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Development of An Inventory to Classify Task Commitment Type in Science Learning and Its Application to Classify Students' Types

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Abstract: The purpose of this study is to develop an inventory to classify task commitment types of science learning and to classify highschool students' task commitment types. Firstly, inventory questions were designed following the literature analysis on the task commitment components which involve self confidence, high goal setting, and focused attention. Prototype inventory underwent the content validity test, pilot test, and reliability test. Through these steps, final inventory was input to 462 high school students and underwent the factor analysis and cluster analysis. Factor analysis confirmed three components of task commitment as the three factors of inventory questions. In order to find how many clusters exist, factors of developed inventory became new variables. Each factor's factor mean was calculated and served as the new variable of the cluster analysis. Cluster analysis extracted five clusters as task commitment types. The 5 clusters were suggested by the agglomarative schedule and dendrogram gained from a hierarchical cluster analysis with the setting of the Ward algorithm and Squared Euclidean distance. Based on the factor mean score, traits of each cluster could be drawn out. Inventory developed by this study is expected to be used to identify student commitment types and assess the effectiveness of task commitment enhancement programs.

Key words: task commitment type, inventory development, science learning, cluster analysis, highschool student

Ⅰ. Introduction

1. Necessity and Purpose of Study

When confronting a laborious task, responses vary from individual to individual. Someone become more committed while others just give it up. Effort invested in the task is positively affected by individual commitment (McCayk *et al.*, 1987). Committing oneself completely to a task for an extended period of time is task commitment (Renzulli, 2002). This is considered the main indicator of one's motivation. Commitment helps people keep track of given tasks in a persistent manner (Dodd & Anderson, 1996) and is often said to be the common requisite for identifying gifted people (Renzulli, 2000).

Renzulli (2000) emphasized that those who exerted stronger commitment to their tasks were much more successful, as compared to those with less commitment, even though both groups had similar levels of intelligence. He pointed out that successful people showed self-confidence, integration toward goals, and persistence on accomplishment.

Feldhusen (1995) argued that learners should commit themselves to enhance their creative thinking. He discussed that exposing students to the challenging task situation is an effective way to develop commitment. Therefore, task commitment can be said to play a pivotal role in helping learners succeed when faced with a challenging task.

Learning science as the task solving process of scientific knowledge generation and application (Kwon *et al*, 2003) requires the task commitment. Task commitment during science learning can be used to enhance interest in the subject matter, provide a sense of achievement and improve self-confidence (Ferreira & Trudel, 2012; Lee-Corbin & Denicolo, 1998; Renzulli,

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2002). However, in spite of possible benefits, students consider science as a challenging subject to master (Granger, 1983).

The task solving process unfolds differently according to individual experience or goal level (Houtz & Selby, 2009). Likewise, task commitment can be shown to be heterogeneous due to the individual difference related to task situation and environment (McHardy *et al.*, 2009). Students are bound to have different task commitment types because they have unique and diverse experiences and interests. These differences lead students to develop different types of task commitment. Understanding these types will help teachers and educators to identify and apply the proper strategy to enhance and maintain student task commitment. As task commitment components which cause differences in commitment, highly-set goal (Locke & Latham, 2002), self-confidence (Bandura, 1997) and focused attention (Pintrich, 2002; Russo, 2004; Zimmerman, 1994) are mainly raised. These components interact with one another and can be expressed in disparate levels according to the characteristic of the tasks or individuals, and the successful completion and application of the task solving process (Greene & Azevedo, 2007; Locke & Latham, 2002; Shernoff *et al.*, 2003).

Previous studies report the necessity of research on the learning commitment types and characteristics (Blank & Hertzog, 2003; Kell & van Deursen, 2003). Notwithstanding such needs, research on the task commitment still falls short. There are studies on the individual differences in respective task commitment components (Bandura, 1986; Kruschke, 2003; Locke & Latham, 2002), but they did not consider the possible interaction among components. Task commitment is deemed important (Mendaglio, 1995; Renzulli, 1997), but it is difficult to find studies investigating the task commitment types.

