment, and 4) intrinsic challenge. The work preference inventory is adapted to detect four motivation dimensions which provides the indications of possible strengths and possible tendencies of individual learners. The reliabilities and validities of the inventory are reported in the Table I. The Cronbach's Alpha value of extrinsic compensation is 0.8484, extrinsic outward is 0.8707, intrinsic enjoyment is 0.8705 and intrinsic challenge is 0.8289. Cronbach's alpha method, conduct reliability tests, is the statistical method for testing constructs' reliability. All the constructs' Alpha value above 0.7 is the acceptable level. Average variance extracted illustrates the percentage of variance which could be interpreted by the latent variables to random measurement error [29]. And the construct validity is determined by the average value AVE (Average Variance Extracted). Average variance extracted values are higher than the recommended lower limit of 0.5 [30] that are treated as indications of convergent validity.

TABLE II. The Cross Loading Table of Extrinsic and Intrinsic Constructs

Construct / Index	Extrinsic Compensation	Extrinsic Outward	Intrinsic Challenge	Intrinsic Enjoyment
EC1	**0.800214**	0.743724	0.592035	0.374411
EC3	**0.807682**	0.645787	0.543362	0.381694
EC4	**0.856114**	0.613442	0.61357	0.379785
EC5	**0.851846**	0.682012	0.624496	0.487069
EO1	0.425071	**0.606454**	0.576061	0.451955
EO2	0.540552	**0.803293**	0.697425	0.622043
EO3	0.685909	**0.726421**	0.663659	0.488129
EO4	0.736748	**0.810697**	0.573399	0.415366
EO5	0.680936	**0.884062**	0.775134	0.759548
EO6	0.723297	**0.838338**	0.680737	0.69875
IC1	0.502163	0.600072	**0.829802**	0.759548
IC2	0.499418	0.733207	**0.811308**	0.756684
IC3	0.444076	0.47279	**0.728387**	0.693016
IC4	0.609888	0.652253	**0.859212**	0.699987
IC5	0.62774	0.727691	**0.638791**	0.462743
IC6	0.499196	0.564375	**0.534051**	0.414038
IE1	0.436899	0.729036	0.717014	**0.890683**
IE2	0.561299	0.654666	0.835976	**0.889046**
IE3	0.337538	0.650948	0.637289	**0.85683**
IE4	0.318715	0.502097	0.726394	**0.757623**

The AVE (Average Variance Extracted) of extrinsic compensation is 0.6879, extrinsic outward is 0.6134, intrinsic enjoyment is 0.7233 and intrinsic challenge is 0.5514. All test of constructs supported convergent validity of the scales. And the composite reliability of extrinsic compensation is 0.898, extrinsic outward is 0.9039, intrinsic enjoyment is 0.9123 and intrinsic challenge is 0.878. The reliabilities, average variance extracted, R Square, Communality, and Discriminability of measurement model. The values of Cronbach's alpha, AVE (Average Variance Extracted), composite reliability, R Square, communality, and discriminability of measurement model are showed in table I. We find the loading factors are higher than 0.5, the reliabilities are higher than 0.7, and the average variance extracted values are higher than 0.5. And the discriminant validities are verified by the square root of average variance extracted values for each construct. In discriminant validity the correlations of the specific construct are greater than all other constructs (Fornell & Larcker, 1981). The square root of AVE (Average Variance Extracted), discriminate validity, of extrinsic compensation is 0.8294, extrinsic outward is 0.7832, intrinsic enjoyment is 0.8504, and intrinsic challenge is 0.7426. The model analysis is based on Partial Least Squares (PLS) which is an exploration or construction technology to predict the causal model form the latent variables for reasoning and comparing. And the causal model maintains the relationships among the latent variables and constructs. Table II illustrates the cross loading table of extrinsic compensation, extrinsic outward, intrinsic challenge, and intrinsic enjoyment. We find a good result of convergent and discriminant validity in Table II. All test of constructs supported convergent validity of the scales.

The aim of this research is to explore the temporal path analysis model of intrinsic and extrinsic motivations in cooperative learning environment. The participants are grade 7th junior high students (12~14 years old, 15 males, 13 females, 28 junior high school students) and the learning content is about the linear equations in mathematical within cooperative learning environments. In Fig. 8, we found that all the paths were positive effect on intrinsic enjoyment except extrinsic outward. In Table III shows all the path coefficients are statistically significant. The path relationships show the intrinsic challenge had high coefficients 0.854 and 0.717 to intrinsic enjoyment and extrinsic compensation with statistically significant. We may infer intrinsic challenge of individual's intrinsic motivation will act an important role during teaching and learning processes. Meanwhile, the extrinsic motivations, extrinsic compensation and extrinsic outward, had low coefficients –0.408 and 0.353 to intrinsic enjoyment. In this empirical results, we found that extrinsic motivations, extrinsic compensation and extrinsic outward, had lower impact than intrinsic challenge on intrinsic enjoyment.

