


# Technological Intelligence as an Intervening Effect of Knowledge Management and Intellectual Capital for Enhancing Competitive Advantage in Educational Institutions

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ARTICLE INFO	ABSTRACT
<p><b>Article history</b> Received Dec 18, 2025 Revised March 23, 2025 Accepted June, 21, 2025</p> <p><b>Keywords</b> Knowledge Management Intellectual Capital Technological Intelligence Competitive Advantage Educational Institutions</p>	<p>The urgency in managing information in nowadays digital century, the goal of management is to increase the productivity of knowledge workers and knowledge work by using the most valuable resource in the form of intellectual capital in the knowledge management process. This research examines the role of technological intelligence as an intervening variable between the influence of knowledge management and intellectual capital on the competitive advantage of educational institutions using a correlational quantitative research design with a research population of educators and educational staff at Upper Secondary Education (<i>Madrasah Aliyah</i>, Senior High Schools, and Vocational Schools) in Malang City, East Java, Indonesia. Data collection used a simple random sampling technique by questionnaires distribution to 376 respondents in 25 schools. Data analysis uses the SmartPLS4 application by testing correlation and analyzing paths in the form of Partial Least Square Structural Equation Modeling (PLS-SEM). The results show that knowledge management and intellectual capital have a significant positive effect on the competitive advantage of educational institutions. Furthermore, technological intelligence is proven to mediate knowledge management and intellectual capital's connection to competitive advantage. These findings indicate that the effective use of information and communication technology can strengthen knowledge management and intellectual capital contribution in increasing competitiveness of educational institutions. The implications of this research highlight the concern of investing technological intelligence, developing a culture of knowledge sharing, and optimizing intellectual assets to achieve competitive advantage in the educational institutions.</p> <p style="text-align: right;">This is an open access article under the <a href="#">CC-BY</a> license.</p> 

## I. Introduction

The determining factors for competitive advantage and the pillars of a nation's development are the quality of education and human resources. Education has always been an important aspect in various rankings of various countries' competitive advantages, like the 2023 Program for International Student Assessment (PISA) study, which showed that Indonesia's literacy skills are ranked 67th out of 81 countries (Kemdikbudristek, 2023). Indonesia's Human Development Index (HDI) is a developing country in terms of three basic areas of human development (life expectancy, illiteracy rate, and applicable standard of living), with a value of 0.75, where the classification of developed countries is above 0.80 (bps.go.id, 2024; kumparan.com, 2024). Likewise, with the Global Competitiveness Index (GCI), Indonesia must maximize the availability, readiness, and quality of human resources

(HR) in various sectors (Nadya, Damia, & Riza, 2020). In the current era of digitalization, educational institutions are required to create superior students as a generation of quality and globally competitive human resources.

Based on research searches for the last three years, assisted by connectedpapers.com and openknowledgemaps.org search engines regarding competitive advantage, most previous research examined the performance of organizations in the economic, business, and other corporate sectors. Research in recent years applies to higher education institutions and links competitive advantage to the role of humans in carrying out knowledge management (Ayyappan, 2022; Khatun, Sarmah, & Dar, 2022), human talent management (Pérez-León, Álvarez, & Jiménez, 2024), new student admissions strategy (Putri, 2024), intellectual capital management (Widyadipraja & Kusumawardhani, 2024), total quality

management (Benchelef, 2024; Skýpalová, Chládková, Nwachukwu, & Vu, 2024), and what is interesting is associated with technology or artificial intelligence (Selitskiy & Inoue, 2024) in today's digital era. Research in the field of education, especially in the context of upper secondary education institutions such as Senior High Schools (SMA) and Vocational High Schools (SMK) under the auspices of the Ministry of Education and Culture, and Madrasah Aliyah (MA) is Islamic Senior High Schools under the auspices of the Ministry of Religion, is still relatively limited. Apart from that, research related to technological intelligence has only been discussed partially, and no research has been found that considers the role of technological intelligence as an intervening variable that can strengthen the relationship between intellectual capital and knowledge management on the competitive advantage of educational institutions. This research gap is a chance to deepen the study of how the synergy between technological intelligence, knowledge management, and intellectual assets can strategically impact educational institutions in the digital era, especially secondary education institutions in Malang City.

Since 1962, Malang City has been known as a city of education. More than fifty universities and over a hundred high schools (MA, SMA, and SMK) in Malang City (Hamamah, 2023; Pemerintah Kota Malang, 2024), so data collection in Malang City can represent schools from other educational cities in Indonesia. Malang City can potentially become a model of superior education in Indonesia (blog.teknokrat.ac.id, 2024; Pemerintah Kota Malang, 2024). The choice of research at upper secondary education levels (MA, SMA, and SMK) was due to the heterogeneous nature of educational institutions. Stable heterogeneity over time is one of the characteristics of resources or capital that can create a competitive advantage if managed well as a strategic resource (Barney, 1991). Each educational institution has its superior resources, so together they can improve the quality of students in line with the expectations of students, parents, society, and the demands of employment or industry in general.