The distinction of task commitment types is important because these differences lead to various performance outcomes (Overton & Macvicar, 2008). If types become classified, it can be applied to teaching strategies for instructors and commitment enhancement program (Greene *et al*, 2004). Therefore, this study was to develop an inventory to classify task commitment types in science learning. In addition, this study applied the inventory to classify students' task commitment types in highschool.

2. Literature Review

Task Commitment

Task commitment has been reported as the main requisite in order to solve tasks which is perceived as the challenging and unstructured problems (Marzano *et al.*, 1988; Renzulli, 2000). Researchers share the common ground on contextual meaning of task commitment even though there exists difference in description. Renzulli (2002) who proposed three conditions of the gifted described the task commitment as the capacity involving oneself wholly in a task for a prolonged period of time and explained task commitment is the persistent effort until one reaches to the task mastery. Marzano *et al.* (1988) delineated the concept of task commitment as the disposition to persist the task mastery.

These descriptions on task commitment commonly include the persistence focused on the task mastery, the goal for mastering task while sustaining the active stance on the task performance. From these common elements, this study defines the task commitment as the tendency persistently attending to a high-level task until one reaches to its goal.

Task commitment is similar with the concept of motivation and flow experience in part. Thus, clarification among these terms will help understanding their relationship. First, task commitment as the pursuit behavior toward task mastery has in common with the motivation. Motivation is the impetus of task performance behavior affecting task commitment. Motivation is internal or external construct of behavior occurrence (Lee *et al.*, 2007). Renzulli (2002) distinguishes motivation as the initiating energy making organism to start the response from task commitment which he says the energy of persistent performance of particular task area. Therefore, motivation affects the task commitment and the degree of one's motivation appears through the task commitment.

Flow experience is the optimal state deeply engaged in the given activity (Csikszentmihalyi, 1997). Flow experience is similar with task commitment because they concern the behavioral structure and evidence. However, the flow experience weighs the enjoyment and the balance between individual ability and experience. This is the point different from task commitment. Both task commitment and flow experience can be the situation of focused attention. However, the flow experience presents the state of delightful trance while the task commitment entertains the state of intensive struggle. Also, tasks arousing the flow experience have the condition of willingly challengeable difficulty and task performer must possess the proper ability to solve it. Meanwhile, tasks evoking task commitment are perceived as unstructured and high-level ones. Thus, persons can experience the negative feelings or consequences, differently from the flow state. This negative experience is not the element of flow experience. On the other hand, the negative experience can be emotional challenge appearing in task commitment. It leads to the feeling of heightened achievement when it is overcome. With this frustration and followed overcome, task commitment might change into the flow state.

In short, the motivation affects the intensity of task commitment in the shape of goal level; the flow experience is the next step of task commitment, possible to reach when they overcome the difficulties and obtain the proper skills. Therefore, task commitment is the mediative indicator between motivation and flow experience. Also, task commitment is proper to be investigated for learners so that they get self-directedly motivated and approach to the flow experience in the future.

Task Commitment Components

From the definition of task commitment and related literature review, three constructs were raised as the task commitment components. They are high goal setting, focused attention, and self confidence. Respective components are composed of sub-components reflecting the steps of task solving.

High Goal Setting

Goal setting is motivation based outcome (Locke & Latham, 2002; Tuckman, 1990). A goal is that an individual wants to reach through purposeful behaviour so goals serve as the criteria for the task completion (Pintrich, 2000). With goal setting, people can be motivated to achieve them (Anderson *et al.*, 2010). Especially, high and precise goal is respected as the moderator of committed performance (Dodd & Anderson, 1996). Goals direct effort and attention toward goal-relevant actions at the cost of irrelevant actions (Locke & Latham, 2006). Understanding the goal of given task, setting one's goal level, and sustaining the goal throughout task performance directly affect the level of task commitment. Such goal setting behaviors are closely related to the task mastery (Hollenbeck *et al.*, 1989).

