

*Full Length Research Paper*

# The development of inspirational test in learning science for junior high school students in schools under the Regional Education Office No. 14

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This study aimed at auditing the quality of inspirational test in learning situational science for junior high school students using Exploratory Factor Analysis and Second Order Confirmatory Factor Analysis. Mixed methodology was used in this study. The sample was divided into 2 groups: (1) qualitative sample of 9 experts who were lecturers in the Department of Educational Psychology, educators or scientific experts who possess published academic work, and experts in religion, and sample of 6 students in Princess Chulabhorn's College Buriram and (2) quantitative sample of 2 student groups, that is, 450 students for Exploratory Factor Analysis and 709 students for Second Order Confirmatory Factor Analysis. The results can be presented based on 3 steps. In step 1, employing quantitative methodology to synthesize literature and related research, 6 factors and 30 indicators were found. Then the outline obtained from the synthesis was applied to in-depth interview with the experts and the students, and the result showed that there were 6 factors and 30 indicators. In step 2, the result obtained from the Exploratory Factor Analysis revealed that there were 6 factors found in the inspirational test, that is, (1) intrinsic motivation, (2) positive effect, (3) confidence, (4) creativity, (5) commitment, and (6) faith. In step 3, the result gained from the Second Order Confirmatory Factor Analysis demonstrated that the model showed its construct validity according to consideration of statistical validity test (e.g. = 368.876,  $df = 339$ ,  $p\text{-value} = 0.1270$ ,  $CFI = 0.991$ ,  $TLI = 0.988$ ,  $RMSEA = 0.011$ ,  $SRMR = 0.026$ , and  $\chi^2/df = 1.088$ ). The standardized factor loading of measurement model of all indicators showed statistical significance of 0.05.

**Key words:** Inspiration in learning science, mixed method research.

## INTRODUCTION

In developing scientific and technological knowledge, scientists believe that research with strong scientific

method as well as scientists' ethics can lead to new discoveries which are sustainably beneficial to

improvement of life and social quality. Therefore, motivation and inspiration to implement scientific and technological knowledge in creating innovation which has a positive effect on Thai society are promoted to increase young scientists possessing high potential including new concept and knowledge which can be applied to national development in the future (Phetchaburi Rajabhat University, 2014).

Learning management in science is currently focused more on subject matter than affective domain because measurement and evaluation emphasize learning achievement which has a strong influence on learners' further study in a reputable educational institution. As a result, learners do definitely not have scientific understanding due to lack of motivation and inspiration. In fact, they should be inspired to learn and enjoy acquiring knowledge with appropriate instruction of science. According to science learning management in the 21st century, powerful learning has to be obtained from learners' inspiration by seeing, touching, understanding, and enjoying through activities designed by teacher. Also, knowledge acquisition of learners is inspired by teacher even though they can access knowledge or information online anytime and anywhere (Nuangchalerm, 2014). As a result, inspiration can be beneficial to learners in terms of knowledge construction (Jamjan, 2015), appreciation for success and ambition, self-confidence (Tonghom, 2013), knowledge application, and stimulation of learning science and technology with creativity (Kachintorn, 2015).

According to reviewed literature and related research on inspiration conducted in Thailand, there has not been any developed inspirational test in learning science used in measuring inspiration (Yoelao et al., 2013). In case of inspirational test development in foreign countries, structuralism of inspirational factors was studied, and 7-point scale test was developed. After that the studies on inspiration were conducted by implementing inspirational test developed by Thrash and Elliot (2003), and there were many variables used as the indicators of inspirational characteristics such as intrinsic motivation, openness to experience, absorption, work mastery, creativity, positive effect, perceptual competence, self-esteem, optimism, and self-determination. However, there were 5 out of 10 variables used as indicators of inspiration gained from daily life experiences, that is, intrinsic motivation, openness to experience, work mastery, creativity, and positive effect (Thrash and Elliot, 2003). These are also employed to develop a tool for auditing and measuring the inspiration (Oleynick et al., 2014).

