Textbook Content Transformation: Interpretive Structural Modelling (ISM) Approach

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Abstract: Textbook in Malaysia is not limited to serve only as a source for curricular document but as the main source of materials to inculcate societal values, philosophy and national identity in realising national aspirations. Thus the purpose of the research is to produce a Textbook Content Transformation Model in Malaysia as a guide for quality enhancement, design and content organising in textbook writing. This research uses ISM as a process for model development and to map the relation between elements involved in textbook content transformation. The research has established a complex system into a few subsystems using practical experience and expert knowledge. The expert group with 112 respondents consisting of 60 subject matter experts (expert teacher, textbook writer and evaluator), 12 lecturers from Malaysian teachers training institutes, 12 university lecturers, 30 officers from Textbook Division and Dewan Bahasa dan Pustaka from all over Malaysia participated in building the Multilevel Structural Model. The expert group achieved consensus on 10 elements of textbook content transformation that need to be implemented in modular content shape; multiple intelligence; application of moral values; socio-cultural element; pupils ethos element; real picture; visual presentation; adjustable language; problem-solving centred and latest and solid facts. The research findings will accommodate textbook writers by providing guidelines for writing textbook contents based on priority.
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1. Introduction

Textbooks continue to play its most important role of whistle blowers in the form of the basic content of a particular syllabus and information provider in the classroom. Debate centers on the issue of textbook transformation is channelled in the form of text (Özgeldi & Esen, 2010; Sulak & Pilten, 2010), illustrations (Kırkgöz, 2009), activities, information and pictures (Anagnostopoulou, Hatzinikita, & Christidou, 2012). However, most of these previous studies only argued on the surface opinion of the public while the nature of transformation should actually consider experts consensus and opinion especially in the curriculum and policy changes.

Therefore, in this study we utilized the Interpretive Structural Modelling (a computer based learning process) to a group of experts to reach consensus on developing an established Multilevel Structural Model. This type of model was based on the relationship between the elements involved in a complex issue should be in line with the level of reading ability and be of interest to students and enhance student motivation to use it (Marohaini, 1999; Willians, Leung, Kent & Heazlewood, 2002) as well as working to improve reading skills (Nutall, 1985) and be well understood (Coleman, 1962).

Most of the research done in textbook evaluation and transformation was based on the traditional method whether using qualitative study or quantitative study. Recent studies for instance, AlEdwan and Hamaidi (2010) and Altundağ, Yıldız, Köğce, and Aydın (2009) was using the teachers' perspective in the textbook evaluation process, while several studies, (Anagnostopoulou et al., 2012; Kavşut, 2010) utilize systematic review, Keklik (2011) and Embong, Noor, Hashim, Ali, and Shaari (2012) utilize content analysis in their textbook transformation studies. Yet, none of the scholars in this field of study applied ISM methodology in their research. Therefore, it is important for us to highlight this research methodology as an important approach in the textbook evaluation and transformation study in order to shed light on the new and reliable method.

2. Methodology *of Interpretive Structural Modelling* (ISM)

ISM is a computer based learning process to allow individuals or groups to develop a model or map based on the relationship between the elements involved in a complex issue. The use of this ISM methodology among others is to demystify a complex system into several subsystems using practical

experience and expert knowledge to build a model of hierarchical structure *(Multilevel Structural Model)*. In addition, the ISM can also be used to identify and analyse the relationship between specific variables to define a complex problem or issue (Warfield, 1974; Sage, 1977; Jane, 1988; Warfield & Perino, 1999). In other words, the ISM will produce a *directed graph (Diagraph)* to reflect the relationship between the elements and thus structuring the complex issues in the hierarchical structure model (Porter, Rossini, Capenter & Roper, 1980).

Three major steps involved in developing *Interpretive Structural Model (ISM)* (Hansen, Mckell, Heitger, 1979) are:

Step 1: Identify the issues or complex problems

Step 2: Identify and list the elements involved in the issue or issues

Step 3: The elements identified are matched through a graphic representation or relationship matrix that forms hierarchical structure model ISM.