Goal setting behavior reveals in different shapes along the steps of task solving. They are task goal exploration, self goal set, self goal clarification, and self goal attainment. These different goal setting behaviors compose of the body of 'high goal setting' component.

Firstly, task performers explore goals the task orients in order to estimate whether they can internalize the given goal as one's goal

(Smith, 2005). They scan how given task is structured, reflecting their relevant experiences. They are aware of what the task goal expects to them even though they are not sure what their own goal must be. This event occurs in the task understanding stage.

Performers set the self goal. The self set goal can be what the task expects to be achieved (Harkins & Lowe, 2000). One's goal level can be lower than task expects. When one's goal matches to the goal of given task, it is named 'task goal' which means task mastery goal. When one's goal does not reach to the level task expects, it is named 'lowered goal' which focuses on the task performance not task mastery. Self goal setting occurs in the second step of task solving.

Performers clarify their own goal during task performance (Locke & Latham, 2002). While they become engaged in task performance, they get to understand the task more. Which goal must be met becomes clear. This leads task performers to modify their initial goal. They can heighten or lower the goal. This behavior appears in the third step of task solving, performing the plan.

Task performers finally attain the self set goal which helps performer feel rewarded (Pintrich, 2000). Self set goal attainment results in higher goal set, retry or task termination with satisfaction. This experience of goal attainment occurs in the task solving step of evaluating a plan. The goal attainment reinforces the self confidence.

High goal setting is one component of task commitment and it develops in four types during task solving. They are task goal exploration, self goal set, self goal clarification, and self goal attainment.

Focused Attention

Focused attention is the second task commitment component. Lots of studies suggested it as the main element of task commitment. Focused attention also can be regarded selective attention which means the capacity to attend and respond to specific areas among multiple stimuli (Spaulding *et al.*, 2008). When people pay attention on the task at hand, they try to bring order in awareness in the pursuit of a goal and even forget everything else momentarily (Csikszentmihalyi, 2008).

Focused attention is categorized into attention toward task identification, attention toward the task goal, attention on task performance and attention on goal achievement.

Attending toward task identification occurs in 'task understanding' step of task solving (Schellings & Broekkamp, 2011). Performers keep in mind the task demand based on the information gained through task identification. What the task is like, which goal the task suggests, whether they have relevant experiences are all the objects of attention. Performers pay their attention to deciphering task demands and identifying the task (Butler & Cartier, 2004; Butler & Winne, 1995).

Attending to the task goal presents in the 'designing a plan' step. Performers need to orient to the goal when they design a plan (Overton & Macvicar, 2008). They try to figure out which goal they can set. They may expect the given goal is proper to reach, then they will set the task goal. If they estimate the task is difficult and the goal is much high to reach, they will set the lower goal than task goal.

Attention on the strategy and performance appears in the 'performing the plan' stage (Schraw & Moshman, 1995). For the most of time of task performance, performers must concentrate on the task performance. They seek potential solutions, apply them to the task and confirm whether the application is successful or not. They can revise solutions and repeat these behaviors until they reach to the goal. While attending on strategy formulation and practice, task conductors feel autonomy and confidence (Lee *et al.*, 2007). They also become rewarded by performance itself.

Attention on goal achievement mainly occurs in the 'evaluating the plan' stage (Ley & Young, 2001). Performers check how closely they have come toward their goal. They pay their attention to the possibility of goal achievement.

In short, attention to task identification, task goal, task performance, and goal achievement form the focused attention as one component of task commitment.

Self Confidence

Self confidence was extracted as one of the task commitment component. Self confidence is accompanied by the sense of autonomy, which increases the motivation (Ryan, 1982). Being confident and feeling self-efficacious is on the path of achievement goal adoption (Roeser *et al.*, 1996). Self confidence helps people expect positive results of task performance even though the task is high leveled. Confident people believe in their capacity to organize and execute courses of action required to achievement (Bandura, 1997). Self confidence is the key independent variable affecting one's effort (Ford, 1992), regarding their ability to perform certain goal-oriented tasks (Greene & Azevedo, 2007). Self confidence is a good indication of whether students can process and complete assigned tasks successfully (Lemcool, 2007; Zimmerman, 1990).

