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EXPLORATORY FACTOR ANALYSIS (EFA) OF CONTROL BELIEF INSTRUMENT FOR SCHOOL LEADERS IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) SCHOOLS

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Abstract: Most principals have an instinctive awareness that organizational culture is a key element of school success. Because understanding, beliefs, and perceptions of educators impact instructional planning, educational reform, and students' educational experiences, there is a genuine need to understand those beliefs and perceptions. They might say their school has a good culture when teachers are expressing a shared vision and students are succeeding. Beliefs of teachers, principals, and policy makers regarding the complexity of STEM content and the ability of students can shape the manner in which STEM education is offered in schools. This study aims to examine the power of control and control belief strength instruments. Control refers to the ability to influence what is happening or what will happen. The preliminary validity evidence of Control belief was gained via exploratory factor analysis (EFA). By virtue of the EFA procedure, the study used the principal axis factoring extraction and the varimax rotation. The amount of 151 samples were taken from school leaders in Malaysia. The results showed that EFA has converged two factors. The complexity and multiple perspective of STEM education add challenges to the scholarly activity in determine the category. Therefore, this study provides a platform for further empirical inquiry and causal relationship study in the future.

Keywords: Normative belief, injunctive belief, descriptive normative belief, school leaders, exploratory factor analysis (EFA)

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2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

INTRODUCTION

The study of school leaders in a pandemic crisis is something new because it is still too early to understand the response and reaction of the new norm in school conditions in a pandemic situation Covid 19 (Nazeri Mohammad and Arshad Jais 2020). The challenge of the new norm depends on the Covid-19 procedure and protocol. And each time it will change based on the pattern of infection. The abrupt shift in school operations became a major challenge. As school leaders they have done their best to plan to provide appropriate learning materials for virtual learning. Educational leaders in schools throughout the country are creating and implementing instructional plans to promote effective teaching and learning of STEM content (Brown, 2012). These challenges must be met and the educational focus on STEM must remain steady so students can be prepared for the modern, technology driven society and the significant number of rapidly expanding career options in STEM related fields (Killion, 2015; Kim, Sinatra, & Seyranian, 2018).

Communicating about tasks and distribution of power is the key role to be played by the leaders in order to resolve any ambiguity and tensions. The way teachers interpreting, transforming, making sense of, and acting upon the situation are influenced by how the school leaders frame the problematic situation. To manage the interactions in the organization, the school leaders should play the various roles. There are multiple perspectives on educational leadership, the most well-known of which are transformational leadership, instructional leadership and distributed leadership. Different practices are emphasized by upholding their individual strength. The effective leadership practices are the broad repertoire of context-dependent combinations of leadership practices so no supremacy among the educational leadership practices.

Having opportunities to choose is a fundamental prerequisite of exerting control. Maximizing the probability of achieving desired outcomes and reducing uncertainty can be done by choosing between the options with different value. The idea of having choices per se carries intrinsic value which stimulates the importance of exerting control over one's environment. In a gamble people value the opportunity to choose. Based on studies people prefer been given option to choose; more chooses will be preferable than fewer. In this line, cues signaling an upcoming choice were associated with increased activity in the ventral striatum, a brain region implicated in dopaminergic reward processing. Pride experiences thus underlie self-esteem, foster intrinsic motivation, and mediate the contribution of internal control beliefs to well-being.

REVIEW OF LITERATURE

21st-century skills include media and technology literacy, productivity, social skills, communication, flexibility and initiative(Nazeri Mohammad, Ruhizan M. Yasin & Ana 2015). Other skills attained through STEM education include problem solving, critical thinking, creativity, curiosity, decision making, leadership, entrepreneurship, acceptance of failure and more. Regardless of the future career path considered by these children, these skill sets go a long way to preparing them to be innovative. STEM is a curriculum based on the idea of educating students in four specific disciplines science, technology, engineering and mathematics in an

2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

interdisciplinary and applied approach(Borrego, Foster & Froyd, 2015). Rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm based on real-world applications. This study attempts to understand what is known about teachers' perceptions of STEM education by examining existing literature (Killion, 2015). These teachers have to know not just their subject matter, but the content of the other disciplines (Kim, Sinatra, & Seyranian, 2018). Also, they must feel capable of creating an educational environment that allows students to solve ill-defined problems while deepening their content knowledge (Farrell & Coburn, 2017).

