

**THE INFLUENCE OF DIGITAL
LEADERSHIP ON TEACHER'S DIGITAL
COMPETENCY IN CHINA: THE MEDIATING
ROLE OF ICT SELF-EFFICACY**

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TEACHER'S DIGITAL COMPETENCY IN
CHINA: THE MEDIATING ROLE OF ICT SELF-
EFFICACY**

by

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TABLE OF CONTENTS

ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS.....	iii
LIST OF TABLES	xii
LIST OF FIGURES	xiv
LIST OF ABBREVIATIONS.....	xvi
LIST OF APPENDICES.....	xvii
ABSTRAK	xviii
ABSTRACT	xx
CHAPTER 1 INTRODUCTION.....	1
1.1 Introduction	1
1.2 Background of the Study	3
1.2.1 From ICT Evolution to the Need for Digital Leadership in Education.....	3
1.2.2 Digital Leadership in Implementing Educational Digitalization in Chinese Secondary Schools	5
1.2.3 Digital Leadership	6
1.2.4 Teachers' Digital Competency	9
1.2.5 Teachers' ICT Self-Efficacy	11
1.3 Problem Statement	13
1.3.1 Level of Digital Leadership in China	13
1.3.2 Level of Teachers' Digital Competency in China.....	14
1.3.3 Level of Teachers' ICT Self-Efficacy in China	15
1.3.4 The Gap Concern to the Relationship Between Three Variables.....	15
1.3.5 The Gap Concern to the Perspective of Methodology	17
1.4 Objectives of Research.....	18

1.5	Research Questions	19
1.6	Research Hypotheses.....	19
1.7	Significance of Study	20
1.8	Limitation	21
1.9	Operational Definition.....	22
1.9.1	Digital Leadership	22
1.9.2	Teacher Digital Competency.....	24
1.9.3	Teachers' ICT Self-Efficacy	25
1.10	Summary	26
CHAPTER 2 LITERATURE REVIEW		27
2.1	Introduction	27
2.2	Digital Leadership	27
2.2.1	The Concept of Digital Leadership	27
2.2.2	The Concept of Principal Digital Leadership.....	29
2.2.3	The Concept of Digital Leadership in China	29
2.2.4	ISTE Standards for Administrators	30
2.2.5	Dimensions of Digital Leadership.....	31
2.2.5(a)	Visionary Leadership.....	31
2.2.5(b)	Digital Age Learning Culture	32
2.2.5(c)	Excellence in Professional Practice	32
2.2.5(d)	Systemic Improvement	33
2.2.5(e)	Digital Citizenship	34
2.3	Digital Evolution of Education in Chinese Secondary Schools.....	34
2.4	Teachers' Digital Competency	36
2.4.1	The Concept of Teachers' Digital Competency	37
2.4.2	The Concept of Teachers' Digital Competency in China	38
2.4.3	Frameworks of Teachers' Digital Competency	39

2.4.4	ISTE Standard for Teachers	40
2.4.5	Dimensions of Teachers' Digital Competency	41
2.4.5(a)	Facilitate and Inspire Student Learning and Creativity	41
2.4.5(b)	Design and Develop Digital Age Learning Experiences and Assessments.....	42
2.4.5(c)	Model Digital Age Work and Learning.....	43
2.4.5(d)	Promote and Model Digital Citizenship and Responsibility	44
2.4.5(e)	Engage in Professional Growth and Leadership.....	45
2.5	Teachers' ICT Self-Efficacy	45
2.5.1	The Concept of Teachers' ICT Self-Efficacy	46
2.5.2	The Concept of Teachers' ICT Self-Efficacy in China.....	47
2.5.3	Dimensions of Teachers' ICT Self-Efficacy	49
2.5.3(a)	General ICT Self-Efficacy	50
2.5.3(b)	ICT Self-Efficacy for Instructional Purposes	51
2.6	Related Research	51
2.6.1	Previous Studies on the Level of Principal Digital Leadership, Teachers' Digital Competency, and Teachers' ICT Self-Efficacy	51
2.6.2	Influence of Principal Digital Leadership on Teachers' Digital Competency.....	53
2.6.3	Influence of Teachers' ICT Self-Efficacy on Digital Competency.....	54
2.6.4	Influence of Principal Digital Leadership on Teachers' ICT Self-Efficacy.....	55
2.6.5	Mediating Role of Teachers' ICT Self-Efficacy	57
2.6.6	Role of Principal Digital Leadership in Promoting Teachers' Digital Competency in Teaching and Learning	58
2.7	Theoretical Framework	59
2.7.1	Role of Theory in Research.....	59