For Thailand, inspirational test developed by Thrash and Elliot (2003) was applied to evaluation research on watching movies to build inspiration among undergraduates in Srinakharinwirot University for the purpose of measuring the inspiration of learners at higher education level only (Yoelao et al., 2013). However, there was not any inspirational test applied to learners at primary and secondary levels.

As mentioned earlier, the studies on inspiration are mostly found in foreign research, that is to say, the studies on this field in Thailand are somewhat fewer, and the inspirational test is adapted from foreign research. Nevertheless, the adapted test does not match with the context of Thai society, and it can be applied to general people only. Also, inspirational test in learning science has not been found. Therefore, the researcher saw the inspiration as important and developed inspirational test based on the concepts of Thrash and Elliot (2003) and Yoelao et al. (2013) to measure individual internal characteristics. This test was designed appropriately for junior high school students to be used for checking the validity of developed test to gain the characteristics that match with the context of Thai society. Inspirational test in learning situational science with 4 choices was used, and score of each choice was based on feeling levels of Krathwohl et al. (1964). This study not only attains to inspirational test with high quality, standard, and reliability, but also helps improve the inspiration among junior high school students. It is also the guidelines for developing the quality of inspirational test in learning science for students in the future.

## **Objective**

To audit the quality of inspirational test in learning situational science for junior high school students using Exploratory Factor Analysis and Second Order Confirmatory Factor Analysis.

## **Scope of the study**

### ***Population and sample***

- (1) The population of this study was 246,047 junior high school students during the second semester of 2017 academic year in schools under the Regional Education Office No. 14.
- (2) The sample was divided into the following 2 groups:
  - (a) Qualitative sample of 9 experts who was lecturers in the

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Department of Educational Psychology and educators or scientific experts who possess published academic work including experts in religion, and sample of 6 students in Princess Chulabhorn's College Buriram; (b) Quantitative sample was composed of 2 student groups: (i) A group of 450 students from 5 schools in Chaiyaphum Province for Exploratory Factor Analysis drawn by Purposive Sampling and (ii) A group of 709 students from 12 schools in the school in Chaiyaphum Province for Second Order Confirmatory Factor Analysis drawn by using Multistage Sampling.

### **Content**

The content on factors and indicators of inspirational characteristics in learning science for junior high school students was highlighted in this study.

### **Tools**

- (1) 6-factor interview form on inspiration in learning science for collecting data from the experts.
- (2) 60-item inspirational test in learning situational science.
- (3) 30-item inspirational test in learning situational science.

## **METHODOLOGY**

This study focused on developing factors and indicators of inspirational characteristics in learning science for junior high school students using mixed methodology of sequential design; in other words, qualitative method is dominant while quantitative one is less dominant. The development was divided into 3 steps: synthesizing factors and indicators of inspirational characteristics in learning science, auditing the quality of inspirational test in learning situational science for junior high school students using Exploratory Factor Analysis, and auditing the quality of inspirational test in learning situational science for junior high school students using Second Order Confirmatory Factor Analysis.

### **Step 1:**

Factors and indicators of inspiration in learning science were synthesized using qualitative method through reviewing related theories, textbooks, documents, and research. Then the obtained content was analyzed to determine an outline of variables for developing factors and indicators of inspiration in learning science. After that, the outline was applied to the in-depth interview with 15 experts who had a good command of scientific learning management. Most of the experts eventually went along with factors and indicators of inspiration.

### **Step 2**

The quality of inspirational test in learning situational science for 450 junior high school students from 5 schools in Chaiyaphum Province

was audited using Mplus Version 7.2 for Exploratory Factor Analysis.

### **Step 3**

The quality of inspirational test in learning situational science for 709 junior high school students from 12 schools in Chaiyaphum Province was audited using Mplus Version 7.2 for Second Order Confirmatory Factor Analysis.

