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The development and validation of the principal innovation leadership scale in Malaysian secondary schools

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ABSTRACT

Scholars used multiple variables in measuring innovation leadership due to the differences in concept and understanding of this leadership in different fields. We develop the instrument to fill in the gaps in academicians' and scholars' assessments pertaining to the concept of innovation leadership, especially in the sense of education. This paper aims to explain the instrument development and validation process of the face and content validity for the purposed dimensions and items. All the constructs were generated through a rigorous review of the literature. There were six experts involved in validating the face and content validity of this instrument. Content validity index (CVI) and Modified Kappa statistics were used. The cut-off point of all items was 0.8 which retained as a final instrument. Therefore, from the 58 items, four were deleted as it is not reached the level of agreement between all the experts. The final instruments for further validation consisted of 54 items which fell under eight dimensions, namely: i) Creative behavior; ii) Ideal influence; iii) Effective communication; iv) Empowerment and mentoring; v) Technical skills; vi) Entrepreneurship; vii) Opening behavior; and viii) Closing behavior were identified. Therefore, this instrument could be utilized for further validation.

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1. INTRODUCTION

The Malaysian Educational Development Plan (PPPM) 2013-2025 aims to transform the country's educational landscape in line with the business and social landscape. Integrating disruptive technologies into our educational environments, such as advanced robotics, the Internet of Things (IoT), and the automation of knowledge-related jobs could help achieve this vision [1]. Thus, the implementation of 21st-century teaching methods such as electronic lesson planning (eRPH), *Sekolah Bestari* (Smart Schools), Smart Lab, Net School Projects, the use of tablets in the classroom, Google Classroom, and many other programs demonstrate that education in Malaysia is evolving at a rapid pace in tandem with technological advancements in the business and social landscape. As determined by the current market, these advancements in technology, teaching methods, and school development have resulted in internationally competitive pupils. Innovation in education is critical for enhancing learning outcomes, educational quality, equity and equality, efficiency, cost reduction, and revenue maximization from education investment [2]. As a result, education must continue to be important in light of society's changing requirements and the economy's rapid transformation.

The introduction of innovation in education necessitates the presence of outstanding principals who possess qualities such as emotional intelligence; critical and analytical thinking; creativity and innovation; technological skills; communication and personal skills; personal management skills; organizational skills; partnership development; teamwork and collaboration; approach, development, and engagement to the community; global awareness and understanding; as well as non-racial equitable and inclusive development [3]. In addition, the need for innovation in the organization had raised a focus on the leader's functions to shape the nature and success of every members' creative efforts in their organization [4]. Therefore, they will have to work with more nuanced problems regularly.

As a result, individuals need to be more innovative and imaginative to overcome daily obstacles [5]. These kinds of leaders would be more effective in influencing the innovation process in organizations [6]. Unfortunately, leadership practices in the 20th century are unable to solve the leadership problems in this century [7]. The old and rigid authoritarian leadership practice cannot decrypt the accumulating and prevalent leadership problems we face in this century. The prevailing leadership practices ignore the necessity of change to meet future challenges. Instead, it is preoccupied with changes that affect short-term outcomes. Contemporary leaders and people often place a higher premium on maintaining the status quo than assessing the effect of real-world problems and projecting their future consequences. As a result, the existing leaders in organizations lack the values, knowledge, and skills to solve the current and future leadership problems.

Many researchers argue that leadership is a crucial factor influencing organizational innovation and development [8]–[16]. However, every scholar has their own opinion on how to lead innovation in organizations. They used various leadership skills definitions due to the complexity of the innovations. Some scholars used single leadership skills to lead innovation [9], [10], [12], [14], [17], [18] A single leadership styles range from transformational leadership [9], [10], [12], [14] to charismatic leadership [18]. However, a single leadership style cannot lead innovation effectively [19]–[21]. It is more useful to have a mixture of leadership skills that can be used flexibly through the innovation process [13], [19], [21]. Different leadership styles are required at different levels, types and in various innovation processes [13]. In other words, leadership must keep up with the complexity and speed of innovation [22].