The theory of competitive advantage is relevant when it is related to educational institutions because it is related to positive competition in the context of improving the quality of academic institutions in the local, national, and international domains. Porter introduced Competitive advantage as a theory that answers market competition in this global era and industrialization in the form of a company's ability to create superior value that differentiates it from competitors. This theory emerged as a strategy for effectively and efficiently utilizing internal resources to create exceptional value for marketing, so that the products or services produced are more valuable than the operational costs incurred (Porter, 1985). This theory can be applied as educational institutions face competitive challenges from local, national, and international

competition. Indonesia keeps working to raise academic standards with a "Merdeka" Curriculum (kemdikbud.go.id, 2024). This curriculum aims to catch up with Indonesia's educational lag (learning loss), producing qualified and highly competitive (Badan Standar, Kurikulum, dan Asesmen Pendidikan, 2024).

Several aspects mentioned in previous research are efforts to face global challenges in managing the diverse resources to establish a competitive advantage for educational institutions. This competitiveness can be assessed based on quality educational services, expectations of students, parents, industry, or society as a reference, and the attractiveness of quality educational institutions (Bashori, 2017; Skýpalová, Chládková, Nwachukwu, & Vu, 2024), because all citizens are entitled to high-quality educational services (Imron, 2016). Several problems can hinder improving the quality of educational institutions, one of which is the capabilities of educators that are not yet in line with industry needs, less reliable in managing facilities, pedagogical abilities, and so on, so that management of competent educational resources in the knowledge management process is essential (Meirani, Sobri, & Sunarni, 2022).

Knowledge management is an institution's holistic capability to discover new insights (knowledge-creation), spread them (knowledge-sharing) through the institution, and materialize them in services, products, and systems as the key to organizational success in continuous innovation (Nonaka & Takeuchi, 1995). Knowledge management implementation can be used in various sectors, including education (Al-Ahbab, Singh, Balasubramanian, & Gaur, 2019). Knowledge management is a practice that focuses on collecting, storing, using, and sharing knowledge within an institution, with the appropriate individuals at the proper moment to develop effective and efficient policies that provide value to the institution (APQC, 2023).

Conceptually, knowledge management and intellectual capital are interrelated (Easterby-Smith & Prieto, 2008). Intellectual capital is a population that can provide all their potential (intellectuality, knowledge, data, information, experience, originality, and everything that can enhance the institution's welfare) to achieve competitive advantage for their organization (Stewart, 1997). Intellectual capital is a set of intangible assets in the form of organizational members' competencies, resources, and capabilities that can improve organizational accomplishments and create organizational value (Edvinsson, 1997). It can also be considered a determining variable in improving organizational performance and sustainable competitive advantage (Rehman, Bresciani, Ashfaq, & Alam, 2022). Effective implementation of knowledge management can increase an organization's competitive advantage and develop intellectual or human resource expertise (Mahdi, Nassar, & Almsafir, 2019) because knowledge is one of

the unique resources needed to win the competition (Mulyanto, 2008).

What cannot be avoided after the COVID-19 pandemic era, nowadays, we face digitalization in every sector, especially educational institutions, to achieve a competitive advantage, is the implementation of technological intelligence (Rabillo & Rotich, 2018; Selitskiy & Inoue, 2024). Technological intelligence is an organization's capability to utilize technological infrastructure effectively to achieve organizational goals (Davenport & Prusak, 1998). Mastery of information technology in educational institutions, in this case, a teacher who effectively adapts several new technologies (such as learning software) in his teaching, will be able to demonstrate the use of this technology to students and use it proactively (Nisa, Sobri, & Imron, 2023). Technology is necessary to utilize knowledge well through various networks, but it is not enough to be said to be the main achiever of success in knowledge management efforts in organizations (Saint-Onge & Armstrong, 2004). The rapid advancement of technological information in various business and social domains requires technological intelligence to adapt. This can affect the loss of organizational members' knowledge bases because, as time passes and circumstances change, each individual's knowledge will become outdated. So, technological intelligence is needed to expand and update individual knowledge to remain relevant to an ever-changing environment and have a competitive advantage (Gurteen, 1999).