Based on current literature, there is strong evidence that educators' understandings, beliefs, and perceptions play a vital role in decision making, academic action, instructional planning, course offerings to students, and implementing change initiatives (Ajzen, 1991; Albarracin, Johnson, Fishbein & Muellerleile, 2001; Amin Senin, 2011). Control beliefs according to Ajzen (2002) are factors that individuals perceive as being present that may facilitate or impede performance of their behavior. Control beliefs have to do with the perceived presence of factors that may facilitate or impede performance of a behavior. It is assumed that these control beliefs in combination with the perceived power of each control factor determine the prevailing perceived behavioral control. Specifically, the perceived power of each control factor to impede or facilitate performance of the behavior contributes to perceived behavioral control in direct proportion to the person's subjective probability that the control factor is present.

Control beliefs refer to the ability to influence what is happening and/or what will happen. It's important to understand those things, both to be able to expect and support them, and to also provide good feedback and evaluation (Asadi, Akbari & Ghafar, 2016). In highly successful environments, efforts have been made to make it possible for teachers to be successful. We know that from research. Respecting the opportunities for teachers to be efficacious in their teaching by giving them the opportunities, the tools and the relationship time with students to be able to be successful (Farrell & Coburn, 2017).

Educators have to understand the value and power of the engineering design process to enable students to fail and persevere. Indeed, leadership is second only to classroom instruction among school-related factors that affect student learning in school.That sometimes means reorganizing the school organization so that it supports the work in a more productive way (Alsbury, 2007).

Teacher quality stood above everything else, but principal leadership came next, outstripping matters including dropout rates, STEM (science, technology, engineering and math) education, student testing, and preparation for college and careers (Ployhart & Vandenberg, 2010). Teachers, as important persons within a student's talent development, hold prior views and experiences that will influence their STEM instruction (Muhammad Sidek Said & Arfah Ahamad, 2017; Margot, & Kettler, 2019).

A review of literature in school improvement and instructional leadership yielded a short but specific list of values and beliefs that influence school culture and promote "powerful and equitable" learning. Many principals work to engage parents and others outside the immediate

2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

school community, such as local business people. But what does it take to make sure these efforts are worth the time and toil required? While there is considerable interest in this question, the evidence on how to answer it is relatively weak. A broad and longstanding consensus in leadership theory holds that leaders in all walks of life and all kinds of organizations, public and private, need to depend on others to accomplish the group's purpose and need to encourage the development of leadership across the organization. Good leadership, the study suggests, improves both teacher motivation and work settings. This, in turn, can fortify classroom instruction (Amin Senin, 2011).

METHODS

This study used the cross-sectional survey method which determines the sampling strategy and the method of data collection techniques as well as validation processes in light of factor analytical approach (Reise et al., 2000). The amount of 151 samples were taken from school leaders in Malaysia. Observational surveys conducted in situations are the cross-sectional survey allows the researcher to collect the data at a given point of time from the intended sample of the target population. At a specific time, researchers can evaluate various variables. This type of survey allows the data be collected from people who are considered for teh research and depict similarity in other variables. The research variable will stay constant throughtout the survey.

MEASURE

The development of indicators or items was intended to capture the manifestation of control belief as reflected by the selected indicators within each factor. The dimensions and proposed factors were represented by several potential indicators or items which have been backed by previous studies instead of self-developed to ensure over inclusiveness in the initial item pool. The items were devised through a specific framework from literature review, previous studies.The validation phase involves validity and reliability testing. Reliability refers to a measurement that yields consistent results every time it is being used.

The reliability values are person and item reliability. Apart from giving information about the replicability of person and item placements along the trait continuum, these two values are also able to estimate the sufficiency of items and respondents used. Validation is an important process to ensure that the developed instrument is able to measure what it intends to measure. Validity also refers to the ability to predict specific events, or its relationship to measure other constructs based on the manner in which a scale was constructed.

Samples

The factor analytical approach determines the theoretical characteristics and the amount of the samples needed. In general, Reise et al. (2000) argues that this procedure favours the heterogeneity of samples which enabled to accurately estimation of the population item inter-correlations. In other words, it demands an adequate representation of respondents at all levels of characteristics

2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

that would emerge as viable factors. For this reason, the study used the quota sampling, a purposive sampling technique.