In the field of manufacturing and construction, ISM methodology has been applied to solve issues regarding cost savings and operational optimisation. Saxena, Sushil and Vrat, (1992) applied the ISM methodology for modelling energy savings at a cement factory in India to identify the relationship between direct and indirect variables. Mandal and Deshmukh (1994) used the ISM methodology to analyse some important criteria in supplier selection and showed the relationship between the criteria. Kannan and Haq (2007) applied the ISM methodology to analyse the interaction between criteria and sub-criteria that influence the selection of suppliers for a *built-to-order* supply chain environment. Harwinder and Khamba (2011) applied the ISM methodology to identify the obstacles in implementation of *Advanced Manufacturing* Model *of technology* and developed the Correlations-Structural Model between the structures of the barriers to successful manufacturing.

ISM methodology is also widely used in organisation management and administration. Sharma and Sushil Gupta (1995) have applied the ISM methodology to build a hierarchy of actions needed to achieve goals for the future of solid waste management in India. Abid Haleem, Sushil, Mohammad Asim, and Sanjay (2012) used ISM methodology to analyse the key factors behind the successful implementation of world class manufacturing practices and further develop the model of hierarchical structure. Mohd Nishat (2010) using the ISM to identify the barriers of corporate social responsibility in the supply chain environment and further develop Hierarchical-Structure Model in Qatar.

In addition, the ISM methodology was applied in design, marketing and business. Chun Wei Chen (2012) has applied the ISM methodology in developing design solutions of razor market products through criteria based on customer preferences. Khodakaram, Mohammad Ali, and Ahmad Ghorbanpur (2010) also applied the ISM methodology in order to understand and identify the key elements for the success of the project *Banking Process Re-engineering* in Iran. Gorvett and Lui (2006) applied the ISM to build a hierarchical structure model and describe the relationship between the risks of the firm. Singh and Kant (2008) were using the ISM to develop relationships within the constraints in *management knowledge* identified in the areas of businesses and develop a *hierarchical structure model* to reflect these constraints.

Education also uses ISM methodology. Georgakopoulos (2009) applied ISM methodology to investigate the effectiveness of various teachers as a phenomenon and holistic dimension. Sahney, Banwet, and Karunes (2006) applied the ISM methodology to identify minimum feature set design or quality components that meet the needs of students as clients in the education system quality. Upadhyay, Gaur, Agrawal, and Arora (2006) were using the ISM methodology to identify the parameters influencing the quality of engineering education system and to develop an integrated model structuring hierarchies and mapping concept related to the quality of engineering education.

3. Applications of Interpretive Structural Modelling Approach (ISM)

This study aims at developing a Textbook Content Transformation Model in Malaysia. The objective is to identify relationship between the elements involved in implementing textbooks transformation in Malaysia.

There are several limitations in applying the ISM methodology, including contextual relationships between these elements is dependent on the knowledge, expertise and experience of outstanding teachers, writers, and textbook evaluators officials. BBT and Routledge are selected related to the publishing and writing textbooks. Hence, the development model to be influenced by individual bias in context.

The methodology of applying measures *Interpretive Structural Model* (modified Jane 1988; Moore, 1987; Malone, 1975) are:

i. **Identify elements influencing textbook content (Issue: Transformation Textbook Contents)**

Step 1:

- Expert group of 112 people of 60 Subjects Specialist Teachers (Excellent Teachers, writers and Textbook Evaluators), 12 Lecturers from Malaysia Institute of Teacher Education, 10 Lecturers from Local University, 30 officers from Text Books Division of MOE and officers of Dewan Bahasa dan Pustaka (National Language and Literary Agency).
- *Idea writing Process* technique used to list as many elements affecting textbooks quality.
- A total of 234 elements that influence the content of textbooks have been identified through *Idea writing Process* technique.

Step 2:

- *Group brainstorming* techniques used to shortlist 20 most relevant elements out of 234 elements influencing the quality of the textbook content by a group of experts.
- After going through four series of presentations and discussions, the twenty elements have been identified and agreed upon as necessary elements in the textbook transformation process in Malaysia.