It can appear in four shapes matching to each step of task solving process (Shawer, 2010). They are self confidence by successful past experience, self confidence on goal achievement, self confidence on task performance and strategy design, and self confidence from the goal achievement.

Self confidence influences on the initiation of one's task performance (Bandura, 1977). Task performers reflect whether they had relevant successful experiences or not at the task understanding stage. Students more willingly internalize a task and the goal of a task when they understand the task and have relevant experience to succeed at it (Ryan & Deci, 2000). Furthermore, successful experiences evoke the feeling of reward and confidence. This affects the efficacy. Efficacy contributes to one's self-belief to solve the task at hand.

When designing a plan for task solving, performers entertain the self confidence on goal achievement (Bandura, 1997). This is the feeling of possibility they readily expect the goal achievement. It offers performers positive attitude and active commitment in task. Confidence on goal achievement functions as a powerful impetus for task commitment.

Task performers exert confidence on the strategy and performance when conducting a plan. They try to figure out which strategy will be effective. They perform varied strategies in order to meet the goal. If confidence on strategy and performance is sufficient, performers present more task commitment. They decipher requirements of a given task and investigate how to satisfy the requirements (Shawer, 2010).

Task performers also gain confidence from goal achievement (Zimmerman, 2002). With sustained commitment, task performers reach to the goal they expected. Efficacy that one gained from the performance success reinforces the confidence on one's ability and strategy (Aznar & Orcajo, 2005). Likewise, when students complete tasks, their confidence about strategies are refined with task knowledge and domain-specific understanding (Butler & Winne, 1995).

Self confidence appears in four manners: self confidence by successful past experience, confidence on goal achievement, confidence on task performance and strategy design, confidence gained from goal achievement.

Each presents in different steps of task solving process.

Following above consideration on task commitment and components of task commitment, this study developed the task commitment type inventory and classified task commitment types through cluster analysis.

Ⅱ. Methodology

1. Subjects

491 high school sophomores living in Chung-Buk and Kang-Won provinces participated in the inventory survey. The reliability of the inventory survey was secured by a pilot input to 29 students. Thus, 462 students participated in the main inventory survey. Data acquired through the main inventory survey were initially used to secure the reliability and validity of inventory and then subsequently analyzed by the cluster analysis.

2. Development of Inventory Question

As explained in the literature review, three components of task commitment are composed of sub-components reflecting the process of task solving. In order to develop inventory questions, those components and sub-components of task commitment were applied to develop the inventory questions. This study also searched existing inventories and extracted proper sentences in order to compose questions. Sentences are all related to the perceived science learning commitment of students and every sentence asks about the science learning situation.

The initial 34-item questions were condensed into more clearly understandable expressions and meanings. The revised 26-item questions were tested for the content validity by two science education experts and three current middle school science teachers. Content validity test was calculated applying the Kappa formula.

After content validity test was conducted, the inventory survey was pilot-tested to 29 high school sophomores in order to check the reliability of questions. If there was any item decreasing the reliability below 0.8, that item was eliminated to ensure the reliability of the inventory survey. When the validity and reliability of the survey were established, a task commitment type inventory survey of 23 questions was created and it was surveyed to 462 high school students. Inventory questions were completed through pilot and main input. The final inventory survey secured reliability at a cronbach's value of 0.8 and had three factors (factor load 〉 0.5). These factors corresponded to the task commitment components.

3. Cluster Analysis

Cluster analysis categorizes data by abstracting underlying structure (Banerjee & Dave, 2011). The purpose of cluster analysis is to identify the 'natural' and 'factual' groups. Clustering is the process of unsupervised classification of data into self-similar groups, 'cluster'. Namely, this analysis distinguishes each cluster so that intra-cluster shares the similar traits while inter-cluster shows different traits (Handcock & Raftery, 2007). Cluster analysis has been used in grouping or patternmaking studies including decision making, machine-learning situations, or pattern recognition.

