Factors Affecting Industrial Behaviors of the Students of Rajamangala University of Technology Thanyaburi

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Abstract
The objectives of the research were to study the levels at which industrial behaviors have been developed by students of Rajamangala University of Technology Thanyaburi and to develop and review a causal model of how certain factors affect such behaviors. Stratified random sampling method was governed so as to select 492 senior students of Rajamangala University of Technology Thanyaburi of the academic year 2018 as samples. Questionnaires of rating 5 scales was governed as the research tool. Descriptive statistic, t-test, and ANOVA were governed to analyze data. LISREL Analysis was applied to revision of the consistency of the data. The results of consistency of the model revealed that the model was consistent with empirical data providing Chi-square (χ^2 = 45.664, df = 76, p = 0.998) which presented probability at 0.05, GFI =0.989, AGFI = 0.978, RMR =0.009, and RMSEA = 0.000. The results showed that predicted variable or casual factor of the students presented variance of variables of industrial behaviors at 78.2 percent. Predicted variable or casual factor of the lecturers, together with organization presented variance of variables of students at 84.1 percent. Predicted variable or casual factor of organization presented variance of industrial behaviors at 73.3 percent.

Keywords**:** Industrial Behaviors, Factors, Causal Model

Introduction

Important elements of human capital development are necessary to enhance Thailand's competitiveness in global and regional economic arenas. That is, the country needs to enhance the competencies of currently employed individuals and skilled labor who are set to enter the workforce under restricted resources and time frames. Accomplishing this goal requires collaboration with network partners in the joint development of basic competencies in accordance with the standards of industry groups. Such a collaboration can be directed toward initiatives designed to improve professional abilities and desirable traits for empowerment, such as ethics and industrial behaviors.

The key skills that the labor market needs are behaviors or characteristics that are typical of the industrial domain; these include (1) honesty, (2) discipline and punctuality, (3) responsibility, (4) the pursuit of learning, (5) diligence and patience, (6) saving, (7) safety, (8) creative thinking, (9) teamwork, and (10) public mindedness (Labor Master Plan, 2016).The development of industrial behaviors or characteristics also means the development of social competence, thinking, and reading, as well as efforts to increase interaction with others.Cultivating various environments conducive to success also makes it possible to solve problems in critical situations that are caused by questionable behavior. The development of labor quality by espousing industrial behaviors must adhere to the educational management process of academic institutions that handle the education of today's youth. A comprehensive approach is for institutions to teach social skills that cover all aspects of life. Other issues that must be considered are core life skills or basic life skills, which must be taught in a way that relates to application in daily life. Additionally, factors that may affect the cultivation of desirable traits, such as industrial behaviors, should also be considered. Accordingly, researchers have compiled studies and related documents to analyze relevant factors and the development of social skills among the youth.These documents consist of information on backgrounds, attitudes toward learning, and the motivation to study.

In consideration of the above-mentioned matters, the present study was conducted to examine the factors affecting the cultivation of industrial behaviors among students of Rajamangala University of Technology Thanyaburi and formulate guidelines on planning the establishment of relevant educational policy for students. The guidelines can inform improvements to the efficiency and effectiveness of course development and activities that promote student progress.

Research objectives

The objectives of the research were to study the levels at which industrial behaviors have been developed by students of Rajamangala University of Technology Thanyaburi and to develop and review a causal model of how certain factors affect such behaviors.

Materials and methods

The research population was composed of 4,184 senior students enrolled during the academic year 2018. The sample size was determined on the basis of the rule of thumb that indicates 10 to 20 people per variable as an appropriate composition (Hair et al., 2010). Because this research probed into multiple causal variables in a structural equation model, there were 17 observable variables examined. Therefore, the researcher needed 20 participants for each variable to obtain a sample of at least 340 individuals. To ensure accuracy in the estimation of parameters, a sample size of 500 individuals was established, and participants were selected via stratified random sampling. Sampling was conducted in an affiliated faculty of the university that consists of nine departments and one college, from which 50 students each were recruited. During the actual data collection, however, the researcher was able to derive data from 492 individuals.