Step 3:

- 20 elements that influence the content of this quality textbook once again were presented right next to a group of experts to get feedback and opinions.
- Expert Group believes that there are some similarities in meaning, themes and functions of these twenty selected elements. Through discussion, the group of experts reached consensus that the three elements have to be dropped because of the similarity in meaning and seven elements need to be combined in a theme because of their functional similarity. Expert Group reached an agreement that only ten most important elements influencing the content of a textbook quality were selected, namely:

Table 1. Textbook Content Elements

No.	Textbook Content Element	Description
1	Modular Content Shaped	Textbooks content should be constructed in modular form and graded according to standard syllabus and curriculum.
2	Multiple intelligence	Text content should be graded according to the level of students intelligence at all levels of learning,
3	Application of Moral Value	Textbooks need to adopt moral values as outlined in the school curriculum
4	Socio-Cultural Element	Textbook content should incorporate cultural elements of every race in Malaysia
5	Pupils ethos element	Textbook content should be able to shape the character and individuality of students according to community cultural manner
6	Real picture	The use of real pictures with coloured printing for each content presented.
7	Visual Presentation	The use of visual graphics to attract and enhance pupils' learning motivation.
8	Adjustable Language (Specific grammar, correct and understandable)	Language and terms used in the textbook content should be clear, precise and specific. The language used should be easy to understand and suited to students' reading level.
9	Problem-Solving Centred	Text content should emphasise *problem solving* and will be able to test the multiple intelligences
10	Latest and solid facts	Text content must be equipped with specific facts, current and concise.

ii. **Construction of the contextual relationship between elements**

The expert group had to use the *Priority Structural* to build contextual relationships between selected elements, by using the phrase: *"To achieve objective"*

iii. **Formation of Self-Interaction Matrix** *(SSIM)*

Expert Group was to identify the relationship between elements in textbook content transformation. The main focus is towards producing quality textbooks as well as to upgrade them globally.

To form SSIM, these elements are analysed by using four symbols that show the relationship between the elements *(i* and *j):*

V: *i* elements *will help objectives* / affecting/influencing *j;*

A: *j* elements *will help objectives* / *affecting i;*

X: elements *i* and *j will assist each other to achieve the objectives;*

O: The elements *i* and *j not related;*

Expert group has reached consensus and the results are shown in table 2.

Developing a *reachability matrix* based on SSIM

Expert group went on to develop *reachability matrix* and revise the matrix for transitivity.

Table 2: *Structural Self-Interaction Matrix* (SSIM) for Element Content Transformation of Textbook in Malaysia

Element number	Element	Element number								
		10	9	8	7	6	5	4	3	2	1
1	Modular Content Shaped	V	V	A	V	V	V	O	V	X	-
2	Multiple intelligence	V	V	A	V	V	V	O	V	-	
3	Application of Moral Value	A	A	A	A	A	V	O	-		
4	Socio-Cultural Element	O	O	A	O	O	O	-			
5	Pupils ethos Element	A	A	A	A	A	-				
6	Real picture	V	O	A	V	-					
7.	Visual Presentation and Graphics	V	O	A	-						
8.	Adjustable Language	V	V	-							
9.	Problem-Solving centred	O	-								
10.	Latest and Solid Facts	-									

SSIM which translated into *binary Matrix,* known as *reachability matrix* uses the *V, A, X* and *O* in which Code 1 or Code 0 will be given for each relationship. Code 1 or Code 0 will be granted on the following conditions:

- If the element (i, j) in the SSIM is V, then (i, j) in *reachability matrix* to 1 and the element (j, i) will be 0;
- If the element (i, j) in the SSIM is A, then (i, j) in *reachability matrix* becomes 0 and the element (j, i) will be 1;
- If the element (i, j) in the SSIM is X, then (i, j) in *reachability matrix* to 1 and the element (j, i) will be 1;
- If the element (i, j) in the SSIM is 0, then (i, j) in the *reachability matrix* becomes 0 and the element (j, i) will be 0.