Exploratory Factor Analysis (EFA)

An exploratory factor analysis (EFA) was used to examine the data for the development of the Control Belief Instruments. First, frequencies were calculated on each item. Analysis revealed that no homogenous scores (all high scores or all low scores) were identified, so no participant data needed to be dropped for that reason. Items with a sufficient diversity of response and a smaller standard deviation than other items were retained as this indicates relative agreement within the sample. Next, the KaiserMeyer-Olkin (KMO) statistic was run to determine the degree of shared variance among items.

The KMO statistic met the .6 minimum to proceed. According to Hoque et al., (2016; 2017), the KMO value obtained should exceed the minimum limit value (KMO > 0.6) and achievement for both of these tests (Bartlet Test - significant and KMO value> 0.6). Lastly, an inter-item correlation matrix with all remaining items was run. Pairs of items that correlated .8 or higher were examined and taken into consideration during the refinement of the Control Belief Instruments. The exploratory factor analysis (EFA) is meant for item reduction while gaining the best factor structure (Hair et al., 2010).

The remaining items were used in the Principle Components Analysis (PCA) with Oblique Rotation, which is the primary analysis to determine the factor structure of the instrument (Kaiser & Rice, 1974). The PCA was run and the factor items with an Eigenvalue of 1 or higher were retained. Next, the Scree Plots of Eigenvalues x factor numbers were run to examine the possibility of additional factors. The identified factors were labeled and the form was shortened. The loading criterion of ±0.40 was the basis for keeping items and naming factors to begin with, while a short form of the tool retained items that have high loadings (for example ±0.80) and made sense regarding the content and themes identified by PCA.

In this study, the EFA procedure employed the principal axis factoring for the factor extraction and oblique rotation of Promax. Oblique rotation was used to extract psychological latent factors that are theoretically correlated among each other. The extracted loading was set to 0.50 for a simple interpretability of the factors for the purpose of item selection.

RESULTS AND DISCUSSION

Normality, Item Analysis and Communality

Normality is described by a symmetrical bell shaped curve that has the greatest frequency of scores in the middle, with smaller frequencies towards the extremes (Pallant, 2007). In this study, after the normality tests were conducted, no extreme outliers were found in the findings, all fell within the acceptable range. The normality tests are supplementary to the graphical assessment of normality. The tests mentioned above compare the scores in the sample to a normally distributed set of scores with the same mean and standard deviation; the null hypothesis is that sample

2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

distribution is normal. If the test is significant, the distribution is non-normal. For small sample sizes, normality tests have little power to reject the null hypothesis and therefore small samples most often pass normality tests.

The reliability test is concerned with whether a scale indicates that it is free from random error. In addition, the reliability of a measure indicates the extent to which it is without bias in ensuring consistent measurement across time and various items in the instruments. The reliability of the scales instrument used in this study was tested through the Cronbach's alpha coefficient test. In this study, Cronbach's alpha coefficient for each variable was used to measure the internal consistency of the scales adopted in the survey. The Cronbach's alpha value of each variable is presented in **Table 1**. The item analysis (corrected item-total correlation) and the communality of 8 items for the Control Belief instrument. The EFA procedure for the study intended to unveil latent factors within this school leaders' sample. The 8 items of the Control Belief instrument were subjected to item analysis using the reliability analysis. The initial reliability is 0.91 which indicates a high internal consistency of the instrument. However, the primary concern in this method was the corrected item to total correlation index for each item that contributed to the reliability of the whole instrument. The corrected item to total correlations displayed the minimum value of 0.04 and the maximum value of 0.63. Only items DBS were below the threshold value of 0.30 (Field, 2009). The communality ranged from 0.04 to 0.82 whereby three items less than 0.30 (Pallant, 2010). Hence, these three items were recommended for exclusion.

Table 1: Factors extracted with the Factor Loading and Cronbach's Alpha for each item

Extracted Factor	**Item Code**	**Factor Loading**	**Alpha**
Power of Control	CBC30	.921	
	CBC31	.912	0.974
	CBC32	.881	
	CBC29	.854	
Control Belief Strength	CBP28	.910	
	CBP26	.900	0.978
	CBP27	.888	
	CBP25	.843	
Overall Reliability of Control Belief		**0.976**	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 3 iterations.