2.7.2	Underpinning Theory: Path-Goal Theory	60
2.7.3	Application of Path-Goal Theory in Education.....	62
2.7.4	Theoretical Framework for This Study	64
2.8	Conceptual Framework	64
2.9	Summary	66
CHAPTER 3 METHODOLOGY.....		68
3.1	Introduction	68
3.1.1	Research Paradigm.....	68
3.1.2	The Explanatory Sequential Design.....	70
3.2	Research Variables	72
3.2.1	Independent Variable: Principals’ Digital Leadership	73
3.2.2	Dependent Variable: Teachers’ Digital Competency.....	73
3.2.3	Mediator Variable: Teachers’ ICT Self-Efficacy.....	73
3.3	Research Population	74
3.4	Sample Procedure and Sample Size	76
3.4.1	Quantitative Sample Procedure and Sample Size	76
3.4.2	Qualitative Sample Procedure and Sample Size	82
3.5	Research Instrument	84
3.5.1	The Demographic Information.....	85
3.5.2	Teachers’ ICT Self-Efficacy	86
3.5.3	Teachers’ Digital Competency	87
3.5.4	The Follow-Up Interview Questions.....	88
3.6	Pilot test.....	92
3.6.1	Translation Adaptation of the Instruments.....	93
3.6.2	Validity of Instrument	94
3.6.3	Reliability of Instrument	100
3.7	Data Collection Procedure	102

3.7.1	Quantitative Data Collection Procedure.....	102
3.7.2	Qualitative Data Collection Procedure.....	103
3.8	Data Analysis Procedure	104
3.8.1	Data Screening	105
3.8.2	Partial Least Squares Structural Equation Modeling (PLS-SEM)	105
3.8.2(a)	Specifying the Structural and Measurement Model	106
3.8.2(b)	Measurement Model Assessment	107
3.8.2(c)	Structural Model Assessment	108
3.8.2(d)	Mediation Analysis Assessment.....	109
3.8.3	Thematic Analysis.....	110
3.9	Summary	112
CHAPTER 4 DATA ANALYSIS AND FINDINGS.....		113
4.1	Introduction	113
4.2	Quantitative Data Preparation for Analysis	113
4.2.1	Data Screening	113
4.2.1(a)	Screening Participant Criterion.....	113
4.2.1(b)	Screening the Response Time.....	114
4.2.2	Data Cleaning.....	114
4.2.2(a)	Handling Missing Values	114
4.2.2(b)	Detecting and Handling Straight-Lining	114
4.2.2(c)	Normality for Data Distribution	115
4.3	Demographic Information of Participants.....	117
4.4	Assessment of Measurement Models(For Answer RQ2-RQ4).....	119
4.4.1	Indices for Internal Consistency Reliability in PLS-SEM	121
4.4.2	Indices for Indicator Reliability in PLS-SEM.....	122
4.4.3	Indices for Convergent Validity in PLS-SEM	123

4.4.4	Results for Assessment of Measurement Models(First-Order Latent Variable of Digital Leadership)	123
4.4.4(a)	Internal Consistency Reliability for Digital leadership.....	124
4.4.4(b)	Indicator Reliability for Digital Leadership	125
4.4.4(c)	Convergent Validity for Digital Leadership	125
4.4.5	Results for Assessment of Measurement Models(First-Order Latent Variable of Teachers' ICT Self-efficacy)	125
4.4.5(a)	Internal Consistency Reliability for Teachers' ICT Self-efficacy.....	126
4.4.5(b)	Indicator Reliability for Teachers' ICT Self-Efficacy.....	126
4.4.5(c)	Convergent Validity for Teachers' ICT Self-Efficacy.....	127
4.4.6	Results for Assessment of Measurement Models(First-Order Latent Variable of Teachers' Digital Competency)	127
4.4.6(a)	Internal Consistency Reliability for Teachers' Digital Competency	128
4.4.6(b)	Indicator Reliability for Teachers' Digital Competency	129
4.4.6(c)	Convergent Validity for Teachers' Digital Competency	129
4.4.7	Results for Assessment of Measurement Models(Second-Order Latent Variables).....	129
4.4.8	Discriminant Validity	131
4.4.9	Descriptive Analysis (For Answer RQ1)	134
4.4.10	The Level of Digital Leadership	134
4.4.11	The level of Teachers' ICT Self-Efficacy.....	135
4.4.12	The Level of Teachers' Digital Competency.....	135
4.5	Assessment of Structural Model(For Answer RQ2-RQ4)	136
4.5.1	The Assessment of the Structural Model for Collinearity Issue(VIF).....	138
4.5.2	The Assessment of the Hypotheses of Structural Model	140