Research exploring the connection between the competitive advantage of educational institutions, intellectual capital management, and the application of knowledge management, with technological intelligence as an intervening variable, is still limited, especially in Indonesia. This gap is an opportunity to conduct research that can provide practical and theoretical contributions to educational institutions in Malang City, especially upper secondary education (MA, SMA and SMK) as institutions that must prepare graduate students with various choices, provide multiple motivations, and give a view of the consequences of the choices that will be taken. The urgency of this study is based on the need to enhance the competitiveness of upper secondary education in Malang City so that these schools can compete at regional and national levels and face the challenges of the times more adaptively and innovatively. Hopefully, this study can make a real contribution to developing competitive advantage theory, knowledge management practices, intellectual management practices, and the technology used in educational institutions in Indonesia. The variables that will be researched can be used as reference material in deciding policies and executing activities of academic institutions.

## II. Method

According to Creswell, this study applies a quantitative method that lets researchers gather data numerically. (2009), the focus of quantitative research is on collecting numerical data that can be calculated using statistical techniques and then explained to explain certain phenomena by testing objective theories and analyzing relationships between variables. In this study, there are four variables: knowledge management (X1), intellectual capital (X2), technological intelligence (M), and competitive advantage (Y).

Population is a data source in specific research with a large number and is broad regarding who will be researched and how much (Darmawan, 2019). In this study, the population used was all teachers who taught at upper secondary level schools (SMA, MA, and SMK) in Malang City, with a total of 3.474 teachers.

The following is data on teachers in Malang City based on data sources from BPS Malang City (BPS Kota Malang, 2023) and Basic Data on Teacher Education for Malang City in 2023-2024 (dapo.kemdikbud.go.id, 2024).

Table 1. Research Population

No	School Type	Units	Teacher Population
1	MA	24	507
2	SMA	47	1.191
3	SMK	52	1.776
Total		123	3.474

The Slovin formula is utilized to limit the sample size in this study, because according to Setiawan (2007), this formula can be used to measure the proportion of the population as a whole, assumes a level of reliability with a standard distribution approach, and there is still freedom in determining the limit of the estimation error value. Slovin's formula is as follows:

$$n = \frac{N}{1+N(e)^2} \rightarrow 359 = \frac{3.474}{1+3.474(0.05)^2}$$

Where:

N = total population

n = number of research samples

e = error tolerance limit

The total population in this study was 3,474 teachers, and the significance level was determined at 0.05 or an error limit of 5%. Sugiyono states (2018) that 5% to 10% is the maximum error rate for social science research that can be tolerated. Thus, the study's minimal sample size was 359 teachers. Survey techniques gathered data by sending questionnaires (Creswell, 2009) to 25 public and private educational institutions in Malang City (MA, SMA, and SMK) to collect data about technological intelligence, intellectual capital, knowledge management, and competitive advantage in educational institutions.

Quantitative data analysis methods will be used to examine the collected data using the SmartPLS4 statistical calculation application to test and understand the relationships between independent, dependent, and intervening factors using descriptive, correlation, and mediation analysis.

### III. Results and Discussion

Considering the data collection at upper secondary education (MA, SMA and SMK) in Malang City, a total of 376 respondents were obtained with the following categories: women 60%; age range 31 to 40 years 33%; teaching experience within a period of 5 to 15 years as much as 51%; and ASN status is at most PPPK 29% and PNS 23%, the rest are non-PNS teachers.