## **RESULTS**

### **Step 1**

Synthesis of factors and indicators in learning science from reviewing theories, textbooks, documents, and research related to inspirational characteristics, factors, and indicators conducted by Bass and Avolio (1994), Thrash and Elliot (2003), Oleynick et al. (2014), Adler (2008) cited in Juhl and Fuglsig (2009), Fulmer (2007), Tansakul (2000), Wipawin (2008), Samutachak (2009), Panmanee (2013), Maksuriwong (2010), Yoelao et al. (2013), Tonghom (2013), Phureesitr (2015), Gothica (2015), and Oonla-or (2010) can receive 6 factors and 30 indicators of inspiration as presented in Table 1.

### **Step 2**

The result of quality audit of inspirational test in learning situational science for 450 junior high school students from 5 schools in Chaiyaphum Province using Mplus Version 7.2 for Exploratory Factor Analysis can be presented as the following.

### ***Analysis result of correlation coefficient between the items of inspirational test in learning situational science***

Relationships between the items of inspirational test were studied to consider the appropriateness of correlation matrix used for analyzing whether the correlation coefficient of factors was different from 0. If any item or variable did not show the relationships; in other words, it did not have a common factor, it would not be used for factor analysis. The result from analyzing the relationships between variables of inspirational test in learning situational science showed 435 pairs of relationships between all items. Apart from that, the correlation coefficient was between -0.013 and 0.664, and Bartlett's Test of Sphericity was 4.863E3 ( $p < 0.000$ ). This can be implied that the correlation matrix was significantly different from identity matrix. In the meantime, Kaiser-Meyer-Olkin was 0.938 signifying that the variables showed the relationships among them and were suitable for factor analysis.

**Table 1.** Factors of Inspiration.

<b>Characteristic-Based Indicators / Factor of Inspiration</b>	
<b>Characteristics / Factors</b>	<b>Indicators</b>
Factor 1: Intrinsic motivation	1.1 Attention and enjoyment
	1.2 Need of having talent
	1.3 Need of challenge
	1.4 Need of self-determination
	1.5 Self-esteem
	1.6 Perseverance
Factor 2: Commitment	2.1 Attempt to finish an assignment
	2.2 Paying attention
	2.3 Endurance
	2.4 Trying to overcome obstacles
	2.5 Desire of real fact accessibility
Factor 3: Positive effect	3.1 Eagerness
	3.2 Happiness
	3.3 Satisfaction
Factor 4: Confidence	4.1 Assertiveness
	4.2 Self-adjustment to any situation
	4.3 Being able to face any situation
	4.4 Being able to solve a problem with self-confidence
	4.5 Being confident of doing something
	4.6 Accepting the consequences with satisfaction and pride
Factor 5: Faith	5.1 Believing and trusting in a faithful person's action
	5.2 Having belief and faith
	5.3 Cause-effect awareness
	5.4 Having co-expectation to achieve a goal
	5.5 Being confident of success
Factor 6: Creativity	6.1 Creating new things
	6.2 Having spirituality of knowledge creation
	6.3 Complex thinking
	6.4 Having spirituality of knowledge creation developed from prior knowledge
	6.5 Taking an interest in innovation

### ***Exploratory factor analysis result***

Common factors of variables in inspirational test in learning situational science were investigated using Principal Component Analysis and there were 22 factors found from the investigation. Oblique rotation after factor extraction employed Promax with Kaiser Normalization to gain the items which were obviously related to the principal component. Factor loading of over 0.30 was used as the criteria for considering and matching between item and factor properly. Any factor loading of below 0.30 with statistical significance, conversely, was

matched with that factor. However, if factor loading of any item had more than one factor, the highest loading of the factor was selected. From the analysis, the factor loading in each item was found in the same factors, that is, 6 factors and 30 indicators. It was also found that indicator of one factor could belong to the indicator of others. For instance, factor 1: intrinsic motivation included 4 indicators (4 items), factor 2: positive effect included 4 indicators (4 items), factor 3: confidence included 10 indicators (10 items), factor 4: creativity included 6 indicators (6 items), factor 5: commitment included 3 indicators (3 items), and factor 6: faith included 3 indicators (3 items) as shown in