4.5.3	The Assessment of the Level of R^2	143
4.5.4	The Assessment of the Level of Effect Size (f^2)	143
4.5.5	The Assessment of the Model's Predictive Power(Q^2).....	144
4.6	Assessment of Mediation Analysis(For Answer RQ5)	145
4.7	Qualitative Data Analysis.....	148
4.7.1	Demographic Information of Interviewees	148
4.7.2	Teachers Digital Competency from Teacher Interviewees	149
4.7.2(a)	The Level of Teachers' Digital Competency from Teacher Interviewees (For Explanatory Answer RQ1)	150
4.7.2(b)	Factors Reduce Teachers' Digital Competency from Teachers Interviewees (For Explanatory Answer RQ2 and RQ4).....	154
4.7.2(c)	Factors Enhance Teachers' Digital Competency from Teachers Interviewees (For Explanatory Answer RQ2 and RQ4).....	158
4.7.3	Teacher Digital Competency from Principal Interviewee(For Explanatory Answer RQ2)	161
4.7.4	Teachers ICT Self-Efficacy from Teacher Interviewees.....	163
4.7.4(a)	The Level of Teachers' ICT Self-Efficacy from Teacher Interviewees(For Explanatory Answer RQ1)	164
4.7.4(b)	Factors Reduce Teachers' ICT Self-Efficacy from Teacher Interviewees(For Explanatory Answer RQ3 and RQ4).....	165
4.7.4(c)	Factors Enhance Teachers' ICT Self-Efficacy from Teacher Interviewees (For Explanatory Answer RQ3 and RQ4).....	166
4.7.5	Teachers ICT Self-Efficacy from Principal Interviewees(For Explanatory Answer RQ3)	169
4.7.6	Principal Digital Leadership from Teacher Interviewees	171
4.7.6(a)	The Level of Principal Digital Leadership from Teacher Interviewees(For Explanatory Answer RQ1)	172

4.7.6(b)	The Role of Principal Digital Leadership from Teacher Interviewees(For Answer RQ6).....	173
4.7.7	Principal Digital Leadership from Principal Interviewees(For Answer RQ6).....	177
4.7.8	Summary of Thematic Analysis Finding	179
4.7.9	Summary of Quantitative and Qualitative Findings.....	183
CHAPTER 5	DISCUSSION AND CONCLUSION.....	185
5.1	Introduction	185
5.2	Summary of Main Findings.....	185
5.3	Discussion of Findings	186
5.3.1	The Level of Principal Digital Leadership	186
5.3.2	The Level of Teachers’ Digital Competency	188
5.3.3	The Level of Teachers’ ICT Self-Efficacy.....	190
5.3.4	The Influence of Principal Digital Leadership on Teachers’ Digital Competency in Chinese Secondary Schools	192
5.3.5	The Influence of Principal Digital Leadership on Teachers’ ICT Self-Efficacy in Chinese Secondary Schools.....	195
5.3.6	The Influence of Teachers’ ICT Self-Efficacy on Teachers’ Digital Competency in Chinese Secondary Schools	198
5.3.7	The Mediate Effect of Teachers’ ICT Self-Efficacy Between the Relationship of Principal Digital Leadership and Teachers’ Digital Competency	200
5.3.8	The Role of Principal Digital Leadership in Promoting Teachers’ Digital Competency in the Teaching and Learning Process.....	202
5.4	Implication of the Research.....	205
5.4.1	The Theoretical Implications	205
5.4.2	The Practical Implications.....	208
5.4.3	The Methodological Implications	209
5.5	Recommendations for Future Research	210
5.6	Summary of Study.....	212