Table 3: *Initial reachability matrix:* Elements of Textbook Content Transformation in Malaysia

Element number	Element	Element number										Driving Power
		10	9	8	7	6	5	4	3	2	1	
1	Modular Content Shaped	1	1	0	1	1	1	0	1	1	1	8
2	Multiple intelligence	1	1	0	1	1	1	0	1	1	1	8
3	Application of Moral Value	0	0	0	0	0	1	0	1	0	0	2
4	Socio-Cultural Element	0	0	0	0	0	0	1	0	0	0	1
5	Pupils ethos Element	0	0	0	0	0	1	0	0	0	0	1
6	Real picture	1	0	0	1	1	1	0	1	0	0	5
7.	Visual Presentation and Graphics	1	0	0	1	0	1	0	1	0	0	4
8.	Adjustable Language	1	1	1	1	1	1	1	1	1	1	10
9.	Problem-Solving centred	0	1	0	0	0	1	0	1	0	0	3
10.	Latest and Solid Facts	1	0	0	0	0	1	0	1	0	0	3
	Power Dependence	6	4	1	5	4	9	2	8	3	3	

v. Dividing the *reachability matrix* to a different level

Consensus of experts for each of the elements identified with the development of r*eachability matrix, reachability* and *antecedent.*

- *Reachability* set gives justification that the element itself and other elements ***is helping to achieve the objectives*** set while *antecedent* justify that the element itself and other elements ***will help to achieve the objectives***
- Element of the same set of *reachability and intersection* will be at the highest level of the hierarchy ISM.

Table 4: *Partition of reachability Matrix:* Transforming Elements Textbook content in Malaysia

Element number	Reachability set	Antecedent Sets	Intersection	Level
1	1, 2, 3, 5,6, 7,9,10	1,2,8	1, 2	
2	1, 2, 3, 5, 6, 7,9,10	1,2,8	1,2	
3	3,5	1,2,3,6,7,8,9,10	3	
4	4	4, 8	4	
5	5	1,2,3,5,6,7,8,9,10	5	
6	3,5,6,7,10	1,2,6,8	6	
7	3, 5,7,10	1,2,6,7,8	7	
8	**1,2,3,4,5,6,7,8,9,10**	8	**8**	I
9	3,5,9	1,2,8,9	9	
10	3, 5,10	1,2,6,7,8,10	10	

Level 1

Table 5: *Partition of reachability Matrix:* Elements of Textbook Content Transformation in Malaysia

Element number	Reachability set	Antecedent Sets	Intersection	Level
1	1, 2, 3, 5,6, 7,9,10	1,2,8	1, 2	2
2	1, 2, 3, 5, 6, 7,9,10	1,2,8	1,2	2
3	3,5	1,2,3,6,7,8,9,10	3	6
4	4	4, 8	4	2
5	5	1,2,3,5,6,7,8,9,10	5	7
6	3,5,6,7,10	1,2,6,8	6	3
7	3, 5,7,10	1,2,6,7,8	7	4
8	**1,2,3,4,5,6,7,8,9,10**	8	**8**	1
9	3,5,9	1,2,8,9	9	3
10	3, 5,10	1,2,6,7,8,10	10	5

Based on the relationship occurred in the *reachability matrix,* then *directed graph* (digraph)

Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*	*Level 6*	*Level 7*

Revenue consensus of these experts can be described by Figure 1.

created and transitive link will be dropped. Then, the elements in Digraph were classified according to *driving power* and *dependent power* into 4 categories (Mandal and Desmukh, 1994), namely:

- *Autonomous lements*
- *Dependent Element*
- *Linkage Element*
- *Independent Elements*

