

Innovation Management Model for Digital Classroom on Public Elementary Schools in Medan City

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Abstract. The purpose of this study is to analyse the effect of leadership style and intellectual capital on digital class innovation management. The approach used is ex post facto. The research sample was 200 school principals. The sampling technique used purposive sampling technique. The research data was collected using a questionnaire that has met the validity and reliability requirements. Validity testing refers to the indicators of each variable. Analysis of research data using structural equation model. The results prove that leadership style has a positive and significant effect on human capital, on structural capital, and on innovation management. Also human and structural capital has a positive and significant effect on innovation management. The results of this study indicate that leadership style encourages principals to utilise the knowledge, skills and digital resources needed to realise digital classroom innovation.

Keywords: leadership style, human capital, structural capital, innovation management, digital classroom

1 Introduction

The implementation of digital technology in schools has become a major requirement in school management in today's digital era. This includes the implementation of digital classroom innovation, in the form of the use of digital technology in learning. The development of education digitalisation in various forms such as the use of the Rumah Belajar platform, the learning teacher program and others nationally has been carried out by the government. The hope is to improve the quality of education, especially in facing the digital era. Education digitisation includes digital schools and digital classes. In the context of accessibility and equity of education, digital schools and digital classes can be used to reach students in different places. Students can access learning materials and interact with teachers online through online learning platforms. In addition, digital schools and digital classrooms can be used to provide more interactive and engaging learning. Students can learn by using various digital learning media, such as videos, animations and simulations. Teachers can use digital technology to deliver subject matter in a more engaging and interactive manner. Digital technology can also be used to monitor students' learning progress more easily. Digital schools and digital classrooms can be used to deliver subject matter more effectively and efficiently.

The digital classroom is one aspect of the digital school. To develop digital schools and digital classrooms in accordance with the potential and resources owned by each school, principals are responsible for improving the quality of learning. Digital schools are expected to be developed in the form of digital classrooms so that the utilisation of digital technology in the learning process can increasingly improve the quality of learning. The digital classroom can be used to deliver subject matter more effectively and efficiently. Teachers can use digital technology to deliver subject matter in a more interesting and interactive way. Digital technology can also be used to monitor students' learning progress more easily.

The results of the field study show that out of 382 public primary schools in Medan City, 24.08% of the schools have not implemented digital classrooms. In addition, there are 2,323 civil servant teachers. Of these civil servant teachers, there are still teachers who have never implemented the use of digital technology in the learning process. This shows that the development of the digital classroom has not been running optimally. There are several indicators that can be used to measure the non-optimal implementation of digital classes: there are various forms of digital classes. Only some schools have sufficient digital infrastructure, there is still teacher dependence on school policies in implementing digital classes. This means that schools prepare one classroom with adequate digital infrastructure facilities for the digital learning process. The use of digital classes is carried out alternately by students (digital classes are used on a moving class basis). Some schools place digital classes in certain study groups so that students who use digital classes do not take turns. In addition, for schools that do not have adequate digital infrastructure, digital classes are only sporadic, with the principal appointing several classes that are required to use digital media in learning. Other forms of digital classes are also carried out by giving teachers the freedom to improvise according to the teacher's ability and existing resources. This condition shows that the digital class as a school innovation in utilising digital technology in the learning process has not been well managed so that the management of digital class innovation is not well prepared in supporting quality learning. Planned and assisted use of technology can improve 21st century skills in students and even have a positive impact on other aspects [1]. Meanwhile, according to Zainil the use of technology accompanied by reflection and mentoring can provide students with opportunities to improve skills [2]. This reinforces that the implementation of digital classes in schools needs to be well prepared, designed, implemented and evaluated. This means that the management of digital classroom innovation must be well managed.