REFERENCE	215
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APPENDICES

LIST OF PUBLICATIONS

LIST OF TABLES

	Page
Table 3.1 Teachers and Principals Respondent for Follow-Up Interview	84
Table 3.2 Distribution Items in Digital Leadership Questionnaire	86
Table 3.3 Distribution of Items in Teachers' ICT Self-Efficacy Questionnaire	87
Table 3.4 Distribution of Items in Teachers' Digital Competency Questionnaire	88
Table 3.5 Translations and the Comments From Experts	94
Table 3.6 Panel Information for Content Validity	95
Table 3.7 The Definition and Formula of CVI Indices	96
Table 3.8 Content Validity Index of the Instrument	97
Table 3.9 Reliability Analysis of Digital Leadership Questionnaire	100
Table 3.10 Reliability Analysis of Teachers' ICT Self-Efficacy Questionnaire	101
Table 3.11 Reliability Analysis of Teachers' Digital Competency Questionnaire	101
Table 4.1 Straight Lining Test.....	115
Table 4.2 Normality Test Result for the Data	116
Table 4.3 Demographic Information of Participant	118
Table 4.4 The Summery of Internal Consistency Reliability Indices in PLS- SEM.....	122
Table 4.5 The Summary of Indices for Indicator Reliability in PLS-SEM.....	122
Table 4.6 The Summary of Indices for Convergent Validity in PLS-SEM	123
Table 4.7 Results of Measurement Model (First-Order Latent Variable of Digital Leadership).....	124

Table 4.8	Result of Measurement Model (First-Order Latent Variable of Teachers' ICT Self-efficacy).....	126
Table 4.9	Result of Measurement Model (First-Order Latent Variable of Teachers' Digital Competency)	128
Table 4.10	Result for Measurement Model(Second-Order Latent Variables)...	131
Table 4.11	Summary of Indices for Discriminant Validity in PLS-SEM	132
Table 4.12	Level of Mean Score	134
Table 4.13	Mean Score of the Variable of Digital Leadership	135
Table 4.14	Mean Score of the Variable of Teachers' ICT Self-Efficacy.....	135
Table 4.15	Mean Score of the Variable of Teacher Digital Competency	136
Table 4.16	The Result of the VIF for Digital Leadership	138
Table 4.17	The Result of the VIF for Teachers' ICT Self-Efficacy	139
Table 4.18	The Result of the VIF for Teachers' Digital Competency	139
Table 4.19	Hypothesis Testing Results	142
Table 4.20	Results for Coefficient of Determination(R^2)	143
Table 4.21	The Results of the Level of Effect Size (f^2)	144
Table 4.22	The Results of the Predictive Power Relevance (Q^2).....	144
Table 4.23	Summary of Indices for Assessment of Structural Model In PLS-SEM.....	145
Table 4.24	Hypothesis Testing on Mediation	146
Table 4.25	The Mediator Model Analysis	147
Table 4.26	Result of Effect Size.....	147
Table 4.27	Participant Demographics of the Research	149
Table 4.28	Summary of Thematic Analysis Finding (Teachers Interviewees)..	180
Table 4.29	Summary of Thematic Analysis Finding (Principals Interviewees)	182
Table 4.30	Summary of Quantitative and Qualitative Findings.....	184