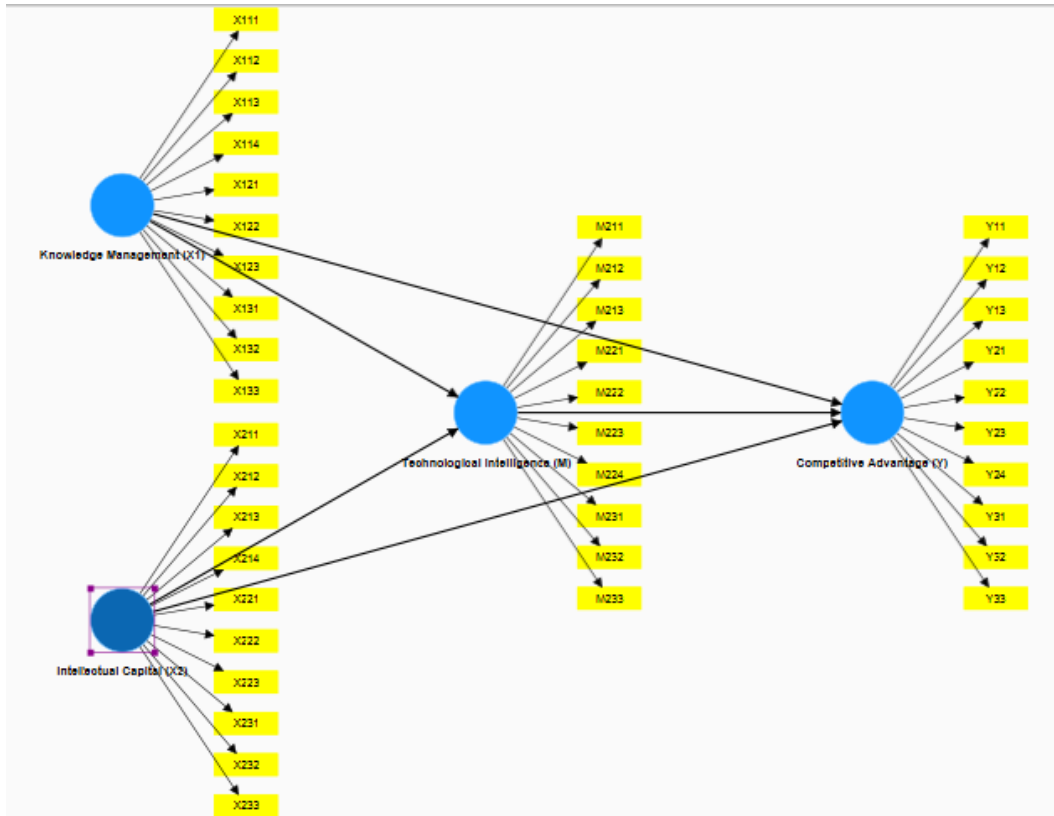


Fig 1. PLS-SEM Path Model

#### A. Model of Measurement (Outer Model)

##### 1) Test for Data Validity and Reliability

Based on data analysis using Partial Least Squares-Structural Equation Modeling (PLS-SEM) on 376 respondents representing upper secondary education levels (MA, SMA, SMK) in Malang City, the evaluation of the PLS-SEM measurement model includes reliability, discriminant validity, and convergent validity testing. Convergent validity is tested using outer loading and AVE (average variance extracted) values; discriminant validity is tested by comparing the root of AVE to the correlation between variables; and reliability is assessed using composite reliability values (Hair, et al., 2021).

Table 2. Measurement Model Criteria

Parameters	Criteria
Outer Loadings	above 0.5
AVE	above 0.5
Cronbach's Alpha	above 0.6
Composite Reliability	above 0.6
Discrimination Validity	AVE square root > correlation values

The following are the consequences of measuring each item's reliability and validity on knowledge management, intellectual capital, competitive advantage, and technological intelligence variables.

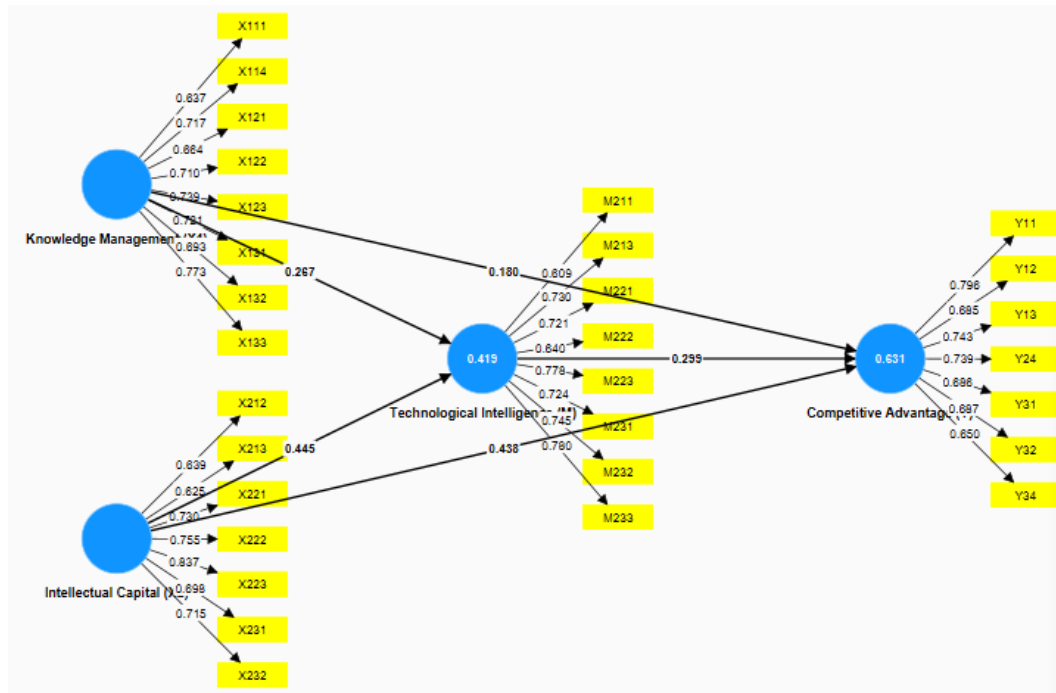


Fig 2. Outer Loading Values More Than 0.5

All variables were measured using valid indicators with the outer loading values between 0.609 and 0.837, showing that the measurement items have a strong relationship in explaining each variable. According to Hair et al. (2021), an outer loading value above 0.50 can meet the convergent validity requirements.