**Table 2.** Loading of indicators in each factors.

Indicator	Factors						Combination value
	1	2	3	4	5	6	
S1	0.637*						0.690
S3	0.769*						0.490
S5	0.339*						0.572
S7	0.326*						0.539
S10		0.328*					0.709
S12		0.732*					0.551
S14					0.282*		0.627
S15		0.317*					0.469
S18			0.261*				0.667
S19			0.413*				0.554
S22				0.408*			0.617
S24		0.293*					0.645
S25			0.547*				0.518
S28			0.308*				0.456
S29			0.246*				0.643
S32			0.428*				0.966
S33			0.528*				0.541
S35					0.439*		0.755
S37			0.230*				0.677
S39						0.330*	0.668
S42					0.396*		0.579
S44			0.301*				0.564
S45				0.290*			0.543
S48						0.469*	0.576
S49						0.297*	0.616
S52				0.249*			0.628
S54				0.182*			0.652
S55				0.323*			0.661
S57			0.278*				0.584
S59				0.213*			0.591

\*P&lt;0.05.

Table 2.

**Step 3**

The result of quality audit of inspirational test in learning situational science for 709 junior high school students from 12 schools in Chaiyaphum Province using Mplus Version 7.2 for Second Order Confirmatory Factor Analysis can be presented as the following.

***Analysis result of correlation coefficient between noticeable variables of inspirational test in learning situational science***

According to the analysis of relationships between

noticeable variables of inspirational test in learning science applying Pearson's correlation to a sample of 709 people under 6 factors and 30 variables: 4 variables of intrinsic motivation (MO), 4 variables of positive effect (POS), 10 variables of confidence (CON), 6 variables of creativity (CRE), 3 variables of commitment (COM), and 3 variables of faith (FAI), the result found 435 pairs of correlation coefficient among variables. However, there were 355 pairs which were statistically significantly different from 0 ( $p < 0.05$ ). Also, there were 398 pairs having positive relationships while only 37 pairs had negative relationships. In addition, correlation coefficient was between -0.003 and 0.558, and Bartlett's Test of Sphericity was 3.678E3 ( $p < 0.000$ ). This indicated that the correlation matrix was significantly different from identity matrix. Kaiser-Meyer-Olkin was 0.910 which was close to 1

indicating that the variables were related to each other and suitable for Second Order Confirmatory Factor Analysis.

### **Result of second order confirmatory factor analysis inspirational test in learning science**

The result of Second Order Confirmatory Factor Analysis of inspirational test in learning situational science using Mplus Version 7.2 revealed that  $\chi^2 = 368.876$ ,  $df = 339$ , and  $p = 0.1270$ . This showed that Chi-Square was significantly from 0; in other words, it rejected the null hypothesis stating that theoretical model was consistent with empirical data considering from  $\chi^2$  which was not statistically significant. Moreover, other values were considered, for instance, Comparative Fit Index (CFI) and Tucker-Lewis (TLI) which were equal to 0.991 and 0.988, respectively; the values were close to 1. Also, considered by the researcher, Root Mean Square of Error Approximation (RMSEA) was equal to 0.011, Standard Root Mean Square Residual (SRMR) was equal to 0.026, and Relative Chi-Square ( $\chi^2/df$ ) was equal to 1.088. In other words, RMSEA was lower than 0.06, SRMR was lower than 0.08, and  $\chi^2/df$  was lower than 2 (Hu and Bentler, 1999 cited in Khampirat, 2005) (Table 3). From this result, it can be concluded that the model was fit for empirical data, or it showed the construct validity representing linear structural relationship obtained from the analysis as illustrated in Figure 1.