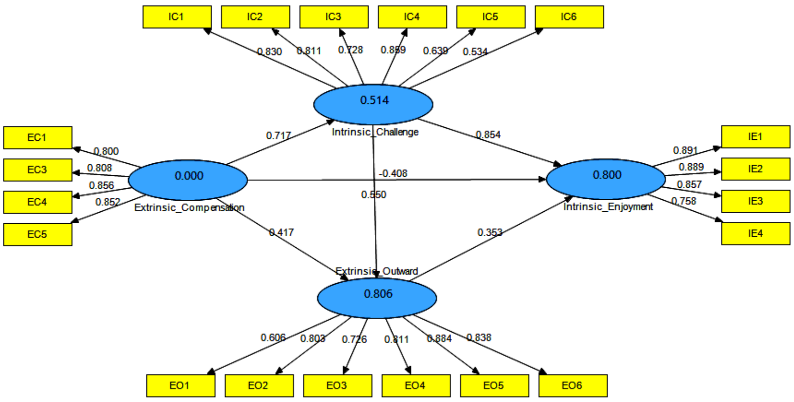

Figure 8. The path analysis of relationships and interactions among the extrinsic compensation, extrinsic outward, intrinsic enjoyment, and intrinsic challenge.

TABLE III. THE TOTAL EFFECTS OF EXTRINSIC AND INTRINSIC PATHS

Values / Path	Path Coefficients	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Extrinsic Compensation → Extrinsic Outward	0.417158 *	0.812554	0.03376	0.03376	24.043654
Extrinsic Compensation → Intrinsic Challenge	0.716876*	0.71962	0.052634	0.052634	13.620047
Extrinsic Compensation → Intrinsic Enjoyment	-0.491246*	0.496481	0.092467	0.092467	5.312676
Extrinsic Outward → Intrinsic Enjoyment	0.353419*	0.357191	0.097679	0.097679	3.61817
Intrinsic Challenge → Extrinsic Outward	0.550385*	0.549921	0.051767	0.051767	10.631905
Intrinsic Challenge -> Intrinsic Enjoyment	0.853654*	1.045091	0.054772	0.054772	19.136845

The intrinsic motivation perspective asserts that learners can potentially monitor, control, and regulate certain aspects in certain events of their own cognition, motivation, and behavior with their metacognition, curious, preferring challenges, and making independent mastery attempts autonomously and voluntarily. Furthermore, the path analysis showed the synergy motivation, the interaction relationships between intrinsic and extrinsic motivations. The path coefficients of extrinsic compensation → intrinsic challenge, extrinsic outward → intrinsic enjoyment, and intrinsic challenge→ extrinsic outward are 0.716876, 0.353419, and 0.550385 with statistically significant. It means that not only the interactions between inner intrinsic or extrinsic motivations, but also the communications between intrinsic and extrinsic motivations. And this research also showed that the path relationship of extrinsic compensation → intrinsic challenge with high path coefficient, 0.716876. It suggests the teaching strategies of extrinsic compensation that may promote individual's intrinsic challenge.

Typically temporal model of learning motivation is usually intended to motivate or reinforce learning processes for better teaching and learning performance. And he effects of cooperative learning were not merely to understand the surface meanings and skills for passing and reaching the learning objectives by sharing or discussing processes, but also to develop the possible meanings and skills for evaluating and creating possible processes into high order thinking to build specific knowledge. In situated learning theory, the situated learning is involved the domain knowledge, learning abilities, and environmental interactions which is embedded within teaching and learning activities, contexts, and classroom atmosphere. Consequently, the situated learning motivations are not merely to maintain the intentional purposes with teaching or learning strategies, but also the unintentional events with interactions among the instructor, learner, and environment.

REFERENCES

[1] V. L. Zammuner, "Individual and cooperative computer-writing and revising: Who gets the best results?" *Learning and Instruction*, vol. 5, pp. 101-124, 1995.

[2] N. Webb and S. Farivar, "Promoting helping behavior in cooperative small groups in middle school mathematics," *American Educational Research Journal*, vol. 31, pp. 369-395. 1994.

[3] R. M. Gillies, "The behaviours, interactions, and perceptions of junior high school students during small-group learning," *J. Educ. Psychol.*, vol. 95, pp. 137–147, 2003.

[4] R. M. Gillies, "Structuring cooperative group work in classrooms," *International Journal of Educational Research*, vol. 39, pp. 35-49, 2003.

[5] C. P. Niemiec, R. M. Ryan, and E. L. Deci, "The path taken: consequences of attaining intrinsic and extrinsic aspirations in post-college life," *Journal of Research in Personality*, vol. 43, pp. 291-306, 2009.

[6] E. L. Deci and R. M. Ryan, *Intrinsic Motivation and Self-Determination in Human Behavior*, New York: Plenum Press, 1985.