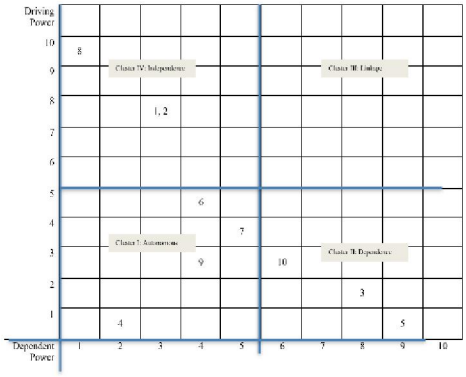

Figure 1: Cluster of elements Textbook Content Transformation in Malaysia

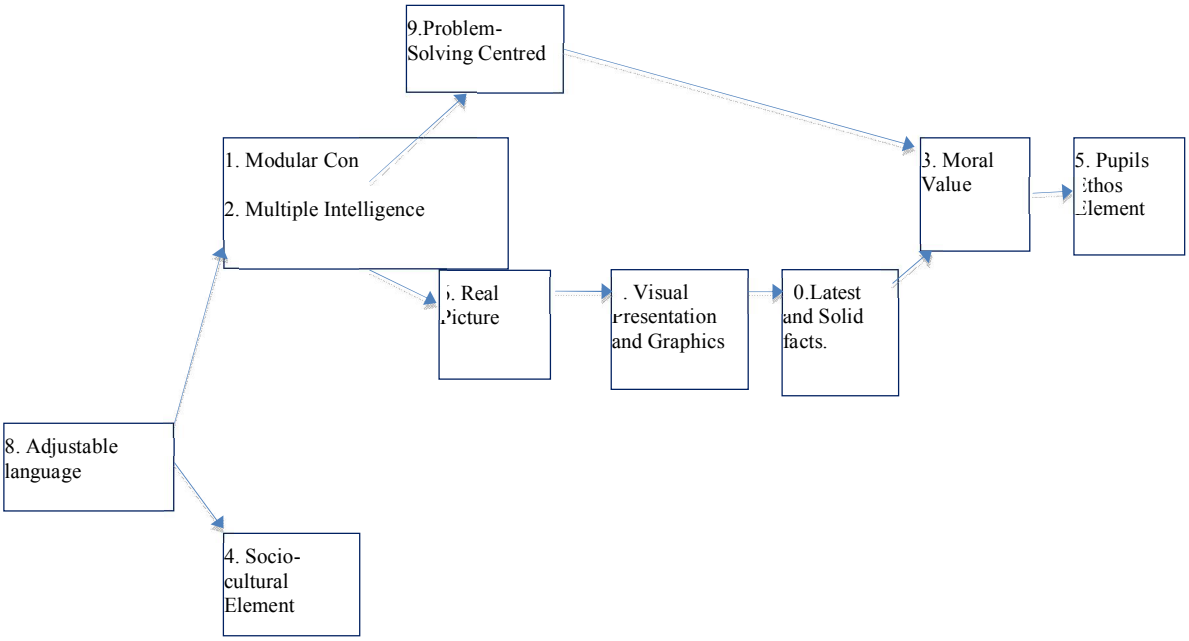

Figure 2*: Interpretive Structural Model:* Transformation of Textbook Content

vii. Textbook Content Develop Model Transformation through ISM Applications

Textbook Content Transformation Model can be produced through the use of ISM applications. Figure 1 shows the result of this Textbook Content Model Transformation using ISM.

This model can also be developed through the *initial reachability matrix* which is known as the *initial directed graph of digraph.*

Ten elements proposed by experts in implementing transformation of the school textbooks content in Malaysia are:

1. Modular Content Shaped
2. Multiple intelligence
3. Moral value
4. Socio-Cultural element
5. Pupils ethos
6. Real picture
7. Visual Presentation
8. Specific grammar, correct and understandable
9. Problem-solving Centred
10. Latest and Solid facts

Textbook Content Transformation Model in Malaysia (Figure 1) was shown to a group of experts in a feedback session to examine and review the appropriateness of the concepts and facts. If necessary, modifications to the model can be done by expert consensus. This session involved 60 experts of; 20 persons of Subject Specialist Teachers (Excellent teacher, writer and Evaluator Textbook Textbook), 5 Lecturers from Malaysia Institute of Teacher Education, 5 local University Lecturers, 30 Officers of Textbook Division (MOE) and DBP. After discussing and arguing every relationship between the elements involved, the expert group has reached a consensus to accept the presented model without any modification.