According to the analysis, the coefficient of factor score can be used for creating the equations of inspirational factors in learning science as follows:

$$\begin{aligned} \text{INSPI} = & 0.217(\text{S1}) + 0.237(\text{S2}) + 0.107(\text{S3}) + 0.070(\text{S4}) \\ & + 0.016(\text{S5}) + 0.029(\text{S6}) + 0.014(\text{S7}) + 0.036(\text{S8}) + 0.015 \\ & (\text{S9}) + 0.011 (\text{S10}) + 0.021(\text{S11}) + 0.027(\text{S12}) + \\ & 0.044(\text{S13}) + 0.013(\text{S14}) + 0.016(\text{S15}) + 0.036(\text{S16}) \\ & + 0.027(\text{S17}) + 0.029(\text{S18}) + 0.028(\text{S19}) + 0.026(\text{S20}) \\ & + 0.028(\text{S21}) + 0.029(\text{S22}) + 0.030(\text{S23}) + 0.039(\text{S24}) + \\ & 0.040(\text{S25}) + 0.031(\text{S26}) + 0.033(\text{S27}) + 0.021(\text{S28}) + \\ & 0.009(\text{S29}) - 0.019(\text{S30}) \end{aligned}$$

In brief, 30 indicators were regarded as major factors for measuring the inspiration in learning science. Indicators from S1 to S29 showed positive loading which indicated that they were related to each other; however, S30 showed negative loading at low level ( $r$  was between -0.232 and 0.742). Also, the factor showing the highest loading was confidence (0.991).

## **DISCUSSION**

In accordance with the study, inspiration in learning science consists of 6 factors: intrinsic motivation, positive

effect, confidence, creativity, commitment, and faith. These factors are inclusive of human emotions and feelings.

From studying all 6 factors, it corresponds with the concept of Krathwohl et al. (1964). This is also consistent with constructionism which is a learning theory focusing on internal processes of learners in creating knowledge by connecting new experiences or information to prior knowledge to make their own understanding (Jamjan, 2015). Lewin's Field Theory can also be used to describe inspiration in learning science to clarify its meaning as well as factors influencing human behaviors as well as physical and mental development for better understanding of inspirational characteristics in learning science. From the analysis of inspirational factors, the loading of confidence, commitment, creativity, positive effect, faith, and intrinsic motivation factors were 0.991, 0.940, 0.933, 0.922, 0.854, and 0.833, respectively. It can be seen that confidence factor shows the highest loading (0.991). Discovered by Yoelao et al. (2013), idealistic personality is the most important cause of inspirational latent variable followed by socialization in terms of goal setting. The most important outcome of inspirational latent variable is motivation in self-regulation showing the loading of a major indicator which is self-regulation from intrinsic motivation. This is the ability in expression and decision on achieving something with confidence as described in Tirasupapkul (2016) that daring to be curious and encounter with experiences of satisfaction or happiness and others can occur when a person gains self-confidence; it probably reflects human spirit.

The creativity factor is consistent with Oleynick et al. (2014) finding out that inspiration is regarded as motivation for stimulating a person to achieve success, and it plays different roles in creativity process. Corresponding to Panmanee (2013), inspiration is beneficial to creativity such as (1) creating commitment to get successful, (2) being insensitive to environmental changes, (3) increase of patience and discipline to do something continuously, (4) being hopeful, joyful, and feeling extremely proud of doing and sharing something.

The positive effect factor is influenced by doing something desirable bringing about to eagerness and pride. The effect can be related to both current and future periods. According to Thepsaeng et al. (2017), the positive effect can lead to work happiness. Additionally, Jebarajakirthy and Lobo (2014), they define positive effect that it influences the senses of eagerness, excitement, inspiration, and interest.

The intrinsic motivation factor is an important mechanism in encouraging learners to be curious about surroundings; however, learners' intrinsic motivation should be cultivated during childhood stage. The intrinsic motivation also encourage learners' internal drive to set their goal and start to achieve it which results in learning motivation created by the learners (Nuangchalem, 2014).