[7] T. M. Amabile, K. Hill, B. A. Hennessey, and E. Tighe, "The work preference inventory: Assessing intrinsic and extrinsic motivational orientations," *Journal of Personality and Social Psychology*, vol. 66, pp. 950-967, 1994.

[8] T. M. Amabile, "The social psychology of creativity: A componential conceptualization," *Journal of Personality and Social Psychology*, vol. 45, pp. 357-377, 1983.

[9] T. M. Amabile, "From individual creativity to organizational innovation," in *Innovation: A Cross Disciplinary Perspective*, K. Gronhaug and G. Kaufmann, Eds., Oslo: Norwegian University Press, 1988.

[10] M. R. Lepper and D. Greene, "Overjustification research and beyond: Toward a means-end analysis of intrinsic and extrinsic motivation," in *Hidden Costs of Reward*, M. R. Lepper and D. Greene, Eds., Hillsdale, NJ: Erlbaum, 1978, pp. 109-148.

[11] F. Herzberg, *Work and the Nature of Man*, Cleveland, OH: World Publishing Company, 1966.

[12] J. R. Hackman and G. R. Oldham, "Motivation through the design of work: Test of a theory," *Organizational Behavior and Human Performance*, vol. 16, pp. 250-279, 1976.

[13] B. J. Zimmerman and M. Martinez-Pons, "Development of a structured interview for assessing students' use of self-regulated learning strategies," *American Educational Research Journal*, vol. 23, pp. 614–628, 1986.

[14] E. Sierens, M. Vansteenkiste, L. Goossens, B. Soenens, and F. Dochy, "The synergistic relationship of perceived autonomy support and structure in the prediction of self-regulated learning," *British Journal of Educational Psychology*, vol. 79, pp. 57-68, 2009.

[15] T. M. Amabile, "Motivational synergy: Toward new conceptualizations of intrinsic and extrinsic motivation in the workplace," *Human Resource Management Review*, vol. 3, pp. 185-201, 1993.

[16] T. M. Amabile, *Creativity in Context: Update to the Social Psychology of Creativity*, Boulder, CO: Westview Press, 1996.

[17] J. Hattie and H. Timperley, "The power of feedback," *Review of Educational Research*, vol. 77, no. 1, pp. 81-112, 2007.

[18] P. R. Pintrich, "A conceptual framework for assessing motivation and self-regulated learning in college students," *Educational Psychology Review*, vol. 16, pp. 385-417, 2004.

[19] E. L. Deci, R. J. Vallerand, L. G. Pelletier, and R. M. Ryan, "Motivation and education: The self-determination perspective," *Educational Psychologist*, vol. 26, pp. 325–346, 1991.

[20] E. L. Deci and R. M. Ryan, "The 'What' and 'Why' of goal pursuits: Human needs and the self-determination of behavior," *Psychological Inquiry*, vol. 11, pp. 227-268. 2000.

[21] J. Henderlong and M. R. Lepper, "The effects of praise on children's intrinsic motivation: A review and synthesis," *Psychological Bulletin*, vol. 128, pp. 774–795, 2002.

[22] R. M. Ryan, V. Huta, and E. L. Deci, "Living well: A self-determination theory perspective on Eudaimonia," *Journal of Happiness Studies*, vol. 9, pp. 139-170, 2008.

[23] V. I. Chirkov and R. M. Ryan, "Parent and teacher autonomy-support in Russian and U.S. adolescents: Common effects on well-being and academic motivation," *Journal of Cross-Cultural Psychology*, vol. 32, no. 5, pp. 618-635, 2001.

[24] P. R. Pintrich, "An achievement goal theory perspective on issues in motivation terminology, theory, and research," *Contemporary Educational Psychology*, vol. 25, no. 1, pp. 92–104. 2000.

[25] D. W. Johnson and R. Johnson, *Cooperation and Competition: Theory and Research*, Edina, MN: Interaction Book Company, 1989.

[26] R. E. Slavin, *Student Team Learning: A Practical Guide to Cooperative Learning*, Washington DC: National Education Association, 1991.

[27] H. J. Chang, "Evolutions of Thinking, Reasoning, and constructing in Learning Polynomial operations," in *Proc. Asian Technology Conference in Mathematics_ ATCM-Korea Chapter*, Advanced Technology Council in Mathematics, 2013.

[28] H. J. Chang, "The problem posing and answering of statistical table and analysis with dynamic data generation," in *Proc. Asian Technology Conference in Mathematics_ ATCM-Korea Chapter*, Advanced Technology Council in Mathematics, 2013.

[29] R. G. Netemeyer, M. W. Johnston, and S. Burton, "Analysis of role conflict and role ambiguity in a structural equations framework," *Journal of Applied Psychology*, vol. 75, no. 2, pp. 148-157, 1990.

[30] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research*, vol. 18, no. 1, pp. 39-50, 1981.

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