Therefore, we conducted this research due to a considerable gap in our current knowledge of acceptable leadership theories. Fuad, Musa, and Hashim [23] conducted a systematic literature review to determine the constructs of Principal Innovation Leadership in this study. The constructs developed in line with the definition of innovation leadership, a mixture of several leadership styles within an organization [24] to inspire people to generate innovative ideas, new services, new solutions, or new products. The combination of these different leadership skills is due to the complicated and complex process of innovation. Additionally, the organizational environment in which innovation occurs also necessitates a new kind of leadership. Often, organizations require different leadership styles for each type of innovation, implementation phase, and level of analysis. Therefore, efforts should be made to identify the key leadership styles that will support innovation in schools. As a result, the development and evaluation of this instrument are critical for guiding the measurement of Malaysia's principal's innovation leadership.

2. RESEARCH METHOD

2.1. Instrument development

The instrument was developed in three steps [25]: i) Determine the domain or constructs based on the theory chosen; ii) Generation of items; and iii) Construction of the instrument. In the first step, a systematic literature review and content analysis were performed to determine the constructs of the innovation leadership skills. The search in four distinct databases uses the terms 'innovation leadership', 'innovative leadership', 'leadership in innovation', 'disruptive innovation leadership', and 'radical innovation leadership'. Scopus, Springer, Emerald, and Google Scholar were the databases used due to their high-quality journal indexing. In addition, Google Scholars were also used as grey literature in this research. After going through a total of 916 journals, there were 62 articles chosen for the final study. The final result showed that 44% of innovation leadership consisted of multiple leadership skills, 36% used transformational leadership in their primary research, 11% used transformational and transactional leadership skills, and 3% used authentic leadership, entrepreneurial leadership, and ambidextrous leadership.

According to the Organisation for Economic Co-operation and Development (OECD) [26], four types of innovation exist in education: product innovation, process innovation, organizational innovation, and marketing innovation. The introduction of new, renewal of products or services, technological advancements, delivery methods, software used in education, marketing the new courses offered, or pedagogical strategies are all considered innovation. Based on this definition of innovation given by the OECD [2], four theoretical leadership skills were chosen in this study: transformational leadership, ambidextrous leadership, and innovation leadership competence. Then, the constructs which agreed upon all these three theoretical

frameworks were formed. In the second stage, the generation of an item adapted based on the transformational leadership Multifactor Leadership Questionnaire (MLQ-5X), Innovation Leadership Questionnaire [27], and Ambidextrous Leadership Questionnaire [21]. Then, the items were placed in a table according to the identified constructs and theoretical codes, as shown in Table 1. The final step was to refine and organize the instruments in suitable formats and sequences. A total of 58 items were finalized in this instrument and consisted of eight main themes, namely: i) Creative behavior; ii) Ideal influence; iii) Effective communication; iv) Empowerment and mentoring; v) Technical skills; vi) Entrepreneurship; vii) Opening behavior; and viii) Closing behavior. Then, this instrument undergoes a review by six-panel experts. Feedback on the face validity and content validity of this instrument was also provided.

Table 1. Items generated for each dimension identified through literature review method

Theoretical codes	Theoretical codes
Dimension 1: Creative behaviors	**Dimension 5: Technical skills**
1. Critical thinking	33. Contribute to innovation activities
2. Different perspectives	34. Choose ideas that can be implemented
3. Different views on problems	35. Know the values of commercialized ideas
4. New ways to solve problems	36. Able to interpret market returns
5. Not criticized the creative ideas	37. Develop cross-functional teams
6. Creative behavior during the processes	**Dimension 6: Entrepreneurship**
7. Solve problems creatively	38. Entrepreneurship skills
8. Give motivation.	39. New ideas from the environment
Dimension 2: Ideal influence	40. Products commercialization
9. Common mission	41. Compare products with other competitors
10. Have pride	42. Generate new ideas based on current situations
11. Team welfare	43. Generate new ideas based on school relationships
12. Idea generation activities	44. The importance of resources
13. Experts help	**Dimension 7: Opening behaviors**
14. Adequate time for innovation	45. Open environments
15. The cross-sectional team between schools	46. New ideas encouragement
16. Convey potential ideas to stakeholders	47. Freedom of thinking
Dimension 3: Effective communication	48. Challenge the status quo
17. Future vision	49. Risk-taking
18. Innovation vision	50. Allows mistakes and learning from mistakes
19. Optimistic	51. High tolerance for failure
20. Full enthusiasm	**Dimension 8: Closing behaviors**
21. Confidence	52. Monitor and control the achievement of the goals
22. Appealing vision	53. Set a routine
23. Innovation commercialization	54. Take corrective action
24. Assessment of innovation success	55. Follow the rules
Dimension 4: Empowerment and mentoring	56. Shared accomplishments in assignments
25. Self-Development	57. Do not allow mistakes
26. Individual player	58. Follow the original plan
27. Different potential	
28. Mentoring teachers	
29. Ideas-generating activities	
30. Idea generation delivery	
31. Avoid controlled work plans	
32. Freedom and autonomy	