**Table 3.** Result of Second Order Confirmatory Factor Analysis of Inspirational Test in Learning Science.

Variable	Coefficient of Standardized Factor Loading ( $\beta$ )	SE	Z	Coefficient of Factor Score (FS)	$R^2$
<b>First Order Factor Analysis</b>					
<b>Intrinsic Motivation (MO)</b>					
S1	0.739	0.024	31.423	0.217	0.546
S2	0.742	0.023	31.987	0.237	0.550
S3	0.535	0.031	17.082	0.107	0.286
S4	0.374	0.037	10.214	0.070	0.140
<b>Positive Effect (POS)</b>					
S5	0.328	0.037	8.858	0.016	0.108
S6	0.521	0.033	15.607	0.029	0.271
S7	0.346	0.038	9.160	0.014	0.120
S8	0.622	0.029	21.079	0.036	0.387
<b>Confidence (CON)</b>					
S9	0.315	0.037	8.544	0.015	0.099
S10	0.279	0.038	7.394	0.011	0.078
S11	0.417	0.034	12.175	0.021	0.174
S12	0.462	0.033	13.838	0.027	0.213
S13	0.652	0.026	25.437	0.044	0.425
S14	0.369	0.036	10.276	0.013	0.136
S15	0.273	0.038	7.166	0.016	0.074
S16	0.614	0.027	22.668	0.036	0.377
S17	0.473	0.033	14.416	0.027	0.224
S18	0.520	0.031	16.747	0.029	0.270
<b>Creativity (CRE)</b>					
S19	0.364	0.037	9.761	0.028	0.133
S20	0.411	0.036	11.327	0.026	0.169
S21	0.408	0.036	11.328	0.028	0.167
S22	0.424	0.036	11.870	0.029	0.180
S23	0.293	0.039	7.561	0.030	0.086
S24	0.542	0.034	15.830	0.039	0.294
<b>Commitment (COM)</b>					
S25	0.458	0.047	9.763	0.040	0.210
S26	0.260	0.046	5.676	0.031	0.067
S27	0.351	0.042	8.332	0.033	0.123
<b>Faith (FAI)</b>					
S28	0.183	0.034	5.335	0.021	0.034
S29	0.104	0.048	2.165	0.009	0.011
S30	-0.232	0.056	-4.177	-0.019	0.054
<b>Second Order Factor Analysis</b>					
MO	0.833	0.034	24.639	0.033	0.693
POS	0.922	0.043	21.199	0.016	0.850
CON	0.991	0.035	28.559	0.027	0.982
CRE	0.933	0.051	18.152	0.022	0.870

Table 3. Contd.

COM	0.940	0.080	11.784	0.038	0.884
FAI	0.854	0.060	14.130	0.021	0.730
$\chi^2=368.876$	$df=339$	$p=0.1270$	$\chi^2/df=1.088$	-	-
CFI=0.991	TLI=0.988	RMSEA=0.011	SRMR=0.026	-	-