Data were collected using a questionnaire on factors that affect the industrial behaviors or characteristics of students at Rajamangala University of Technology Thanyaburi. The instrument, which was developed on the basis of relevant documents and research, consists of items rated on a five-point scale. It is divided into six parts: (1) a section on factors related to personal background, (2) a test of attitudes toward learning, (3) a test of the motivation to study, (4) a section on instructor-related factors, (5) a section containing questions about organizational factors, and (6) a section inquiring into industrial behaviors or characteristics. The content validity of the instrument was examined by five experts on the grounds of the index of congruence; the analysis showed that each item acquired a score higher than 0.5. The reliability of the instrument was analyzed on the basis of internal consistency, which was determined using the Cronbach's alpha coefficients of each set of items. The items generated a Cronbach's alpha coefficient of 0.971.

The data from the 492 questionnaires were analyzed in two steps. First, general data were examined on the basis of frequency, percentage, mean, and standard deviation. Second, the coefficient of correlation between variables and goodness of fit indices (GFIs) were analyzed to answer the research questions.

Results

The results on the correlation coefficients in the causal model showed that most of the variables were statistically significant at the .01 level and that the correlation coefficients ranged from .119 to .735. The variables with the strongest relationship were teaching and learning and the personality of an instructor, with the correlation coefficient equal to .735. The variables with the second strongest association were teamwork and public mindedness, with the correlation coefficient equal to .721. Bartlett's test of sphericity was conducted to verify the hypothesis on whether the correlation matrix is an identity matrix or not. The statistical result showed a value of 4853.204 ($p = .000$), indicating a unified matrix. The correlation between the observable variables differed from the identity matrix, with the former being statistically significant at the .01 level. This finding is consistent with the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, which was equal to .941. Its closeness to 1 indicates that the variables in the dataset were very relevant and appropriate for the analysis. Details are shown in Table 1.

Table 1: Average, standard deviation and Pearson's product moment correlation coefficient of variables in the causal model affecting the industrial behaviors of students at Rajamangala University of Technology Thanyaburi.

variables	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	X1	X2
Y1	1																
Y2	.735**	1															
Y3	0.018	.113*	1														
Y4	.471**	.522**	.402**	1													
Y5	.675**	.689**	.093*	.528**	1												
Y6	.534**	.465**	.128**	.398**	.547**	1											
Y7	.472**	.448**	.153**	.346**	.505**	.565**	1										
Y8	.492**	.461**	.155**	.385**	.538**	.609**	.642**	1									
Y9	.494**	.505**	.148**	.388**	.565**	.477**	.609**	.577**	1								
Y10	.426**	.388**	.157**	.294**	.465**	.511**	.479**	.544**	.439**	1							
Y11	.361**	.337**	.182**	.285**	.391**	.425**	.356**	.422**	.376**	.541**	1						
Y12	.428**	.429**	.177**	.334**	.503**	.495**	.459**	.497**	.468**	.538**	.544**	1					
Y13	.467**	.447**	.119**	.307**	.509**	.513**	.478**	.491**	.517**	.479**	.545**	.615**	1				
Y14	.509**	.473**	.164**	.383**	.553**	.489**	.433**	.477**	.508**	.461**	.421**	.561**	.605**	1			
Y15	.493**	.463**	.176**	.388**	.555**	.459**	.469**	.444**	.496**	.364**	.372**	.541**	.600**	.721**	1		
X1	.608**	.599**	0.028	.394**	.586**	.473**	.445**	.469**	.436**	.427**	.356**	.417**	.477**	.492**	.451**	1	
X2	.627**	.626**	0.043	.398**	.570**	.466**	.425**	.446**	.476**	.426**	.419**	.437**	.482**	.487**	.438**	.709**	1
M	3.75	3.89	3.01	3.51	3.86	3.76	3.80	3.74	3.90	3.63	3.61	3.74	3.70	3.83	3.89	3.72	3.77
SD	.71	.77	.45	.56	.78	.83	.87	.85	.83	.85	.85	.82	.82	.87	.87	.74	.76

Bartlett's Test of Sphericity = 4853.204, P = .000, df = 136

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .941

* p < .05, ** p < .01

The analysis was aimed at ascertaining the factors that promote the development of industrial habits/characteristics among students of Rajamangala University of Technology Thanyaburi. The conceptual framework of the research dictated the use of a causal model for this purpose. The exogenous variables were organizational factors (ORG), and the mediating variables were teacher- and student-related factors (TEACHER and STUDENT, respectively). The endogenous variables were industrial behaviors (HABITS).