Accordingly, this study applied cluster analysis in order to extract clusters from the survey data of task commitment type inventory. In order to find how many clusters exist, factors of developed inventory became new variables. Each factor's factor mean was calculated and served as the new variable of the cluster analysis. In order to find the cluster number, this study used both hierarchical and non-hierarchical cluster analysis. First was the hierarchical cluster analysis of ward method and squared euclidean distance measure. The number of clusters was chosen, referring to the dendrogram, vertical icicle and agglomeration schedule. Then, non-hierarchical k-mean cluster analysis followed. The cluster number decided by the hierarchical cluster analysis was used. Non-hierarchical cluster analysis offered the information on each cluster's profile. Also, 462 cases were respectively designated to fittest cluster.

Ⅲ. Results and Discussions

This study developed the task commitment type inventory. Also, the data acquired from inventory survey were used to classify task commitment types by the cluster analysis.

1. Development of Task Commitment Type Inventory

Inventory are composed of the questions on the task commitment type inventory. The first factor, high goal setting included nine items, and the second factor, focused attention, included 8 items, and the third factor, self confidence, included 6 items. The reliability of each factor was higher than 0.8 (Table 3-1). Doran (1980) suggested that an α=0.8 verifies that an inventory is reliable enough to distinguish group

Table 3-1

The developed inventory items

Component (Cronbach's α)	Sub Component	Items of Inventory	Factor Load
High Goal Setting (.929)	Task Goal Exploration	I try to figure out what is the learning goal when I begin the science learning.	.633
		I enjoy science learning when I understand the goal of learning.	.622
	Self Goal Set	I am motivated by the science learning itself.	.655
		I am determined to reach to the goal of science learning.	.658
		It is helpful for me to set the goal by myself.	.615
	Self Goal Clarification	Having goal helps me consistently perform the science learning.	.582
		I pursue my goal until I reach to it even though it is difficult.	.682
	Self Goal Achievement	I can reach to the goal if I try hard even though the goal is high.	.712
		Achieving one goal leads me to pursue the higher goal.	.606
Focused Attention (.906)	Attention toward Task Identification	When learning science, I firstly concentrate on what the learning is about.	.631
	Attention toward the Goal of Task	I do my best to set the stepwise goal when I learn science.	.740
		I elaborate to set a specific goal during science learning.	.756
	Attention on Strategy and Performance	I pay consistent attention in order to master the science learning.	.593
		I am hardly disturbed by external stimuli when I focus on the science learning.	.609
		I do not care about out-of-learning stimuli when I am learning science.	.722
	Attention on Goal Achievement	I persistently try to achieve the goal of science learning.	.641
		I keep learning science until I achieve the learning goal even when I made wrong solutions or mistakes.	.696

Self Confidence (.830)	Self Confidence by Successful Experience	I believe that I can successfully perform the science learning even though it is difficult.	.661
	Self Confidence on Goal Achievement	I usually get lost the confidence on goal achievement when the science learning seems difficult to me. (R)	.519
		I set the given task's high goal as my own goal.	.713
	Self Confidence on Strategy and Performance	I give up the science learning when I feel unable to do it well. (R)	.740
		I try to sustain the confidence even though the performance is not going well.	.635
	Self Confidence from Goal Achievement	Feeling of goal achievement reinforces my confidence.	.698

characteristic. This study tries to find types of task commitment. Thus, this value is considered to meet the conditions of an inventory survey.

2. Classification of Students' Task Commitment Types

The developed inventory was used to classify highschool student's task commitment types. Inventory included three factors of task commitment. The inventory score gained from each subject was divided into three factor-scores. Factor scores became the basis of the cluster analysis. That is, the clusters were made from the distribution of factor scores. Cluster analysis classified five clusters as the five types of task commitment. This was confirmed after referring to the dendrogram, vertical icicle and agglomeration schedule extracted by the hierarchical cluster analysis. Following non-hierarchical cluster analysis generated the information on each cluster's profile.