2.2. Judgement of the developed instruments

In this stage, judgment on the developed questionnaires was performed by the experts. This judgement is to ensure that the items meet the required level of face validity and content validity. According to Shrotyia and Dhanda [28], experts must be chosen based on their knowledge, professional experiences, and specific training on the subject matter. Therefore, in this study, the selection of the panel experts was based on their expertise in school leadership skills, broad experience in educational management studies, and adequate training in education administration. Table 2 summarizes the designation of the domain experts, their affiliation and years of experience. All the experts have more than ten years of experience in educational administration and are familiar with the thematic domain of concepts in innovation leadership practice in education. The selection number of experts was based on Lynn's [29], which advised a minimum of three experts and a must not be more than ten. As a result, six experts were chosen to validate the instrument's face and content validity throughout this stage.

The clarity and ambiguity of the items, appropriateness of the grammar used, sentence structuring, the spelling of the words, relevance font size, and the instrument's structure either in its constructions or format used to assess the item for face validity [30]. We used comments and suggestions from the panel experts' experiences to improve the instruments [31].

Table 2. Subject matters experts (SMEs) demography for the content validity phase

Designation of domain experts	Organization	Years of experience
Professor	Universiti Pendidikan Sultan Idris	36
Professor	Universiti Sultan Zainal Abidin	30
Associate Professor	Universiti Pendidikan Sultan Idris	29
Senior Lecturer	University Utara Malaysia	20
Senior Lecturer	University Utara Malaysia	20
Senior Lecturer	Kedah Institute of Teacher Training	23

The content validity index (CVI) was assessed using 4 points ordinal scale. Lynn [29] suggested a 4-point scale to avoid ambivalent or neutral answers. According to Polit and Beck [32], for this 4-point scale, the most used continuum is the one introduced by Davis [33], which is 1=not relevant, 2=somewhat relevant, 3=quite relevant, and 4=highly relevant. Then, the computation of the item-level CVI (I-CVI) is done when the experts give rates 3 and 4, which is the proportion of consensus between experts on the relevance of the items. The acceptance level of I-CVI in this stage, as recommended by Lynn [29], must be 1.00 if there are five or fewer panel experts. However, if more experts are involved, a slight difference in the disagreement is acceptable (the I-CVI must be at 0.83 if there are six experts in a single item). The adequate level of scale-level CVI (S-CVI) on the clarity of items should not be less than 0.8 [30], [32].

According to Shrotryia and Dhanda [28], the CVI calculation does not consider the inflated value that may occur due to the possibility of a total agreement between experts. They suggested the computation of Kappa coefficients to remove any random chance agreement invalidation to address this issue. Therefore, the Modified Kappa Statistic introduced by Polit and Beck [32] was used as an interrater agreement index between experts to ensure that their consensus was beyond chance. In this step, the probability of chance agreement (Pc) is calculated based on the formula given $Pc=[N!/A!\ (N-A)!]x0.5^N$. Where, N=number of experts in the panel, A=number of experts in the panel who agree that the item is relevant. Then, the Kappa Statistic was calculated based on the formula, K=(I-CVI-Pc)/(1–Pc). According to previous studies [25], [32], Kappa Statistics values are outstanding if they are more than 7.4, decent if they are between 0.6 and 0.74, and fair if they are between 0.4 and 0.59.