LIST OF FIGURES

	Page
Figure 2.1 Theoretical Framework	64
Figure 2.2 Conceptual Framework	65
Figure 3.1 The Explanatory Sequential Design of the Research.....	71
Figure 3.3 Multistage Cluster Sampling Procedure.....	80
Figure 3.4 Qualitative Sampling Procedure	83
Figure 3.5 Draft of Interview Questions for Teachers.....	90
Figure 3.6 Draft of Interview Questions for Principals	91
Figure 3.7 Quantitative Data Collection Procedure.....	103
Figure 3.8 Qualitative Data Collection Procedure.....	104
Figure 3.9 Thematic Analysis Procedure	112
Figure 4.1 Measurement Model of the Research.....	120
Figure 4.2 HTMT Criterion Result of the Model	133
Figure 4.3 Structural Model of the Research.....	137
Figure 4.4 Mediator Model.....	146
Figure 4.5 The Thematic Map of Teachers' Digital Competency(Teacher Interviewee).....	150
Figure 4.6 The Thematic Map of Teachers' Digital Competency(Principal Interviewee).....	161
Figure 4.7 The Thematic Map of Teachers' ICT Self-efficacy(Teacher Interviewee).....	164
Figure 4.8 The Thematic Map of Teachers' ICT self-efficacy (Principal Interviewee).....	169
Figure 4.9 The Thematic Map of Principal Digital Leadership	172

Figure 4.10	The Thematic Map of Principals' Digital Leadership (Principal Interviewee).....	177
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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
CVI	Content Validity Index
CR	Composite Reliability
DigComp	The European Digital Competency Framework for Citizens
DigCompEdu	The Digital Competency Framework for Educators
EFA	Exploratory Factor Analysis
ICT	Information and Communication Technology
IT	Information Technology
ISTE	International Society for Technology in Education
ISTE-A	ISTE-Standards for Administrators
KMO	Kaiser-Meyer-Olkin
NETS-A	National Educational Technology Standards for Administrators
PLS-SEM	Partial Least Squares Structural Equation Modeling
PTLA	Principal Technology Leadership Assessment
RQ	Research Questions
SEM	Structural Equation Modeling
TPACK	Technological Pedagogical Content Knowledge
UNESCO	United Nations Educational, Scientific and Cultural Organization
USM	University Sains Malaysia
VIF	Variance Inflation Factor
WEF	World Economic Forum

LIST OF APPENDICES

Appendix A	Permission to use Digital Leadership Scale
Appendix B	Permission to use Teachers' ICT Self-Efficacy Scale
Appendix C	Permission to use Teachers' Digital Competency Scale
Appendix D	Template of Content Validation Form for Expert
Appendix E	Improvement of Instrument
Appendix F	Comments of Instrument from Experts
Appendix G	Questionnaire of Survey
Appendix H	Ethical Approval Letter from USM
Appendix I	Principal Interviewee Interview Manuscript (Sample)
Appendix J	Teacher Interviewee Interview Manuscript (Sample)

**PENGARUH KEPIMPINAN DIGITAL TERHADAP KOMPETENSI
DIGITAL GURU DI CHINA: PERANAN EFIKASI ICT SEBAGAI
MEDIATOR**

ABSTRAK

Transformasi digital pendidikan yang pesat di China menekankan keperluan kepimpinan sekolah untuk mengintegrasikan teknologi dan menyokong pembangunan kompetensi digital guru secara berkesan. Kajian ini bertujuan untuk menilai tahap kepimpinan digital pengetua, kecekapan digital guru, dan efikasi sendiri ICT dalam kalangan guru sekolah menengah di China. Selain itu, kajian ini menyiasat hubungan antara kepimpinan digital, kecekapan digital guru, dan efikasi sendiri ICT guru, serta meneliti peranan mediator efikasi sendiri ICT dan bagaimana kepimpinan digital dapat meningkatkan kecekapan digital guru dalam proses pengajaran dan pembelajaran. Kajian ini menggunakan reka bentuk kaedah campuran eksplanatori berurutan untuk mengumpulkan data kajian. Seramai 399 orang guru di sekolah menengah di bandar Meizhou dan Chaozhou, Wilayah Guangdong, China telah terlibat sebagai sampel kajian, manakala 16 orang daripada mereka menjadi peserta kajian kualitatif untuk temu bual susulan. Hasil kajian menunjukkan bahawa kepimpinan digital, efikasi sendiri ICT guru, dan kecekapan digital guru berada pada tahap yang tinggi dalam kalangan guru sekolah menengah di China. Terdapat pengaruh signifikan kepimpinan digital pengetua terhadap kecekapan digital guru dan efikasi sendiri ICT guru. Selain itu, terdapat pengaruh signifikan efikasi sendiri ICT guru terhadap kecekapan digital guru. Kajian ini juga mendapati bahawa efikasi sendiri ICT guru mempunyai kesan pengantara yang signifikan dalam hubungan antara kepimpinan digital pengetua dan kecekapan digital guru. Merujuk kepada peranan kepimpinan digital pengetua, guru