The diversity in implementing the digital classroom will be influenced by the preferences and perceptions of school principals in addressing the need to use digital technology in the learning process. While the use of digital technology is the main thing. The different capabilities and leadership styles of school principals in public primary schools in Medan City lead to different digital classroom management in each school. Principal leadership describes the school as an institution in the form of a process of influencing others within the scope of the school to work together in a productive way [3]. The principal's leadership style can influence the school's organisational culture, the motivation and participation of school members, and the school's ability to cope with change. Principals can condition and build processes, systems, and equip the required digital technology and utilise existing digital technology to implement digital classrooms in schools. In this context, the existing processes, systems and technologies in schools are structural capital. In accordance with the opinion that structural capital is a process, system, and technology that supports the creation and dissemination of knowledge [4]. Structural capital can help school organisations to improve efficiency, effectiveness and innovation [5] and [6]. In addition, the low knowledge of principals and teachers indicates a

lack of competence. The low use of digital learning media, digital learning models, indicates low experience. Competence, experience, knowledge are indicators of human capital. Human capital is human resources, namely principals, teachers and education personnel. The role of school principals as human capital in creating quality education is largely determined by the ability of their intellectual capital to transfer knowledge. This shows that the management of digital classroom innovation has not run optimally. The implementation of digital classes is carried out by each school and even each teacher because it is not well planned and designed. Based on the background of the problem above, the problems of this study are formulated as follows: 1) How is the innovation management model developed by public primary school principals in Medan City in implementing digital classrooms to support the learning process? 2) Do leadership style and intellectual capital affect digital classroom innovation management?

2 Literature Review

A digital classroom is a classroom that uses digital technology to support the learning process. The digital classroom uses digital devices, such as computers, tablets or smartphones, to deliver subject matter, interact with students and monitor students' learning progress. The digital classroom uses digital learning media, such as videos, animations and simulations, to deliver subject matter. Digital learning media can make learning more interesting and interactive. Digital classrooms can make learning more interactive. Students can interact with teachers and other students directly through digital devices. Students can learn from anywhere and anytime, as long as they have digital devices and internet connection. Digital classroom implementation needs to be carefully planned and implemented in order to achieve the expected benefits. The digital classroom activities include identifying digital technology needs according to learning needs, developing digital-based learning processes and implementing digital technology in the classroom to assist quality learning. This process implements innovation management.

Innovation management is the process of defining, developing, and implementing innovations [7]. Innovation management is a complex and dynamic process that involves various aspects, including strategy, organisation, and technology. Innovation management should focus on creating value for customers and other stakeholders [8]. The digital classroom focuses on the utilisation of digital technology in classroom learning. This technique creates a borderless classroom that allows students to explore knowledge freely without restrictions. The implementation of the digital classroom can improve student learning achievement as it provides access to a wider and more diverse range of learning materials, and can increase interactivity and personalisation of learning [9].

Digital classroom innovation management is the process of planning, implementing, and evaluating the implementation of digital classroom in schools [10]. Digital classroom innovation management aims to ensure that the implementation of digital classroom can run effectively and efficiently, and can achieve the goals that have been set. Digital classroom innovation management can be divided into several stages. In the planning stage, a needs analysis is carried out and a digital classroom implementation plan is prepared. Needs analysis is carried out to determine the needs of schools and students in implementing digital classes. The digital class implementation plan is prepared to set goals, objectives, strategies and steps for implementing digital classes. In the implementation stage, the implementation of digital classes is carried out in accordance with the plans that have been prepared. The implementation of digital classes can be carried out by teachers, students or other education personnel. At the evaluation stage, an

assessment of the implementation of digital classes is carried out. The assessment is carried out to find out whether the implementation of digital classes has achieved the stated objectives.