Exploratory Factor Analysis

A few series of EFA were conducted accordingly. The application of oblique rotation via Promax normalized rotation could give the early sign whether the respective data have the multicollinearity issue (Pallant, 2010). The correlation matrix among factors from the final factor solution would serve this purpose (Reise, Waller & Comrey, 2000). The intercorrelation among factors were from

2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

the minimum value of 0.11 to the maximum value of 0.64. The maximum range of constructs correlation was below the threshold value of 0.90 suggesting no multicollinearity issue.

On the other hand, a quick look showed that the majority of the correlations were more than 0.30, clarifying the appropriateness of using a Promax oblique rotation, which reflected the nature of the psychological construct (Reise et al., 2000). This would permit as many factors as required to sufficiently represent each of the original variables. In the final round of EFA, the extraction sums of squared loading of the eight-factor solution in Table 2 managed to capture 60% of total variance explained, which is quite respectable for a newly conceptualized multidimensional construct.

Table 2: Total variance explained by 8 variable factors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.410	80.122	80.122	6.410	80.122	80.122	3.767	47.084	47.084
2	1.065	13.315	93.437	1.065	13.315	93.437	3.708	46.353	93.437
3	.142	1.781	95.218						
4	.106	1.325	96.543						
5	.098	1.230	97.773						
6	.083	1.036	98.809						
7	.062	.778	99.587						
8	.033	.413	100.000						

Extraction Method: Principal Component Analysis.

Meanwhile, the remaining 40% of variance was unable to explain the latent construct of control belief in the sample school leaders. The measure of sampling adequacy, the Kaiser-Mayer-Olkin (KMO) was 0.90 indicating sufficient samples of EFA (Pallant, 2010). This value was expected due to a high participant to variable ratio 5:1. Bartlett's Test of Sphericity was significant (X^2=9062. 095, p=.000) with p below 0.05 (Pallant, 2010 ;Reise, Waller & Comrey, 2000). These results denoted the sampling adequacy that would yield meaningful factorability of the current data. The Anti-Image Matrix diagonals of indices of the current data were far beyond the cut-off correlation value of 0.50 with the range between 0.85 and 0.96 (Hair et al., 2010.

All items were loaded into their respective factors and indicating that the data fitted pretty well according to the theory suggested except for control belief factor. Thus, it was excluded in the model. Therefore, the dimension of control belief which comprised power of control, and control belief strength factors (Reise, Waller & Comrey, 2000). The extracted factor, factors loadings, eigenvalues and variance explained are shown in Table 2.

As a normal practice, the theoretical assertion would determine the number factor to be retained. In this study, the researcher strived to retain as many factors as possible to maintain the comprehensiveness of control belief (Fishbein & Ajzen, 1975). Finally, the researcher decided to include all two extracted factors with 8 items in accordance with the theoretical and practical reason with the overall internal consistency of 0.976. To end the procedure, the overall internal

2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

consistency of the final factor structure was 0.976. most importantly, the final factor structure of control belief gained its dimensionality and demonstrated the evidence of initial construct validity by having essential psychometric properties (Wang, Beal, Newman, Vancouver & Vandenberg, 2017). The results of the above analysis led to the establishment of the final model as represented in Figure 1.