Table 3. Results of the Measurement Model

Constructs	Cronbach's Alpha	CR	AVE	Decision
Knowledge Management (X1)	0.858	0.889	0.501	Valid and reliable
Intellectual Capital (X2)	0.841	0.880	0.514	Valid and reliable
Technological Intelligence (M)	0.865	0.894	0.516	Valid and reliable
Competitive Advantage (Y)	0.838	0.879	0.509	Valid and reliable

Table 3 shows that these constructs are valid and reliable. Based on the results of the AVE calculation, all variables show values of more than 0.5, so it can be said that all convergent indicators explain substantial variance in forming their respective variables. Apart from that, the Cronbach's Alpha and Composite Reliability have a value of more than 0.6 for all variables, which shows the consistency of this construct. So, it can be concluded that all variables used in this research meet validity and reliability in variable measurement.

Table 4. Discriminant Validity

	Competitive Advantage (Y)	Intellectual Capital (X2)	Knowledge Management (X1)	Technological Intelligence (M)
Competitive Advantage (Y)	0.870			
Intellectual Capital (X2)	0.713	0.751		
Knowledge Management (X1)	0.772	0.708	0.610	
Technological Intelligence (M)				

Evaluation of discriminant validity can be seen through the Heterotrait-Monotrait (HTMT) criteria, where discriminant validity is a form of assessment that ensures the variables studied are proven theoretically different and proven empirically through statistical testing. The HTMT criteria are met if the AVE root of the variable is greater than the correlation between variables (Hair, et al., 2021). Based on the statistical analysis results, the competitive advantage variable has an AVE root (0.870), which is bigger than the correlation of the other four variables, so it can be said that the competitive advantage's discriminant validity is valid. The strongest correlation is 0.870 between intellectual capital and the competitive advantage of educational institutions, while the lowest is 0.610 between technological intelligence and knowledge management. This confirms that the variables do not overlap significantly, thus ensuring proper and reliable analysis.

2) *Multicollinearity Test*

Table 5. Collinearity Statistics (VIF)

	VIF
Knowledge Management (X1) → Technological Intelligence (M)	1.659
Intellectual Capital (X2) → Technological Intelligence (M)	1.659
Knowledge Management (X1) → Competitive Advantage (Y)	1.781
Intellectual Capital (X2) → Competitive Advantage (Y)	2.000
Technological Intelligence (M) → Competitive Advantage (Y)	1.721

The multicollinearity is intended to see the correlation between each variable. A good regression model should not correlate with the independent variables (Ghozali, 2005). The quantity that can be used to detect multicollinearity is the variance inflation factor (VIF). The measurement results show that the inner VIF value is less than 5, meaning that all direct relationships between variables have no multicollinearity problems or can be said to be unbiased.

B. *Structural Model (Inner Model)*a) *Fit Test*

Table 6. R-Square

	R <sup>2</sup>	R <sup>2</sup> -adjusted
Competitive Advantage (Y)	0.631	0.628
Technological Intelligence (M)	0.419	0.416

A statistical model's goodness of fit test indicates how well it matches a collection of observations. The goodness of fit index summarizes the discrepancy between actual and predicted values in a statistical model. Using the coefficient of determination, the Goodness of Fit test determines whether the data used to quantify the connection between variables is reliable. The model suitability test shows that the R-Square values for the competitive advantage (Y) and technological intelligence (M) are 0.628 and 0.416, respectively.

In the R-Square, the variable Y shows a value of 0.628, which shows that the contribution of knowledge management (X1), intellectual capital (X2), and technological intelligence (M) to school competitiveness or competitive advantage (Y) is 62,8%, so it is 37,2% is influenced by other indicators that not listed in this research. According to Chin (1998), this value is categorized as substantial or strongly influenced. Likewise, the R-Square on the sharing knowledge culture (M) variable shows that the knowledge management variable (X1) makes a relatively high contribution, namely 41,6%, to the technological intelligence (M) variable.

Table 7. F-Square

	f <sup>2</sup>
Knowledge Management (X1) → Technological Intelligence (M)	0.074
Intellectual Capital (X2) → Technological Intelligence (M)	0.206
Knowledge Management (X1) → Competitive Advantage (Y)	0.049
Intellectual Capital (X2) → Competitive Advantage (Y)	0.260
Technological Intelligence (M) → Competitive Advantage (Y)	0.141

The result of the F<sup>2</sup> effect size (F-squared) is used to assess the relative impact of exogenous variables on endogenous variables. According to Cohen (1998), the criteria for an F-squared value = 0,02 means small or bad, an F-squared value = 0,15 means medium, and an F-squared value = 0,35 means good. Based on table 7 above, it can be concluded that the magnitude of the influence of the direct relationship is; (1) there is a small influence, namely 0.049 between Knowledge Management and Competitive Advantage, (2) there is a small influence, namely 0.074 between Knowledge Management and Technological Intelligence, (3) there is a moderate influence, namely 0.260 between Intellectual Capital and Competitive Advantage, (4) there is a moderate influence, namely 0.206 from Intellectual Capital and Technological Intelligence, (5) there is a moderate influence, namely 0.141 from Technological Intelligence towards Competitive Advantage.