The results of the analysis via causal–structural equation modeling (SEM) revealed that the conceptual framework was inconsistent with the empirical data. The researcher then adjusted the model by relaxing the initial level of agreement required to allow for measurement errors. The observable variables were related. The causal model was consistent with the empirical data. Figure 1 illustrates the results of the proposed parameter estimation, together with the findings of the analysis of the correlation between direct and indirect effects. The other statistical results are presented in Tables 2 and 3.

Table 2: Estimation parameters and related statistics for validation of causal models affecting industrial behaviors of students at Rajamangala University of Technology Thanyaburi.

Cause variable → Effect variable	**Parameter estimation**		**SE**	**t**
	Raw score	**Standard score**		
Measurement model				
Matrix LX				
ORG				
X1	1.000	0.831	<--->	<--->
X2	1.054	0.853	0.052	20.158
Matrix LY				
TEACHER				
Y1	1.000	0.866	<--->	<--->
Y2	1.062	0.848	0.049	21.804
STUDENT				
Y3	1.000	0.274	<--->	<--->
Y4	2.698	0.595	0.510	5.291
Y5	5.473	0.865	1.125	4.863
HABBITS				
Y6	1.000	0.717	<--->	<--->
Y7	0.980	0.670	0.066	14.806
Y8	0.998	0.698	0.062	16.022
Y9	1.004	0.717	0.071	14.166
Y10	0.915	0.641	0.067	13.624
Y11	0.803	0.563	0.070	11.460
Y12	0.928	0.673	0.069	13.447
Y13	0.982	0.711	0.069	14.127
Y14	1.047	0.714	0.073	14.260
Y15	0.992	0.677	0.074	13.463
Structural equation model				
Matrix GA (Gamma)				
ORG -> TEACHER	0.855	0.856	0.049	17.330
ORG -> STUDENT	0.083	0.414	0.028	2.973
Matrix BE (Beta)				
TEACHER -> STUDENT	0.108	0.538	0.031	3.480
STUDENT -> HABBITS	4.261	0.884	0.898	4.746

note: ** $p < .01$, <---> Do not report values SE and t because it is a constrained parameter

Table 3: Statistical analysis of the influence of causal model on industrial behaviors of students at Rajamangala University of Technology Thanyaburi.

effect variables / casual variables	TEACHER			STUDENT			HABBITS		
	TE	IE	DE	TE	IE	DE	TE	IE	DE
ORG	0.855	-	0.855	0.175	0.092	0.083	0.746	0.746	-
	(0.049)	-	(0.049)	(0.036)	(0.026)	(0.028)	(0.057)	(0.057)	-
	0.856	-	**0.856**	**0.874**	**0.460**	**0.414**	**0.773**	**0.773**	-
TEACHER	-	-	-	0.108	-	0.108	0.460	0.460	-
	-	-	-	(0.031)	-	(0.031)	(0.097)	(0.097)	-
	-	-	-	**0.538**	-	**0.538**	**0.476**	**0.476**	-
STUDENT	-	-	-	-	-	-	4.261	-	4.261
	-	-	-	-	-	-	(0.898)	-	(0.898)
	-	-	-	-	-	-	**0.884**	-	**0.884**

Statistics
Chi-square = 45.664 df = 76 p = 0.998 GFI = 0.989 AGFI = 0.978 RMR = 0.009 RMSEA = 0.000

Variables	X1	X2	Y1	Y2	Y3	Y4	Y5	Y6	Y7
Reliability	0.69	0.73	0.75	0.72	0.08	0.35	0.75	0.51	0.45
Variables	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	
Reliability	0.49	0.52	0.41	0.32	0.45	0.51	0.51	0.49	

Variable structure equation	TEACHER	STUDENT	HABBITS
R^2	0.733	0.841	0.782

Correlation matrix between variables	TEACHER	STUDENT	HABBITS	ORG
TEACHER	1.000			
STUDENT	0.892	1.000		
HABBITS	0.789	0.884	1.000	
ORG	0.856	0.874	0.773	1.000

note: Total Effect (TE), Indirect Effect (IE) and Direct Effect (DE) were statistically significant at the level of .01 ($p < .01$).