4. Discussions

The findings are shown in Figure 1: Textbook Content Transformation Model in Malaysia. Structural equations, variables and the level of each element are displayed in visual form through hierarchical structure model ISM (Warfield, 1976). Advance Knowledge each level of element in the content is important in order to perform the textbook content transformation.

Adjusting the appropriate language, specific and easy to understand is the highest hierarchy level of *ISM-Based Model* based on *High Driving Power* and *Low Dependent Power* clusters elements. The findings of this study indicate that the transformation of textbooks should emphasise grammar. Indeed, each subject use different *jargon* and has a distinctive tendency (White, 1974; Natthesan Sellapan, 1992; Samat Single, 1994; Mohd Zubil, 1997). This proves that the use of correct grammar, spelling, and punctuation; simple and clearly defined sentence structure; easy level of words and language used, attracting language style according to the level of student ability (Harris, 1970; Krisnan 1997, School Inspectorate, 2000; Sidin, 2000; Textbook Division, 2005) and will be able to motivate students (Day, 1994; Dubay, 2002; Jones, 1993; Kitao, 1994; Soyibo & Mckenzie-Briscoe, 1998; William et al., 2002) enjoy reading become an important element in the textbooks transformation.

Referring to Figure 1, emphasis should be given to the appropriate use of grammar in the textbook content. This is because it will help to achieve the objective of creating modular content and multiple intelligence that suppress the use of the actual image, the visual presentation with the latest and solid facts. These findings support the findings Marohaini (1999) which states that the use of graphic techniques such as charts, real pictures, graphs, tables, and figures should be considered in addition to the text content of accurate and comprehensive information. Therefore, these elements will inculcate the effort of implementing *problem- solving* based content as well as incorporate students' moral values and ethos elements.

Thus, textbooks transformation efforts should emphasise the implementation of Modular Content Shaped and Multiple Intelligence, and Adjustable Language with High *Driving Power* and *Low Dependent Power* over various elements of the Socio-Culture, Real Picture, Visual Presentation and Problem-Solving Centred and are compact in which clusters Autonomous *weak driver* and *weak dependents*. These elements are not so affect the achievement of the transformation effort textbooks. This caused a great many experts argue textbooks present accurate and compact. This statement is supported by Guzzeti, Willians, Skeels and Shurs Ming Wu (1997) who found that students are not interested in reading books especially science subject textbooks as the text is difficult to understand and boring. They only use the textbook when receiving assignments from the teacher to get the compact and correct facts (Maroihaini, 1999; Rosmawati Jamaluddin, 2002)

The Moral Value, Pupils Ethos and Latest and Solid Facts elements clustered Dependence of *High Dependent Power* and *Low Driving Power*. This means that efforts to bring about a transformation in the Moral Value, Pupils Ethos and Latest Solid Facts of text content transformation will affect all elements

of the textbook content. Thus, the visual presentation in text content will drive the transformation of the textbook content. This is consistent with studies conducted, found that aspects of Moral Value (Abram, 2012), Pupils Ethos and Latest and Solid Facts (Declan Butler, 2009) to facilitate the reader to understand the content of a complex, conceptual and abstract work, but can help to recall the contents of the reading (Watts & Nisbet, 1974).

Thus, these findings suggest that efforts to implement the transformation of textbooks should emphasise all elements that have been identified by an expert group in accordance with the level of hierarchical structure model ISM.

5. Conclusion

Based on these findings, it can be concluded that the ten elements identified affect textbook content transformation efforts although there are some elements at various levels in the *hierarchy-Base Model ISM*. In this study, only ten of the 234 elements of the transformation of textbooks were selected by an expert group on the basis of priority and suitability in the context of developing a ISM model: Textbook Content Transformation in Malaysia.

This study shows the relationship between the elements involved in the transformation of textbooks but each element was not tested for validity and reliability. Therefore, further study is proposed to test the model developed using the *Structural Equation Model* (SEM). This is because the SEM is also developing a relationship approach or *linear structural model* where they can test the validity and reliability of a model. Indeed, the ISM is a tool to develop an *initial model* while SEM has the ability in terms of statistical tests based on the theoretical approach.

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