C. *Hypothesis Testing*1) *Analysis of Direct and Indirect Relationships*

All results of measuring direct relationships between variables show a positive relationship assessed from the path coefficient results, and significant assessed from a significance level below 0.05 (95% confidence) and a t-statistic greater than 1.96, as follows: knowledge management has a substantial and favorable impact on technological intelligence (path coefficient=0.267; p-values=0.000<0.05; t-statistic=4.999>1.96); there is a positive and significant influence of Intellectual Capital on Technological Intelligence (path coefficient=0.445; p-values=0.000<0.05; t-statistic=8.535>1.96); there is a positive and significant influence of Knowledge Management on Competitive Advantage (path coefficient=0.180; p-values=0.002<0.05; t-statistic=3.057>1.96); there is a positive and considerable influence of Intellectual Capital on Competitive Advantage (path coefficient=0.438; p-values=0.000<0.05; t-statistics=6.313>1.96); and there is a positive and significant influence of Technological Intelligence on Competitive Advantage (path coefficient=0.299; p-values=0.000<0.05; t-statistics=5.995>1.96). Overall, the direct relationship hypothesis is accepted.

Table 8. Direct Relationship Analysis

	<b>Path Analysis Model</b>	<b>Original Sample (O)</b>	<b>Sample Mean (M)</b>	<b>Standard Deviation (STDEV)</b>	<b>T Statistics ( O/STDEV ) (&gt;1.96)</b>	<b>P Values (&lt;0.05)</b>	<b>Sig. Decision</b>
H1	Knowledge Management (X1) → Technological Intelligence (M)	0.267	0.269	0.053	4.998	0.000	Accepted
H2	Intellectual Capital (X2) → Technological Intelligence (M)	0.445	0.448	0.052	8.535	0.000	Accepted
H3	Knowledge Management (X1) → Competitive Advantage (Y)	0.180	0.179	0.059	3.057	0.002	Accepted
H4	Intellectual Capital (X2) → Competitive Advantage (Y)	0.438	0.442	0.069	6.313	0.000	Accepted
H5	Technological Intelligence (M) → Competitive Advantage (Y)	0.299	0.298	0.050	5.995	0.000	Accepted

<sup>a</sup> (Note: P value < 0.05 and T statistics > 1.96)

Table 9. Indirect Relationship Analysis

	<b>Path Analysis Model</b>	<b>Original Sample (O)</b>	<b>Sample Mean (M)</b>	<b>Standard Deviation (STDEV)</b>	<b>T Statistics ( O/STDEV ) (&gt;1.96)</b>	<b>P Values (&lt;0.05)</b>	<b>Sig. Decision</b>
H6	Knowledge Management (X1) → Technological Intelligence (M) → Competitive Advantage (Y)	0.080	0.080	0.021	3.794	0.000	Accepted
H7	Intellectual Capital (X2) → Technological Intelligence (M) → Competitive Advantage (Y)	0.133	0.133	0.028	4.785	0.000	Accepted

<sup>b</sup> (Note: P value < 0.05 and T statistics > 1.96)

Based on table 9, it shows that all indirect relationships between variables are positive and significant, namely the variable X1 → M → Y is 0.080 (positive) and 0.000<0.05; 3,794>1.96 (significant), which means that the Technological Intelligence (M) variable plays a role in mediating the influence of Knowledge Management variable (X1) to the Competitive Advantage variable (Y).

Likewise, variable X2 → M → Y is 0.133 (positive) and 0.000<0.05; 4,785>1.96 (significant), which means that the Technological Intelligence (M) variable plays an intervening role in mediating the influence of the Intellectual Capital variable (X2) on the Competitive Advantage (Y) variable.