Solid numerical values are the effect values in the standard score. Numbers in parentheses is the standard error.

The validation of the causal model uncovered good consistency with the empirical data, as evidenced by the chi-square value (χ^2 = 45.664, df = 76, p = 0.998), which had a probability greater than 0.05, indicating that the main hypothesis is accepted. The hypothesis model was developed on the basis of the empirical data. The GFI was = 0.989, and the adjusted GFI (AGFI) was 0.978, regarded as 1 or approaching 1. The root mean square residual (RMR) was 0.009, while the root mean square error of approximation (RMSEA) was 0.000, with values approaching 0.

When reliability in the measurement of each observable variable was considered, the results revealed that most of these variables had good reliability, with values ranging from 0.50 to 0.75, except for the measurement variables, namely, cumulative grade point average (Y3), economics (Y11), attitudes toward learning (Y4), diligence and patience (Y10), discipline and punctuality (Y7), safety (Y12), responsibility (Y8), and creativity (Y15), which have relatively low precision, as reflected by values falling between 0.03 and 0.49. The consideration of the predictive coefficient (R^2)of the structural equation of internal variables that are dependent and transmitted in nature indicated that the predictive variables or causal factors explained up to 78.2% of the variance in industrial behaviors. These variables were industrial behaviors (R^2 = 0.782), student-related factors (R^2 = 0.841), and teacher-related factors (R^2 = 0.733). The predictive variables or causal factors for the instructor and organizational factors collectively explained 84.1% of the variance in student-related variables, whereas the predictive variables or organizational factors explained 73.3% of the variance in industrial habits.

To interpret the results, the magnitude of the influence between variables was analyzed. The variables are discussed in order thus:

Industrial habits

The extent of influence in the form of standard scores of variables in the model that are predictive or causal in nature with respect to industrial characteristics was investigated. The results indicated that the variables directly influencing industrial characteristics were the student-related factors (cumulative GPA, attitudes toward learning, motivation to study), with the magnitude being 0.884. This value reflects that the students had considerable industrial characteristics. The teacher-related factors indirectly influenced the industrial characteristics of the students. The indirect influence of the student-associated factors reached a level of 0.476, and the organizational factors indirectly influenced the industrial characteristics of the students through teacher- and learner-associated factors, with the degree of influence amounting to 0.733.

The total effect (TE), direct effect (DE), and indirect effect (IE) on industrial characteristics were also considered. The variables with the highest influence on industrial characteristics were the student-related factors (TE = 0.884), followed by the organizational factors (TE = 0.773) and instructor-associated determinants (TE = 0.476). The variables with the highest direct influence on industrial characteristics were the student-related factors (TE = 0.884), whereas those exerting the highest indirect influence were the organizational factors (TE = 0.773) and instructor-related factors (TE = 0.476).