3. RESULTS AND DISCUSSION

The result of the face validity by experts is shown in Table 3. Generally, all experts agreed on the items formulated to measure each construct. Some of the advice and comments from the experts are to split the double-barrel questions, reduce the number of items, improve sentence structure to be more consistent, and items need to reflect the Malaysian educational system context. One expert commented that a scale of one to ten in the questionnaire was appropriate for data analysis. Table 4 to Table 11 show the ratings on creative behavior, ideal influence, effective communication, empowering and mentoring, technical skills, entrepreneurship, opening behaviors, and closing behaviors.

The I-CVI for all items in the eight dimensions ranged from 0.88 to 1. The S-CVI (average) for creative behaviors, ideal influence, effective communication, empowerment and mentoring, technical skills, entrepreneurship, opening behaviors, and closing behaviors dimensions for principal innovation leadership were 0.96 (Table 4), 0.90 (Table 5), 0.90 (Table 6), 0.94 (Table 7), 1.00 (Table 8), 1.00 (Table 9), 0.88 (Table 10) and 0.93 (Table 11) respectively. Thus, the overall S-CVI for the 58 items was 0.93, which indicated a high content validity of the items to measure the principal innovation leadership skills. However, there were four items with an I-CVI value less than 0.80. As a result, items 57 (0.41 I-CVI) and items 5, 16, and 24 (0.56 I-CVI) were removed from the final instrument. Next, these 54 items were undergone construct validation.

Table 3. Panel comments for face validity

Panel	Comments
1	Items need to reflect on the Malaysian educational system
2	The correct scale used for statistic measurement
3	Improve sentence structure to be more consistent Split the double-barrel questions
4	Split the double-barrel questions
5	Split the double-barrel questions Reduce the number of items.
6	Split the double-barrel items Reduce the number of items.

Table 4. Ratings on an 8-item scale for "creative behaviors" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
1	√	√	√	√	√	√	6	1.00	0.015625	1.00
2	√	√	√	√	√	√	6	1.00	0.015625	1.00
3	√	√	√	√	√	√	6	1.00	0.015625	1.00
4	√	√	√	√	√	√	6	1.00	0.015625	1.00
5	√	-	√	-	√	√	4	0.67	0.2344	0.56
6	√	√	√	√	√	√	6	1.00	0.015625	1.00
7	√	√	√	√	√	√	6	1.00	0.015625	1.00
8	√	√	√	√	√	√	6	1.00	0.015625	1.00

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=0.96 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Table 5. Ratings on an 8-item scale for "ideal influence" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
9	√	√	√	√	-	√	5	0.83	0.09375	0.82
10	√	√	√	√	-	√	5	0.83	0.09375	0.82
11	√	√	√	√	-	√	5	0.83	0.09375	0.82
12	√	√	√	√	√	√	6	1.00	0.015625	1.00
13	√	√	√	√	√	√	6	1.00	0.015625	1.00
14	√	√	√	√	√	√	6	1.00	0.015625	1.00
15	√	√	√	√	√	√	6	1.00	0.015625	1.00
16	-	√	√	√	-	√	4	0.67	0.2344	0.56

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=0.90 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Table 6. Ratings on an 8-item scale for "effective communication" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
17	√	√	√	-	√	√	5	0.83	0.09375	0.82
18	√	√	√	√	√	√	6	1.00	0.015625	1.00
19	√	√	√	√	-	√	5	0.83	0.09375	0.82
20	√	√	√	√	-	√	5	0.83	0.09375	0.82
21	√	√	√	√	√	√	6	1.00	0.015625	1.00
22	√	√	√	√	√	√	6	1.00	0.015625	1.00
23	√	√	√	√	√	√	6	1.00	0.015625	1.00
24	√	-	√	√	-	√	4	0.67	0.2344	0.56

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=0.90 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Table 7. Ratings on an 8-item scale for "empowerment and mentoring" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
25	√	√	√	√	-	√	5	0.83	0.09375	0.82
26	√	√	√	√	-	√	5	0.83	0.09375	0.82
27	√	√	√	√	-	√	5	0.83	0.09375	0.82
28	√	√	√	√	√	√	6	1.00	0.015625	1.00
29	√	√	√	√	√	√	6	1.00	0.015625	1.00
30	√	√	√	√	√	√	6	1.00	0.015625	1.00
31	√	√	√	√	√	√	6	1.00	0.015625	1.00
32	√	√	√	√	√	√	6	1.00	0.015625	1.00