Leadership style is a pattern of behaviour used by a leader to influence, motivate, and direct his team members. According to Northouse leadership style is a pattern of behaviour used by leaders to influence their subordinates. In school organisations [11]. The leadership style is seen from the leader in the school, namely the principal. Conceptually, the principal's leadership style can be interpreted as a way or pattern used by the principal in influencing and directing school members to achieve school goals. This is in accordance with Utami that the principal's leadership style is the method used by the principal to influence the behaviour of school members in achieving school goals [12]. Meanwhile, another opinion was conveyed by Fitria), that the principal's leadership style is the principal's ability to influence and mobilise school members to achieve school goals [13]. The pattern of behaviour may vary, depending on the characteristics of the principal, the characteristics of the school community, and the situation faced by the school. Therefore, principals need to understand various leadership styles and choose a leadership style that suits the needs of the school. Principals need to develop person-centred and adaptive leadership styles. These leadership styles can help principals to lead the school effectively and achieve school goals. An effective principal's leadership style can improve school performance and job satisfaction of school members. The indicators used to measure the principal's leadership style refer to the opinion of Northouse [11], that the indicators of the principal's leadership style include: Task-oriented behaviour, which is the principal's behaviour in setting goals, planning and implementing work programs, and evaluating performance. People-oriented behaviour, which is the principal's behaviour in building positive relationships with subordinates, developing subordinates' motivation and morale, and creating a conducive work environment. Change-oriented behaviour, which is the principal's behaviour in dealing with changes and challenges, and developing innovations.

In general, intellectual capital is an intangible asset that can provide value to an organisation. Intellectual capital can be defined as the knowledge, information, and skills possessed by an individual, organisation, or society. Intellectual capital is the term given to the combination of intangible assets, intellectual property, employees, and infrastructure that enable an organisation to function [14]. Intellectual capital is a type of knowledge activity, the use of brain power, and fundamental or basic sources of organisational performance to achieve the organisation's goals [15]. Good intellectual capital management can help organisations to improve their performance and competitiveness. According to Sveiby [16], and Bontis [17],. Intellectual capital can be grouped into three categories, namely: Human capital: human resources that include knowledge, skills, and experience of employees. Structural capital: intangible assets resulting from business processes, such as processes, systems, and corporate culture. Relational capital: the relationships that exist between the company and its stakeholders, such as customers, suppliers, and business partners.

Conceptually, human capital is a combination of ability, motivation and leadership that exists in a person supported by the effectiveness of his work in the group so as to create value for an organisation. Human capital has four components, namely individual capability, individual motivation, leadership, and workgroup effectiveness [18], [19]. One indicator of human capital is the competence of Botis (2000). Competencies are professional competence and social competence [20]. Both professional competence and social competence can be measured by several approaches or indicators [20]. Human capital is a form of human resource management as valuable capital owned by the organisation and needs to be increased in value in order to

provide value to the organisation. Human capital has a function to design strategies that aim to build engagement, increase staff loyalty, and improve leadership skills. Human capital will also focus on the development of staff so that the function of human capital as a driver of the organisation periodically optimally.

Meanwhile, structural capital according to expert opinion is as follows: Structural capital is the processes, systems, and technologies that support the creation and dissemination of knowledge. They argue that structural capital can help organisations to improve efficiency and effectiveness by providing a framework for sharing and using knowledge [4]. Structural capital is an intangible organisational asset that facilitates efficient and effective actions and decisions [21]. Structural capital can help organisations to enhance innovation by providing the necessary infrastructure and processes to support creativity and experimentation. Structural capital will affect innovation capability and operational efficiency. High innovation capability can improve performance through improved service quality, increased customer satisfaction, and increased competitiveness. High capital operational efficiency can improve organisational performance through increased productivity. structural capital on innovation capability and capital operational efficiency and its implications for business performance found that structural capital has a positive influence on innovation capability and capital operational efficiency.

High innovation capability can improve business performance through improved product and service quality, increased customer satisfaction, and improved competitiveness. High capital operational efficiency can improve business performance through reduced production costs and increased productivity. Structural capital indicators can be classified into: organisational capability, network capability, process capability and knowledge capability [22]. This study shows hypotheses that have a positive and significant influence, namely: 1) leadership style on human capital, 2) leadership style on structural capital, 3) leadership style on innovation management, 4) human capital on innovation management, and 5) structural on innovation management.