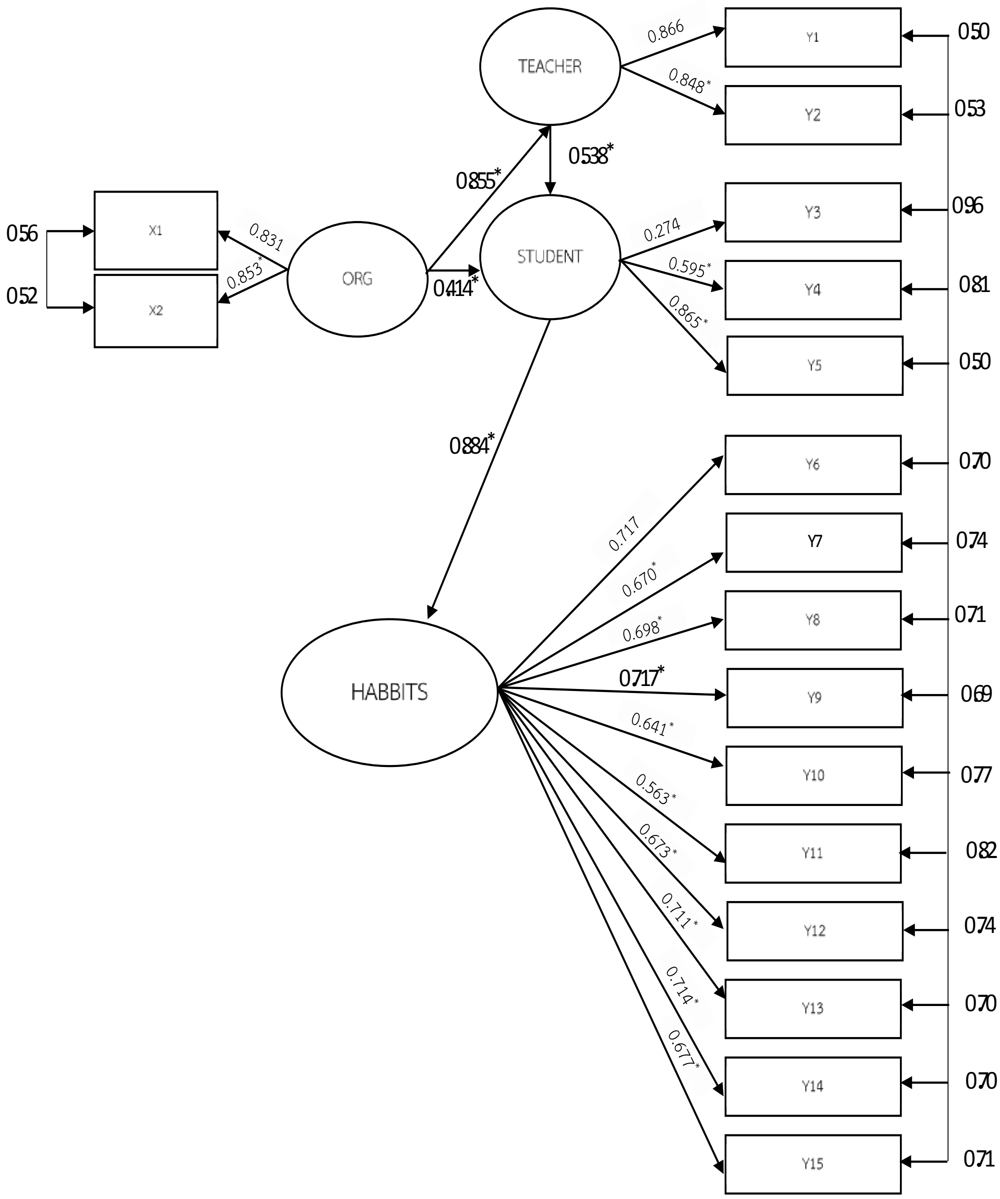
Learner-related factors

Influence was ascertained on the grounds of the standard scores of the predictive variables or causal factors in relation to learners. The findings showed that the variables with the strongest direct influence on the learner-related factors were the teacher-associated determinants, followed by the organizational factors. The magnitudes of influence from these variables were 0.538 and 0.414, respectively, showing that student development of industrial characteristics are affected by both teaching and learning factors as well as the personality of competent teachers. The organizational factors, either in terms of classroom atmosphere or a good school environment, enhanced the student-related factors, which in turn, paved the way for the meaningful development of industrial characteristics.

Teacher-related factors

The analysis of the teacher-related factors unraveled that the variables directly influencing instructor-associated determinants were the organizational factors, with the extent of influence being equal to 0.856. This finding shows that students who are exposed to organizational factors are also exposed to high-quality teacher-associated factors; this exposure, in turn, means enhanced student-related factors and the consequent substantial development of industrial characteristics. The results are presented in Table 3 and Figure 1.

Figure 1: Causal model affecting industrial characteristics of students at Rajamangala University of Technology Thanyaburi consistent with empirical data.



Conclusion

Causal modeling was carried out in three phases: the analysis of the coefficient of correlation between the observable variables of the model, the validation of the model, and the analysis of influence between the variables.

First, the results of the correlation coefficient analysis revealed that most of the variables were statistically significant at the .01 level and that the correlation coefficients ranged from .119 to .735. The variables with the strongest relationship were the teaching and learning variables and the personality of an instructor. The correlation coefficient was equal to .735. The second strongest relationship was that exhibited by teamwork and public mindedness, with the correlation coefficient being .721. Bartlett's test of sphericity generated a value equal to 4853.204 ($p = .000$), showing that the matrix of correlation between the observable variables differed from the identity matrix, with statistical significance at the .01 level. This finding is consistent with the results of the KMO index, which amounted to .941. This reflected that the variables in the dataset were highly relevant related and suitable for the analysis.