menekankan peranan pengetua dalam penggunaan digital yang beretika, pembinaan keyakinan, kelestarian ICT, akses kepada sumber, dan pembangunan profesional. Sebaliknya, pengetua menekankan pemodelan amalan ICT, menggalakkan inovasi, pengurusan sumber, meningkatkan kemahiran digital pengurus pertengahan, dasar pendidikan, serta sokongan latihan guru. Kajian ini memperluas teori laluan-matlamat kepada pendidikan digital, dengan menunjukkan bahawa kepimpinan digital pengetua memberi pengaruh yang signifikan terhadap kompetensi digital guru melalui kecekapan sendiri ICT. Dapatan kajian ini memberikan panduan praktikal untuk memperkukuh amalan kepimpinan, latihan guru, dan integrasi teknologi di sekolah.

THE INFLUENCE OF DIGITAL LEADERSHIP ON TEACHER'S DIGITAL COMPETENCY IN CHINA: THE MEDIATING ROLE OF ICT SELF-EFFICACY

ABSTRACT

The rapid digital transformation of education in China has emphasized the need for school leadership to integrate technology and support teachers' digital competency development effectively. This study aims to assess the level of principal digital leadership, teachers' digital competency, and ICT self-efficacy in Chinese secondary schools. It also aims to investigate the relationship between digital leadership, teachers' digital competency and teachers' ICT self-efficacy, and also examines ICT self-efficacy's mediating role, and explores how digital leadership contributes to enhancing teachers' digital competency in the teaching and learning process. This study conducted the explanatory sequential mixed method research design in data gathering process. The explanatory sequential mixed methods design will be used that involves collecting quantitative data first and then explaining the quantitative results with in-depth qualitative data. A total of 399 secondary school teachers in Meizhou and Chaozhou cities, Guangdong Province, China, were involved as respondents in survey data collection and 16 of them in follow-up interviews. The research findings reveal that digital leadership, teachers' ICT self-efficacy and teachers' digital competency indicated a high level in Chinese secondary schools. There is a significant influence of principal digital leadership on teachers' digital competency and teachers' ICT self-efficacy in Chinese secondary schools. There is a significant influence of teachers' ICT self-efficacy on teachers' digital competency in Chinese secondary schools. There is a significant mediate effect of teachers' ICT self-efficacy between

the relationship of principal digital leadership and teachers' digital competency. Refers to the role of principal digital leadership, teachers emphasize principals' roles in ethical digital use, confidence building, ICT sustainability, resource accessibility, and professional development. Principals highlight modelling ICT practices, fostering innovation, managing resources, enhancing middle managers' digital skills, policymaking, and supporting teacher training. This study extends the path-goal theory to digital education, showing that principals' digital leadership significantly influences teachers' digital competency through ICT self-efficacy. The findings provide practical guidance for strengthening leadership practices, teacher training, and technology integration in schools.

CHAPTER 1

INTRODUCTION

1.1 Introduction

In the history of the evolution of education, social change and the media technology revolution have been thought of as crucial forces for the reform in the educational pattern and method. In the era of Industry 4.0, integration, intelligence, and innovation have become the keyword of social and industrial development (Hu et al., 2019). Under the context of Industry 4.0, educators put forward the concept of Education 4.0 aims to efficiently incorporate digital technologies into the learning process. These digital technologies include cloud computing technologies, artificial intelligence, Mobil technologies, Flip-flopped classroom and so on(Himmetoglu, 2020).

This change in the educational field also brings the discussion about the role and responsibilities of principals have changed continually within the evolution of the educational environment. Digitalization in the educational field also gives new meaning to the principal's role in ICT integration in school. For school leaders, understanding on all organizational levels appears to be necessary, and this understanding includes understanding which digital capabilities are required for different stakeholders on different levels (Håkansson Lindqvist & Pettersson, 2019). The evolving concept of principal digital leadership highlights the principal's role in coordinating initiatives to facilitate, adopt, and incorporate digital tools as a platform for teaching and learning. In fact, leadership functions as the central driver of digital transformation in schools. Without strong principal leadership, the integration of technology risks being fragmented or superficial. Principals not only manage resources but also create a shared digital vision, motivate teachers to engage with new

technologies, and establish a school culture that embraces innovation. Thus, digital leadership forms the foundation for sustaining meaningful change in teaching and learning practices.