3 Method

This research uses an ex post facto approach and in accordance with its objectives, the research is quantitative to test the effect of leadership style on human capital, test the effect of leadership style on structural capital, test the effect of leadership style on innovation management, test the effect of human capital on innovation management and test the effect of structural capital on innovation management. The object of research is the principal with a population of 382 people, the sample is taken using purposivesampling by considering the resources and digital infrastructure available in each school. The number of samples was 200 people. The variables in this study consist of independent variables of leadership style, intervening variables of human capital and structural capital and dependent variables of innovation management. Leadership style is measured by task-oriented leadership style, people-oriented leadership style, and change-oriented leadership style [11], Human capital is measured by knowledge, skills, experience and individual abilities [4], [12], [23], Structural capital is measured by organisational capability, network capability, process capability and knowledge capability [22]. Innovation management is measured by Planning, implementation and evaluation [9], [10]. All questionnaires have been declared valid and reliable with Cronbach's Alpha of 0.710 for leadership style, 0.853 for human capital, 0.833 for structural capital and 0.727 for innovation management. The collected data were analysed using variant-based structural equation

modelling using partial least squares with statistical tools. To test the hypothesis, path analysis was used. :

4 Results

To test the hypothesis, testing the significance of the influence between research variables is carried out before testing the hypothesis, first conducting a classical assumption test which includes data normality test and homogeneity test. The data normality test uses the Kolmogorof-Smirnov test (K-S test). The result of the Kolmogorov Smirnov (K-S) normality test is 0.056 with a significance level of 0.200 which is above $\alpha = 0.05$. Thus the data is normally distributed.

Homogeneity test is conducted to determine that the sample data group comes from a population that has the same variance. The data is said to be homogeneous if the significance of the test results > 0.05 , on the other hand, if the significance value < 0.05 means that the data is not homogeneous. The results of the homogeneity test calculation are shown in table 1.

Table 1. Homogeneity test

Variable	Levene Statistik	Sig.	Conclusion
Leadership Style	0,861	0,580	Homogen
Human Capital	1,735	0,069	Homogen
Structural Capital	1,415	0,169	Homogen

Based on the table above, it is known that the significance value of all research variables is > 0.05 . These results indicate that the homogeneity requirements of all variables are met.

Furthermore, for hypothesis testing using path analysis. The stages in path analysis include several analyses. The stages and results of the path analysis carried out are shown in the following description. The linearity test is seen from the Anova analysis results, by looking at the Sig value. Deviation from Linearity. Two variables are said to be linear if the Sig. Deviation from Linearity is greater than 0.05. The results of the linearity test will be presented in table 2.

Table 2. Linearity test

No.	Variable	F-test	Sig. Deviation from Linierity	Conclusion
1.	$X_1 \rightarrow X_2$	1,437	0,947	Linier
2.	$X_1 \rightarrow X_3$	1,017	0,435	Linier
3.	$X_1 \rightarrow X_4$	1,710	0,740	Linier
4.	$X_2 \rightarrow X_4$	1,031	0,419	Linier
5.	$X_3 \rightarrow X_4$	1,371	0,190	Linier

Based on the table above, it is known that the regression model for all research variables studied is linear and the significance value of Deviation from Linearity > 0.05 . This means that there is a linear relationship between the independent variables and the dependent variable so that the analysis can be continued.

Furthermore, path analysis is carried out to determine the direct effect between a set of variables. From the results of the calculation of the path coefficient, a path diagram can be drawn. Figure 1 is a picture of path analysis in this study:

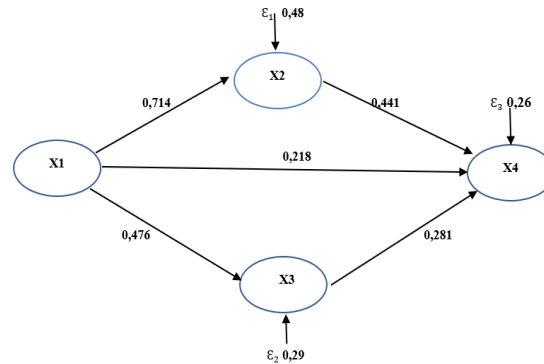


Fig. 1. Path Analysis

Based on the path analysis picture above, the path value coefficient and residual error are obtained below.