Second, the validation of the causal model uncovered good consistency with the empirical data, as manifested in the chi-square value ($\chi^2 = 45.664$, df = 76, $p = 0.998$), which had a probability greater than 0.05. This result means acceptance of the main assumption. The theoretical model was developed on the basis of the empirical data. The GFI = 0.989, the AGFI = 0.978, the RMR = 0.009, and the RMSEA = 0.000. The examination of the reliability of variable measurement indicated that most of the observable variables had good reliability. The reliability value fell between 0.50 to 0.75, except for cumulative grade point average (Y3), economics (Y11), attitudes toward learning (Y4), diligence and patience (Y10), discipline and punctuality (Y7), safety (Y12), responsibility (Y8), and creativity (Y15). These had relatively low precision that fell between 0.03 and 0.49. The predictive coefficient (R^2) of the structural equation of internal variables that are dependent and transmitted variables demonstrated that the predictor variables or causal factors explained 78.2% of the variance in industrial behaviors. These variables were industrial behaviors ($R^2 = 0.782$), student factors ($R^2 = 0.841$), and teacher factors ($R^2 = 0.733$. The predictive variables or causal factors for the teacher-associated and organizational determinants jointly explained up to 84.1% of the variance in the student variables, and the predictive variables or organizational factors explained 73.3% of the variance in industrial habits.

Finally, the magnitude of influence between the variables were analyzed thus: The variables that directly affected industrial behaviors were the student factors, with the influence reaching a magnitude of 0.884. This shows that students with high-quality student factors (cumulative GPA, attitudes toward learning, motivation to study) substantially develop industrial characteristics. The teacher-related factors indirectly influenced industrial characteristics. The variables on student factors with indirect influence of 0.476 and the organizational factors also indirectly affected industrial characteristics through the teacher- and learner-related factors, with the influence reaching a level of 0.733. The TE, DE, and IE of the variables on industrial characteristics pointed to the fact that the variables with the highest influence on industrial characteristics were the student-related factors (TE = 0.884), followed by the organizational factors (TE = 0.773) and instructor-related factors (TE = 0.476). The variables with the strongest direct influence on industrial attributes were also the student-related factors (TE = 0.884). The greatest indirect influence was exerted by the organizational factors (TE = 0.773) and instructor-related factors (TE = 0.476).

The variables that directly affected the learner-related factors were the teacher-related determinants and organizational factors, with magnitudes amounting to 0.538 and 0.414, respectively. These values indicate that students exposed to both teaching management factors and teacher personalities satisfactorily develop industrial behaviors. The organizational factors, either in terms of classroom atmosphere or good school environment, resulted in strong student-related factors, thereby facilitating the improved cultivation of industrial characteristics. As regards the teacher-associated factors, the variables with direct effects were the organizational factors, whose extent of influence reached 0.856, reflecting that the students were exposed to favorable organizational factors. This positive result, in turn, translates to exposure to high-quality teacher- and student-associated factors and, ultimately, to the enhanced development of industrial characteristics.

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References

Bhadouria, P. (2013). Role of Emotional Intelligence for Academic Achievement for Students. *Research Journal of Educational Sciences*, 1(2), 8 – 12.

Bloom, B. S. (1976). *Human Characteristic and School Learning*. New York : McGraw-Hill.

Bollen, K. A. (1989). *Structural Equations with Latent Variables*. New York: JohnWiley& Sons.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., and Tatham, R.L. (2010). Multivariate Data Analysis. 7th ed. New Jersey: Pearson Education.

Hough, John B. and Duncan, Jam'es K. (1970). *Teaching description and analysis*. Addison-Westlu.

Spafford, Carol Sullivan, Pesce, Augustus I. and Grosser, George SO. (1997). *The Cyclopedic Education Dictionary*. USA: Delmar Publishers.

WHO. (1944). *Life skills education for children and adolescences in school*. London: Education Department of Health.

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