#### D. Discussion of Direct Relationship Analysis

Based on the results of the calculation of Technological Intelligence as an intervening influence of Knowledge Management and Intellectual Capital on the Competitive Advantage of Educational Institutions at MA, SMA and SMK in Malang City, the first finding (H1) shows that there is a positive and significant influence of the Knowledge Management variable on the Technological Intelligence variable (coefficient path= 0.267; p-values= 0.000<0.05; t-statistic= 4.999>1.96). This shows that

knowledge management in educational institutions is closely related to the use of technological intelligence in the context of modern educational institutions. According to Jarrahi, Askay, Eshraghi, & Smith, (2023) applying knowledge management integrated with technological intelligence is an effective strategy to help organizations achieve their goals. Knowledge management helps adapt existing technology in an institution to increase efficiency, such as speeding up access to information content and required expertise, so that technology better supports daily work and helps align with what employees and customers need (O'Dell & Davenport, 2023). Knowledge management membantu meningkatkan kinerja lembaga dengan memperkuat proses pembelajaran internal melalui teknologi, seperti jaringan komunikasi elektronik, repositori pengetahuan, dan portal lembaga (Machadoa, Secinarob, Calandra, & Lanzalongab, 2022). According to Loisa (2016), knowledge management helps improve institutional performance by strengthening internal learning processes through technology, such as electronic communication networks, knowledge repositories, and institutional portals.

The results of the second direct relationship analysis (H2) show that there is a positive and significant Intellectual Capital on Technological Intelligence (path coefficient= 0.445; p-values= 0.000<0.05; t-statistic=

8.535>1.96), which shows that intellectual capital has an essential influence on technological intelligence. Intellectual capital includes knowledge, abilities, intellectual property rights, and experience that individuals possess in an organization (Stewart, 1997). Effective and efficient intellectual capital management can increase technological orientation in decision making and management (Dinu, 2022). According to Secundo et.al. (2020), human capital, structural capital, and relational capital contained in intellectual capital can be the basis for increasing technological development, primarily to support quality education, infrastructure, health, city development, and accelerating SDG achievement.

In the third finding (H3), there is a positive and significant influence of Knowledge Management on Competitive Advantage (path coefficient= 0.180; p-values= 0.002<0.05; t-statistics= 3.057>1.96). Knowledge management is a set of processes for discovering and disseminating knowledge assets to optimize the use of human resources, which is meaningful for individuals and organizations in increasing competitive advantage (Nurcahyo & Sensuse, 2019). Mulyanto (2008) revealed that knowledge is one of the unique resources needed to win the competition. A wise organization is an organization that can safeguard the various interests of members who seek to increase competence and experience, so that the organization also develops through mechanisms for increasing collective intelligence and employee skills to achieve an organizational knowledge-based competitive advantage (Mubarok, 2017; Reno, 2024). According to Rasyid et al. (2021), implementing knowledge management strategies in educational institutions has a positive effect on the competitive advantage of institutions, as indicated by the performance of academic institutions and human relations between staff and students.

Furthermore, in the result of the fourth direct relationship analysis (H4), there is a positive and significant influence of Intellectual Capital on Competitive Advantage (path coefficient= 0.438; p-values= 0.000<0.05; t-statistics= 6.313>1.96). Intellectual capital, namely invisible capital, in the form of human capital, institutional structural capital, and relationship capital owned by an institution has a vital role in creating a competitive advantage for an institution in a positive competitive atmosphere in the form of highlighting its uniqueness or added value (Khoiriyah & Yuliana, 2018) and improving institutional value creation processes, such as increasing reputation and innovation (Naseem, Battisti, Salvi, & Ahmad, 2024; Alkhatib & Valeri, 2024). Intellectual capital considers knowledge as rare and difficult to transfer and imitate by others, which is an essential resource for achieving competitive advantage in the face of competition. The ability and effectiveness of an organization in creating, processing, sharing, and conveying knowledge and information determines the value obtained by the organization as a basis for assessing

the organization's sustainable competitive advantage in the long term (continuous improvement) (Khoiriyah & Yuliana, 2018).

The fifth direct relationship analysis (H5) result shows there is a positive and significant influence of Technological Intelligence on Competitive Advantage (path coefficient= 0.299; p-values= 0.000<0.05; t-statistics= 5.995>1.96), which shows that the use of technology is effective and can efficiently increase the competitive advantage of educational institutions. In the digital transition era from 4.0 to 5.0, all business fields use technology to increase competitive advantage (Amalia, et al., 2024). Investment in information technology and integrating information systems with business strategy significantly contributes to a company's success in competing in the global market (Jannah & Firdaus, 2024). Technological Intelligence is a strategic ability to create and maintain an organization's competitive advantage (Zack, 1999); apart from that, it can support the emergence of creativity and innovation in the organization, which impacts achieving competitive advantage (Zieba, Durst, Foli, & Gonsiorowska, 2024).