- $\rho_{X_2 X_1}$ = Path Coefficient of $X_1 \rightarrow X_2$ = 0.714
- $\rho_{X_3 X_1}$ = Path Coefficient of $X_1 \rightarrow X_3$ = 0.476
- $\rho_{X_4 X_1}$ = Path Coefficient of $X_1 \rightarrow X_4$ = 0.218
- $\rho_{X_4 X_2}$ = Path Coefficient of $X_2 \rightarrow X_4$ = 0.441
- $\rho_{X_4 X_3}$ = Path Coefficient of $X_3 \rightarrow X_4$ = 0.281
- ϵ_1 = Residual Error = 0.48
- ϵ_2 = Residual Error = 0.29
- ϵ_3 = Residual Error = 0.26

Based on the value above, the path equation is then formulated to determine the value of the path coefficient and its contribution to each variable. Based on the results of the path analysis, a Structural Equation Modeling (SEM) structural equation model was developed which allows researchers to examine the relationship between complex variables both recursive and non-recursive to obtain a comprehensive picture of the entire model.

The following is the calculation of path equation I

$$X_2 = \rho_{21}X_1 + \epsilon_1 \quad (1)$$

$$X_2 = 0,714 X_1 + 0,478 \quad (2)$$

The following is the calculation of path equation II

$$X_3 = \rho_{31} X_1 + \epsilon_2 \quad (3)$$

$$X_3 = 0,476 X_1 + 0,292 \quad (4)$$

The following is the calculation of path equation III

$$X_4 = \rho_{41}X_1 + \rho_{42}X_2 + \rho_{43}X_3 + \epsilon_3 \quad (5)$$

$$X_4 = 0,218 X_1 + 0,441 X_2 + 0,281 X_3 + 0,262 \quad (6)$$

The goodness of fit test is used to test the model used in the study. The goodness fit test determines the influence of leadership style, human capital and structural capital on innovation management. According to Ghozali, in SEM analysis, several statistical tests are used to

measure the level of suitability of the model in the study after the assumptions in SEM are met [24]. Below are the results of the goodness of fit test obtained through data analysis.

Table 3. Goodness of Fit of SEM Model

No.	Criteria	SEM Model	Cut of Value	Evaluation
1.	Chi-square	167,441	Small	Good
2.	χ^2 significance probability	0,108	≥ 0.05	Good
3.	GFI	0,918	≥ 0.90	Good
4.	AGFI	0,893	≥ 0.90	Marginal
5.	TLI	0,945	≥ 0.90	Good
6.	RMSEA	0,028	≤ 0.08	Good
7.	CFI	0,953	≥ 0.95	Good
8.	CMIN	1,147	≤ 2.00	Good

The results above indicate that all tests in the overall model feasibility test are good. The values of the chi-square, probability, GFI, TLI, RMSEA, CFI, CMIN criteria are good and the AGFI criteria are at marginal values. Thus, based on several results of the Goodness of Fit test, this research model meets and based on these results, the research hypothesis test is then carried out. Hypothesis testing is carried out using path analysis. The criteria for accepting and rejecting the hypothesis are seen from the critical ratio (CR) value at a significance of <0.05 . The basis for making decisions on hypothesis testing is: the hypothesis is accepted if the p-value \leq alpha 0.05, and if the p-value $>$ alpha 0.05, then the hypothesis is rejected.

Table 4. Hypothesis Test

No.	Variable	Estimate	S.E.	C.R.	P value
1.	HC \leftarrow GP	2,144	,535	4,011	0,00
2.	SC \leftarrow GP	,623	,156	3,984	0,00
3.	MI \leftarrow GP	,407	,100	4,072	0,00
4.	MI \leftarrow HC	,318	,087	3,645	0,00
5.	MI \leftarrow SC	,398	,068	5,859	0,00

Based on the results of the data analysis shown in table 5, it is known that the CR (Critical Ratio) value between leadership style and human capital is 4.011 with a p value of 0.00. Based on these results, the hypothesis is accepted. This means that statistically there is a positive and significant influence between leadership style and human capital. Thus, the hypothesis states that there is a positive and significant influence between leadership style and human capital. The CR (Critical Ratio) value between leadership style and structural capital is 3.984, with a significance level of 0.00. Based on these results, the hypothesis is accepted. This means that statistically there is a positive and significant influence between leadership style and structural capital. Thus, the hypothesis states that there is a positive and significant influence between leadership style and structural capital is accepted.