In table 3-2, the cluster number corresponds to the order of cluster formation. Cluster 1 shows the highest mean of factor scores. Cluster 2 shows the lowest mean of factor scores. Cluster 2 is followed by cluster 1. It is organized in this manner because the Ward method of agglomerative hierarchical cluster analysis classifies cases according to the dissimilarity

Table 3-2
Factor scores of clusters

Factor	Cluster				
	1(A)	2(E)	3(D)	4(C)	5(B)
GS (Goal Setting)	4.64	1.46	2.33	3.16	3.99
FA (Focused Attention)	4.52	1.34	2.29	2.94	3.65
SC (Self Confidence)	3.83	2.19	2.87	3.35	3.22

* The alphabet order beside cluster number means the order of factor mean scores.

from the first cluster.

With this logic, clusters can be rearranged in the order of factor score means from 1 to 5 → 4 → 3 → 2. Regarding this order of factor score means, cluster 1 was named to cluster A, cluster 5 to cluster B, 4 to C, 3 to D, and 2 to E. It can be said that cluster A tends to possess the highest level of task commitment among all clusters.

However, it cannot be readily interpreted that cases having a higher total score always have a higher level of task commitment. For example, imagine one case having a goal setting factor of 5.0, a focused attention factor of 5.0, but a self confidence factor of 0.0. Even though the total score of 10.0 is relatively high, this 'imaginary' case does not fulfill the requirements of a high level of commitment due to the imbalance of the factor scores. Task commitment relies on the interaction of three factor scores. In short, the balance of scores is more decisive than the summation of scores when clustering.

Cases were designated to fittest cluster after k-mean cluster analysis. Table 3-3 shows profiles about the number of cases, the minimum and maximum values, mean score and the standard deviation of each cluster. This table is also expected to benefit future inventory users with its information on task commitment type profiles. Researchers or teachers will be able to easily determine which cluster their subjects or students belong to when they apply the inventory this study developed. They can refer to the minimum and maximum values, mean score

Table 3-3

Statistical analysis of each cluster

Cluster	Factor	N	Min	Max	Mean	SD
A	GS	24	3.89	5.00	4.6389	.39624
	FA	24	3.88	5.00	4.5208	.37349
	SC	24	2.67	5.00	3.8333	.69678
	SUM	24	4.00	5.00	4.3310	.31220
B	GS	108	3.22	5.00	3.9897	.35837
	FA	108	2.88	4.38	3.6458	.29625
	SC	108	2.33	4.67	3.2222	.37992
	SUM	108	3.26	3.97	3.6193	.18131
C	GS	219	2.11	4.00	3.1634	.32460
	FA	219	2.00	3.75	2.9372	.31821
	SC	219	2.33	4.17	3.3455	.38921
	SUM	219	2.76	3.69	3.1487	.19669
D	GS	82	1.44	3.00	2.3347	.30516
	FA	82	1.38	3.00	2.2866	.35053
	SC	82	2.00	3.83	2.8720	.47162
	SUM	82	2.07	2.85	2.4977	.22577
E	GS	29	1.00	2.44	1.4598	.42696
	FA	29	1.00	2.50	1.3362	.40793
	SC	29	1.00	3.67	2.1897	.67806
	SUM	29	1.00	2.08	1.6619	.31012

and standard deviation to identify one's commitment type.

Based on the factor mean score, traits of each cluster can be drawn out. This interpretation, of course, is based on the statistical data. Cluster A showed the highest score mean in every factor. This indicates that cases of this cluster tend to set high level goals, pay attention when learning science, and have a high level of self confidence. They are expected to not only pursue the high level goal even though the learning content may seem difficult, but also succeed in completing it. This successful experience would be rewarding and promote the self confidence.

Cluster B revealed the second highest score mean in every factor. Participants in this cluster would get committed moderately. Based on their moderate level of confidence, they would choose an easily achievable goal and pay attention as much as they can attain those easily attainable goal.