Analysis of indirect relationships shows that all relationships have a positive and significant effect. In H6, the analysis of the influence of knowledge management on competitive advantage through technological intelligence shows positive results seen from the path coefficient (0.080) and significant from the p-values (0.000<0.05) and t-statistics (3.794>1.96), which means the Technological variable Intelligence plays a role in mediating the influence of the Knowledge Management variable on the Competitive Advantage variable. According to Shujahat et al. (2019), to improve the quality of an organization's competitive advantage, primary attention needs to be given to increasing the productivity of knowledge workers through the creation and utilization of knowledge with the help of technology and systems such as Big Data and information technology. Taqorub et al. (2018) also stated that implementing knowledge management regarding teacher professionalism, recruitment processes, and mastery of information and communication technology positively influences educational institutions' competitive advantage or quality. Support for technological intelligence variables in the implementation of knowledge management, such as technological infrastructure, the use of technology in innovation, and the use of technology in knowledge sharing or organizational learning activities, can build the competitive advantage of educational institutions (Lartey, Kong, Afriyie, Santosh, & Bah, 2021; Machado, Secinaro, Calandra, & Lanzalongab, 2022). Big data-based technological intelligence is also a link between knowledge management and storing knowledge as a data source for rational decision-making to improve institutional performance, which leads to institutional competitive advantage. (Bag, Gupta, Kumar, & Sivarajah, 2021)

Likewise, technological intelligence as an intervening influence of the intellectual capital variable on competitive advantage shows positive results assessed from the path coefficient (0.133) and significant assessed from p-values ( $0.000 < 0.05$ ) or t-statistics ( $4.785 > 1.96$ ), which means the variable Technological Intelligence plays a role in mediating the influence of the Intellectual Capital variable on the Competitive Advantage variable. According to Mahmood & Mubarik (2020), technological intelligence supports the optimization of intellectual capital in balancing innovation exploration and resource exploitation, which impacts increasing institutional competitiveness. Support for technological intelligence in managing intellectual capital to improve organizational performance and competitiveness can be in customer service, databases, information systems, brands, copyrights, and other things that demonstrate the institution's superior value (Ekayani, Purbawangsa, Sariyani, & Suriani, 2021). Technological intelligence enables organizations to integrate intellectual assets with advanced technology to support increased innovation, operational efficiency, and added value as an element of institutional competitive advantage (Noor, 2021; Suzan & Ramadhani, 2023). The majority of research related to the role of intellectual capital in an organization's competitive advantage through technological intelligence is applied to the industrial, economic and business sectors, where optimizing human resources in the form of managing intellectual capital, experience, innovation, and other intellectual capital can increase an organization's competitive advantage through digital technology media (Aji & Mala, 2024; Padila & Muslimin, 2024; Al-Nimri & Altarawaneh, 2020; Muftiasa, Wibowo, Hurriyati, & Rahayu, 2023). So, research in the education sector is still limited, and it is necessary to improve the effectiveness of these variables in increasing the excellence of educational institutions.

This means that good and efficient use of knowledge management strategies, intellectual capital, and technological intelligence media can increase the competitive advantage of schools. As according to Nonaka & Takeuchi (1995), knowledge that exists in the human mind (tacit knowledge) can be converted into explicit knowledge through various media so that it can be accessed and studied by all members of the organization, which in the context of educational institutions is all school members, from top management to users of school services.

#### IV. Conclusion

This research emphasizes the role of technological intelligence as an intervening influence on knowledge management and intellectual capital to the competitive advantage in upper secondary education institutions (MA, SMA, and SMK) in Malang City, East Java, Indonesia. These educational institutions are the final stage of student outcomes that are prepared according to the direction of

their role in the community environment, so it is necessary to study how to increase the competitive advantage value of educational institutions to maximize the role of education according to society's demands. Overall, technological intelligence enables educational institutions to optimize the role of knowledge management and intellectual capital for the competitive advantage of educational institutions. Technology helps transform knowledge and intellectual assets into practical strategies that support innovation and efficiency and improve educational service quality. In this way, educational institutions can achieve sustainable competitive advantage amidst the demands of an increasingly dynamic and digital environment.

Knowledge management is creating, storing, and sharing information within educational institutions, with technological intelligence, through learning management systems, big data, and other collaborative platforms. This knowledge can be optimized to improve operational efficiency, teaching quality, and innovation in methods. learning. This allows educational institutions to create added value, improve reputation and gain competitive advantage. Likewise, with the intellectual capital variable. Intellectual capital includes human capital (teacher and staff competency), structural capital (systems, curriculum and technological infrastructure), as well as relational capital (relationships with students, parents and stakeholders), has great potential to increase the competitiveness of educational institutions, where technological intelligence functions as a medium for optimizing the potential of this intellectual capital, such as the use of technology in teacher professional development, digitalization of administrative systems, and improvement of technology-based education services. So, the technological intelligence variable strengthens the role of managing knowledge resources and intellectual assets in increasing the competitive value of educational institutions with several indicators, such as the institution's capacity to innovate, improving performance, and expanding access to quality educational services.

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