And the CR (Critical Ratio) value between leadership style and innovation management is 4.072, with a significance level of 0.00. These results prove that the research hypothesis is accepted. This means that statistically there is a positive and significant influence between leadership style and innovation management. Thus, the hypothesis stating that there is a positive and significant influence between leadership style and innovation management is accepted.

The CR (Critical Ratio) value between human capital and innovation management is 3.645, with a significance level of 0.00. This result proves that the research hypothesis is accepted. This means that statistically there is a positive and significant influence between human capital and innovation management. Thus, the hypothesis stating that there is a positive and significant influence between human capital and innovation management is accepted. Meanwhile, the CR (Critical Ratio) value between structural capital and innovation management is 5.859, with a significance level of 0.00. This result proves that the research hypothesis is accepted. This means that statistically there is a positive and significant influence between structural capital and innovation management. Thus, the hypothesis stating that there is a positive and significant influence between structural capital and innovation management is accepted.

5 Discussion

The results of data analysis to test the first hypothesis (H1) show that the magnitude of the influence of leadership style on human capital is 71.4%. The results of this study are in line with Dirgayasa's research that transformational leadership style has a positive and significant influence on human capital [25], [26]. The higher the leadership style, the higher the human capital. Therefore, the principal as a leader really needs to develop a leadership style according to the needs and situations that surround him so that human capital in the form of knowledge, experience, motivation and competence of school members can develop. Thus, the principal has an important role in increasing knowledge, experience, motivation and competence.

The results of data analysis to test the second hypothesis (H2) show that the magnitude of the influence of leadership style on structural capital is 47.6%. Transformational leadership style has a positive and significant effect on structural capital [27], [28]. The higher the leadership style, the more it will increase. Structural capital. Therefore, by improving the leadership conditions of the principal in the organization, structural capital increases. Thus, the principal has an important role in increasing structural capital, both organizational capital and technological capital. Organizational capital includes digital infrastructure and school management processes. While technological digital includes school development and innovation, especially knowledge and intellectual property [29].

In addition to the above, the results of data analysis to test the third hypothesis (H3) show that the magnitude of the influence of leadership style on innovation management is 21.9%. Leadership style has a positive and significant influence on innovation management. The results of this study are in line with Łukowski's opinion, that various stages in innovation management and various types of innovation require different leadership [30]. Different leadership styles will produce different innovations as well.

Furthermore, the results of data analysis to test the fourth hypothesis (H4) show statistical results with path analysis that the weight of the influence between human capital and innovation management is 44.1%. The results of the study that human capital has a positive and significant influence on innovation management are in line with the research of Kusumawijaya & Astuti [31]. The potential value of human capital can be utilized to develop school innovation capabilities. Good human capital management practices will also have a good impact on innovation growth capabilities in schools. Thus, the success of human capital management will determine the success of innovation capabilities.

The last is the fifth hypothesis (H5). The weight of the influence between structural capital and innovation management is 28.1%. The results of this study support previous research that structural capital that is strengthened by solid structures, systems, and processes produces a positive effect on the innovation process [32]. Structural capital will increase knowledge about digital technology. And structural capital is able to increase innovation competence. Greater resources are needed to develop technology internally. Schools need time to get to know, learn and utilize new technology and IT through learning and adoption. Technology and IT will lead to school innovation.

6 Conclusion

Based on the results of data analysis and hypothesis testing, several conclusions can be formulated that the significant value indicated by the p-value to test all research hypotheses is 0.00 which is below the alpha value = 0.05. These results prove that all research hypotheses are accepted. This means that leadership style has a positive and significant effect on human capital, on structural capital, and on innovation management. Also human and structural capital has a positive and significant effect on innovation management.

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