In terms of teacher competencies in the age of digitization of education. From the perspective from Ramírez-Montoya et al.(2021) research on teaching profiles within the framework of Education 4.0. Teachers should use new applications and technologies and enhance teaching quality and efficiency through artificial intelligence, digital tools, and virtuality technology. Teachers' digital competency is a comprehensiveness concept. In addition to these digital technology competencies, teachers are also required to access to content competency, pedagogical competency and professional competency (Falloon, 2020; Pettersson, 2018; Redecker, 2017).

Following the global trend of digitization in the educational field, in 2018, the Chinese official educational organization published the *“Education IT 2.0 Action Plan”*, which also indicates that a new digital age has begun in Chinese schools. China is approaching the Education IT 2.0 era, which is characterised by innovation-driven growth and goes beyond the use of IT as a tool to assist the educational system. It is necessary to change the focus of information technology from external variables to endogenous variables(Yan & Yang, 2021). The swift advancement of digital technologies has brought substantial transformations to China's educational landscape. Therefore, digital transformation is becoming important in China's educational context. This study attempts to investigate the role of school principals in China and to what extent this role influences the teachers' digital competency. Furthermore, this research aims to analyze the mediating role of teachers' self-efficacy in the connection between digital leadership and digital competency within the context of Chinese secondary schools.

1.2 Background of the Study

In this section that follows, the relevant information about the evolution of ICT and the impact in education field, digital leadership, digital competency, and self-efficacy will be explained.

1.2.1 From ICT Evolution to the Need for Digital Leadership in Education

The World Economic Forum's (2020) Education 4.0 framework emphasizes the importance of technological proficiency as a prerequisite for high-quality learning and for cultivating the digital skills and responsibilities required of future citizens. Industry 4.0, characterized by digital transformation, intelligent technologies, and interconnected systems, has placed unprecedented demands on education systems to prepare learners for participation in a rapidly evolving society. Consequently, educational institutions must not only integrate digital expertise into curricula but also transform pedagogical models to respond effectively to the demands of this new era (Wang et al., 2020). In this context, the expansion of ICT has fundamentally altered the traditional educational paradigm, giving rise to a dramatic shift in teaching and learning processes (Pérez-Sanagustín et al., 2017).

In response, many countries have launched national strategies to cultivate digital competencies in both citizens and educators. For example, the United States Department of Education introduced the National Education Technology Plan (2017), which underscores the need to prepare preservice teachers for technology-enriched classrooms (Keengwe & Onchwari, 2019). Similarly, the European Union's DigComp 2.0 framework (2016) sought to enhance digital literacy among citizens, while its complementary DigCompEdu initiative focused on strengthening the digital skills of educators (Riina et al., 2016; Sánchez-Cruzado et al., 2021). These international

initiatives collectively reflect a consensus that teacher digital competence is a foundational requirement for the advancement of education in the digital era.

The COVID-19 pandemic further accelerated this trend. School closures worldwide compelled teachers to adopt digital tools rapidly, fundamentally reshaping pedagogical practices and establishing digital competence as an indispensable aspect of professional teaching (Pozo et al., 2021). In this way, cultivating digital talent has become a central component of teacher professional growth and educational reform agendas globally.

At the organizational level, the digital transformation has introduced substantial changes to work design, management structures, and leadership approaches. These changes encompass new patterns of ICT use, shifts in organizational hierarchies, and reconfigurations of performance management (Schwarz Müller et al., 2018). Within educational institutions, research increasingly highlights the pivotal role of leadership in navigating these changes. School leaders are expected not only to develop their own digital competencies but also to coordinate, integrate, and mobilize resources in order to facilitate school-wide digital transformation (Himmeloglu et al., 2020).