Cluster C had an average level score in every factor. This demonstrates conditional commitment. Cases of this cluster are highly possible to be contingent on what the learning is like. If the topic or goal of science learning seems easy and interesting, they might be committed. However, if they feel difficulty, they may give up quickly. Also, this cluster has the largest number of cases (47.4%). It indicates that lots of students present conditional commitment, which is why educational intervention is needed to encourage sustained commitment.

Cluster D had a moderately low score mean. Cases of cluster D will perform task at least once, but, they would find themselves bored or frustrated when learning science and give up easily.

Cluster E presented the lowest score mean. It is likely that cases in this cluster are hardly motivated when learning science. They seldom acknowledge why learning science can be useful and interesting. This would lead them to a low level of task commitment. They would not attempt to learning science.

Ⅳ. Conclusions and Implications

This study was aimed to develop an inventory and to classify task commitment types of science learning. The definition and components of task commitment were extracted through literature review. Task commitment is the tendency to persistently attend to a high-level task until one reaches to the task's goal. Components of task commitment are high goal setting, focused attention, and self confidence. Each component has sub-components. High goal setting involves goal setting, clarification, and achievement. Focused attention is composed of attention toward task identification, task goal, and strategy. Self confidence includes confidence derived from successful past experiences, goal achievement or strategy development. These components and sub-components of task commitment were used to form the foundation of the inventory survey.

Next, the five clusters, corresponding to the 5 types of task commitment, were discovered from cluster analysis. Through pilot and main input, the 23 items, satisfying a factor load of more than 0.5 and ensuring reliability, became the final inventory questions. This inventory secured three factors corresponding to three task commitment components. 9 items are about high goal setting, 8 about focused attention, and 6 about self confidence. The Cronbach alpha value of each factor was 0.93 on high goal setting, 0.91 on focused attention, and 0.83 on self confidence. The cluster analysis, based on the factor mean scores of 462 high school students, extracted five clusters. The 5 clusters were suggested by the agglomarative schedule and dendrogram gained from a hierarchical cluster analysis with the setting of the Ward algorithm and Squared Euclidean distance. K-mean non-hierarchical clustering imparted a cluster number to the respective 462 cases.

Based on the factor mean score, traits of each cluster could be drawn out. Cluster A showed the highest score mean in every factor. Cluster B revealed the second highest score mean in every factor. Cluster C had an average level score in every factor. This demonstrates conditional commitment. Cluster D had a moderately low score mean. Cluster E presented the lowest score mean. It is likely that cases in this cluster are hardly motivated when learning science.

This study developed the type inventory which can be used to classify students' task commitment types. Teachers can test students' task commitment types from the inventory test and data collection. Teachers can consult with the typological score distribution drawn out from this study before or after the classes. According to the score distribution, students can be designated to the type A, B, or E. Then, it would offer the information on the educational strategy to encourage or sustain the students' task commitment level. Also, teachers can use the inventory test in order to check whether the science class was proper to elevate students' task commitment.

On the other hand, interpretation on each cluster's characteristic in science learning should be backed by the further study which can investigate the real task commitment situation. Moreover, above interpretation can be applied to some representative cases of each cluster, but not to all cases of cluster. Not all cases in the same cluster will exhibit identical commitment even though intra-cluster difference is much smaller than between-cluster one. Some will be committed while others will not. There is a difference spectrum in the degree of commitment.

Nevertheless, understanding the typological characteristics of clusters will be fruitful because it will offer the foundation for any task commitment enhancement strategies used during science learning. Then, it can be possible for researchers to figure out timely and individualized strategies for commitment encouragement and to enhance science-related aptitude.

This study found heterogeneous five types of task commitment using cluster analysis. Those clusters show the statistical differences in factor scores and case distribution. Describing the particular characteristics of each cluster during science learning needs an in-depth approach. Thus, it is required that future studies investigate the typological characteristics of commitment during a science learning situation. Furthermore, inventory developed by this study is expected to function as the task commitment type tester in future studies. Teachers can assess the effect of future teaching programs for task commitment enhancement, using this inventory.

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