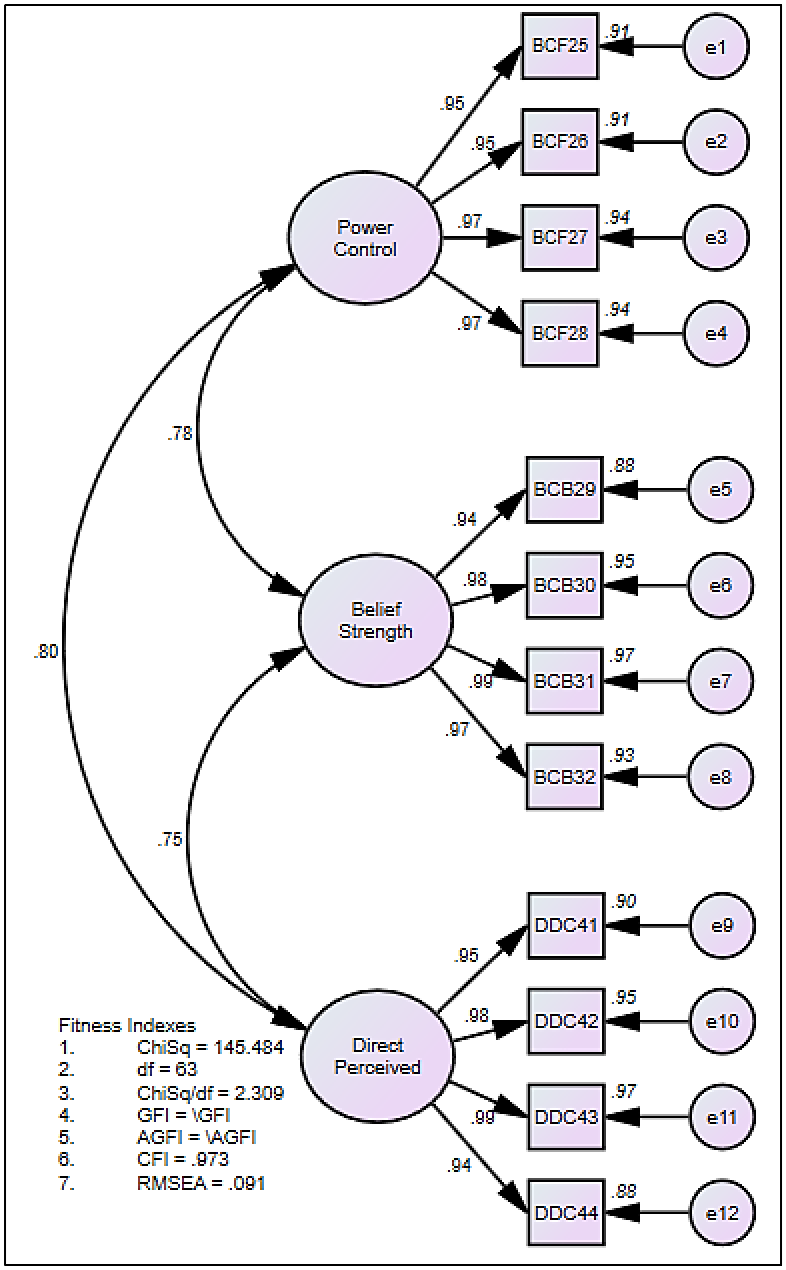

Figure 1: The final model of control belief

2021, Vol. 1, No, 2, p. 77-87. e-ISSN: 2805-4695

CONCLUSION

Every dimension and factor would deliver a new understanding on the theory of Behavioural Belief for school leaders (Ajzen, 1991; Albarracin, Johnson, Fishbein & Muellerleile, 2001). Most importantly, this instrument could be applied in empirical inquiry and causal relationship studies in various fields in the future. Moreover, there is a relationship between the power of control and control belief strength construct has been found in the test results based on the predictive validity of the instrument.

Control belief strength is the likelihood of factors such as time, financial resources, manpower, stakeholders' support will be present and the factors' power to facilitate or impede performance of implementing STEM education with a whole school approach for the next three (3) months. Those enable factors must be made ready ahead to facilitate the implementation of STEM Education by the school principal. Item fit test, unidimensionality, local independence, item polarity and separation index were used to test all the items discretely to confirm the assumption in the model. The adequacy and variance of the sample have be proven to add value to the person and item reliability (Alotaibi & Wald, 2013).

Those factors enabled pupils to pursue their STEM interests within a broader context that incorporated their learning. This environment supported the learners to complete their project tasks, some of which incorporated the use of digital technologies. The staff in schools demonstrated high levels of confidence and competence in using digital resources to support their teaching (Bryan, Moore, Johnson & Roehrig, 2016). Hence, it is prudent for the principals to ensure that the appropriate technological innovations make it into learning spaces, whether face-to-face classrooms or not, guided by educators who understand how modern technology can affect learning, and how to use technology to enhance context and enrich learning experiences for students (Banks & Barlex, 2014). On top of that, supportive policies from stakeholders can go a long way to achieve the vision of STEM education for all (Kelley & Knowles, 2016).

The goals of educational improvement will be very easy to achieve with effective leaders (Muhammad Sidek Said & Arfah Ahamad. 2017). In reality, the standards and goals that we have set for ourselves should be given great attention. The leadership of school principals and their relationship with the student improvement have be proven vital importance by the empirical evidences and researches. The journey to enhance school leadership is still far reaching. School leadership needs to catch up new knowledges and face many challenges in the era of VUCA world.

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