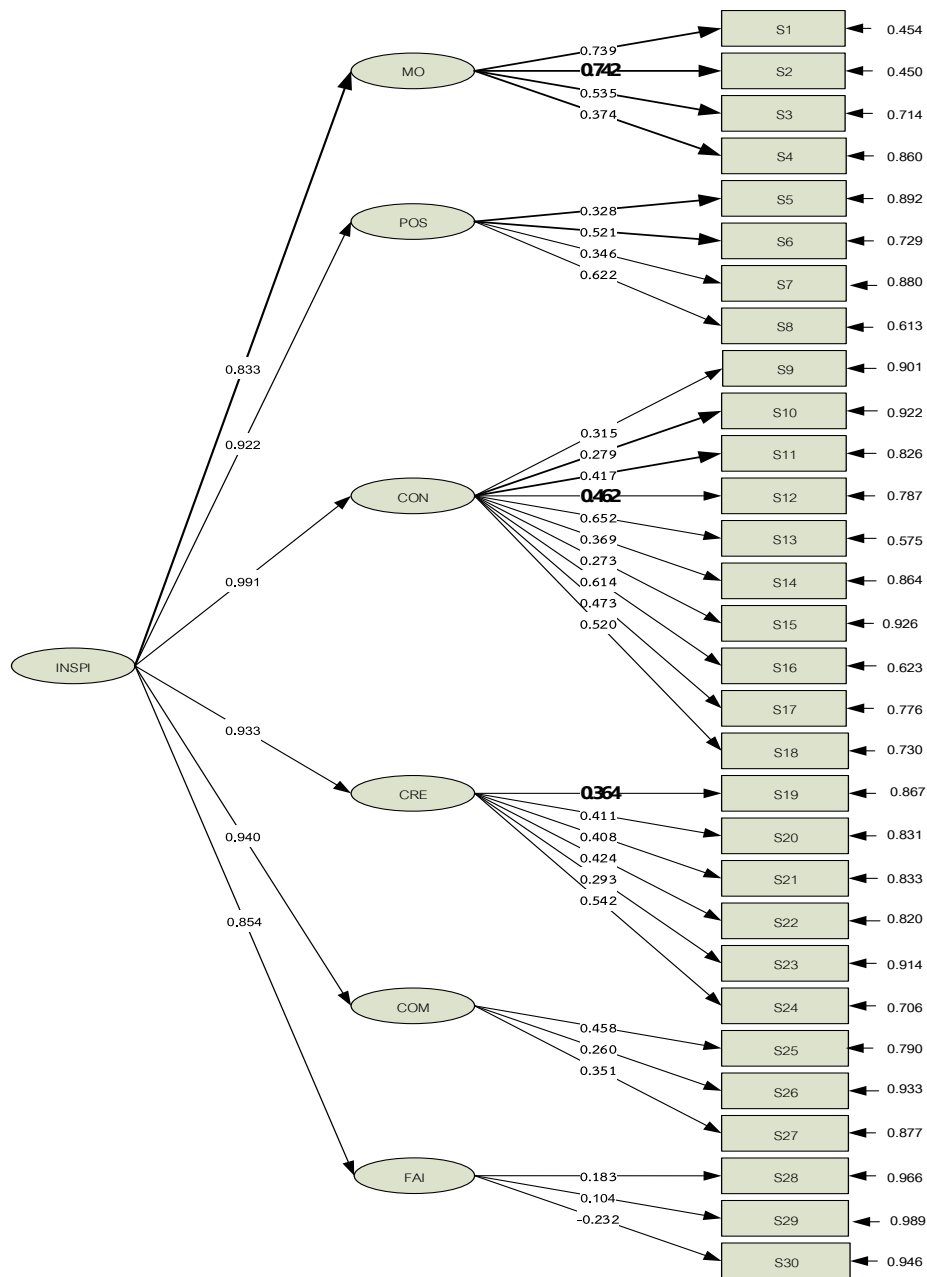


Figure 1. Model for Second Order Confirmatory Factor Analysis of Inspirational Indicators in Learning Science.  $\chi^2 = 368.876$ ,  $df = 339$ ,  $p$ -value = 0.1270, CFI = 0.991, TLI = 0.988, RMSEA = 0.011, SRMR = 0.026,  $\chi^2/df = 1.088$ .



This agrees with Yoelao et al. (2013) describing that idealistic personality is the most important cause of inspirational latent variable followed by socialization in terms of goal setting, and the most important outcome of inspirational latent variable is motivation in self-regulation.

Commitment factor is a behavior showing determination to do something seriously and continuously with accountability, endeavor, and patience to reach a goal. Said by Suwansawat (2018), inspiration together with commitment of reaching a goal is important for gaining self-development and achievement.

Faith factor is defined as the senses of confidence, believability, trust, and liking towards a stimulator without enforcement or reason that causes a belief or changes a behavior into success. This is consistent with Thepsaeng et al. (2017) stating that inspiration creation can produce faith and trust. In addition, found by Yoelao et al. (2013), self-confidence, commitment to do something, and faith in expected achievement are related to inspiration creation.

It can be concluded that inspiration consists of 6 factors and 30 indicators, that is, intrinsic motivation, positive effect, confidence, creativity, commitment, and faith; all can be applied to learners.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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