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=0.94 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Table 8. Ratings on a 5-item scale for "technical skills" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
33	√	√	√	√	√	√	6	1.00	0.015625	1.00
34	√	√	√	√	√	√	6	1.00	0.015625	1.00
35	√	√	√	√	√	√	6	1.00	0.015625	1.00
36	√	√	√	√	√	√	6	1.00	0.015625	1.00
37	√	√	√	√	√	√	6	1.00	0.015625	1.00

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=1.00 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Table 9. Ratings on a 7-item scale for "entrepreneurship" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
38	√	√	√	√	√	√	6	1.00	0.015625	1.00
39	√	√	√	√	√	√	6	1.00	0.015625	1.00
40	√	√	√	√	√	√	6	1.00	0.015625	1.00
41	√	√	√	√	√	√	6	1.00	0.015625	1.00
42	√	√	√	√	√	√	6	1.00	0.015625	1.00
43	√	√	√	√	√	√	6	1.00	0.015625	1.00
44	√	√	√	√	√	√	6	1.00	0.015625	1.00

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=1.00 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Table 10. Ratings on a 7-item scale for "opening behaviors" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
45	√	√	√	√	√	√	6	1.00	0.015625	1.00
46	√	√	√	√	√	√	6	1.00	0.015625	1.00
47	√	√	√	-	√	√	5	0.83	0.09375	0.82
48	√	√	√	-	√	√	5	0.83	0.09375	0.82
49	√	√	√	-	√	√	5	0.83	0.09375	0.82
50	√	√	√	-	√	√	5	0.83	0.09375	0.82
51	√	√	√	-	√	√	5	0.83	0.09375	0.82

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=0.88 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Table 11. Ratings on a 7-item scale for "closing behaviors" dimension of principal innovation leadership

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	No. in agreement	I-CVI	Pc	Kappa Statistic
52	√	√	√	√	√	√	6	1.00	0.015625	1.00
53	√	√	√	√	√	√	6	1.00	0.015625	1.00
54	√	√	√	√	√	√	6	1.00	0.015625	1.00
55	√	√	√	√	√	√	6	1.00	0.015625	1.00
56	√	√	√	√	√	√	6	1.00	0.015625	1.00
57	-	-	√	√	√	-	3	0.50	0.3125	0.27
58	√	√	√	√	√	√	6	1.00	0.015625	1.00

Note: Items rated 3 or 4 on a 4-point relevant scale. S-CVI (Average)=0.93 (accepted)
I-CVI=item content validity index; Pc=Probability of chance agreement; S-CVI=scale content validity index

Overall, these eight dimensions of principal's innovation leadership model, namely: creative behavior; ideal influence; effective communication; empowerment and mentoring; technical skills; entrepreneurship; opening behavior; and closing behavior are in line with previous studies [34]–[38]. These leadership skills will influence the creative behavior of employees [34]. Leaders will encourage their followers to challenge existing situations and stimulate their intellectuals to find innovative solutions to existing problems. Meanwhile, leaders with effective communication will efficiently deliver the goals of innovation [35]–[37]. These excellent communication skills will encourage teachers to work as a team, collaborate in groups, and create networks between departments. Thus, promoting innovative behaviors among teachers and encouraging them to raise opinions in problem-solving. In technical skills, the ability of principals to procure experts during the implementation phase of innovation is necessary to promote innovation in education [38]. Leaders with excellent technical skills are critical to the innovation evaluation process [39]. Furthermore, leaders' opening and closing behaviors had a direct impact on team innovation [40]. Principals will use the opening behaviors as a motivator to increase innovation and at the same time use the closing behaviors to control the innovation process. These behaviors will affect the innovations performed by each unit in the organization [17].

4. CONCLUSION

This research produced 54 final items to assess eight dimensions of principal innovation leadership in Malaysian secondary schools. Furthermore, based on the results from the literature review and input from experts in education and management, the developed instruments were updated and changed. Thus, this instrument showed a high content validity, which is at 0.93. This result indicated that this instrument had met the requirements of the appropriate level of content validity. Nonetheless, researchers will enhance this instrument's reliability and validity to measure principal innovative leadership in schools.

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