Moreover, effective leadership in this context extends beyond formal authority. Researchers argue that principals influence teachers and stakeholders less through bureaucratic control and more by fostering open dialogue and participatory cultures. Such leadership encourages teachers and other stakeholders to perceive the integration of digital resources as an opportunity to transform pedagogy and align education with the demands of the digital era (Navaridas-Nalda et al., 2020).

1.2.2 Digital Leadership in Implementing Educational Digitalization in Chinese Secondary Schools

In the context of China, over the past decade, the Chinese government has remained dedicated to advancing information infrastructure in primary and secondary education. Between 2000 to 2017, the education information construction in China was marked for the “*Education IT 1.0*” stage. During this era, the government was committed to popularizing school information technology. The emphasis is on using ICT as a tool to improve teaching and learning efficiency. Until of 2017, the internet connectivity rate within Chinese primary and secondary education climbed from 25% to 90%, while the percentage of multimedia classrooms went from under 40% to 83% (Lei, 2018)

The People's Republic of China's Ministry of Education issued the "Education IT 2.0 Action Plan" in 2018. Education IT 2.0 is an upgrade of ICT development in the educational section. It mentions that educational ICT cannot only be embedded in the teaching and learning environment but also within the educational system. In 2019, the China State Council released China's Educational Modernization 2035, indicating Chinese educational reform in the future era must focus on creating smart schools and utilizing digital technology to teach and improve the sharing of digital educational resources (The State Council, 2019).

Besides the Education IT 2.0 plan and China's Educational Modernization 2035, Chinese educational department also released some specific policy consider educational digitalization in Chinese secondary school like “Action Plan for Deepening the Reform of Basic Education Curriculum Teaching”. This plan emphasizes the need to share digital resources and advocates for standardized administration in digital transformation in Chinese secondary schools(Yen, 2023).

While these national policies set a clear direction, their success ultimately depends on effective implementation at the school level. Research indicates that principals serve as the key agents in operationalizing policy objectives and ensuring that digital reforms are embedded in classroom practices. Their leadership is critical in shaping teachers' readiness, guiding professional development, and cultivating school cultures that are receptive to innovation (Yan & Yang, 2021). Without such leadership, the aspirations of national policies risk remaining unfulfilled at the local level.

Moreover, principals' digital leadership is particularly crucial in supporting teachers' transition from basic technological proficiency to the development of comprehensive digital competency. Teachers must not only master technical skills but also integrate ICT into pedagogy, collaboration, and innovation (Tang et al., 2022). Principals, by modeling technology use, aligning resources, and encouraging experimentation, provide the enabling conditions for this progression. In this way, leadership bridges the gap between macro-level policy ambitions and micro-level classroom realities, making principals indispensable actors in China's ongoing digital transformation of education.

1.2.3 Digital Leadership

In this study, the concept of digital leadership is framed using the ISTE Standards for Administrators (2009), which outline five key dimensions: visionary leadership, digital age learning culture, excellence in professional practice, systemic improvement, and digital citizenship. These dimensions provide a structured framework for understanding the ways in which principals lead schools in the digital era. They also form the foundation for the discussion that follows.

With the technology integrated into the teaching and learning practices of schools, this advanced ICT also changed the educational setting and remind researchers to think and structure new concepts of leadership. The concepts of leadership related to technology, electronic and digital have received attention in recent years. However, those concepts have plenty of different expressions like “e-leadership”, “ICT leadership” and “technology leadership” and “digital leadership”. Among these concepts, “E-leadership” is the most common used by researchers. The earlier scholars Avolio et al., (2014) have defined “e-leadership” as “a social influence process embedded in both proximal and distal contexts mediated by advanced information technology that can produce a change in attitudes, feelings, thinking, behaviour, and performance” (p.107). From the perspective of Van Wart et al.(2017), they defined “e-leadership” as “the ability to effectively select and use ICT for both personal and organizational purposes” (p.529). In spite of the definition of “e-leadership” varies among researchers, it can be observed that they all focus on the use of technology. This research will use the concept of “digital leadership” but not the concept of “e-leadership” because digital leadership will be more relevant to the dependent variable and context of this research.

The digital leadership concept is a new concept which has been proposed based on the concepts of “e-leadership” (Arnold & Sangrà, 2018). The raised of the concept of digital leadership is also closely correlated to the context of the digitalization of education. From the perspective of Brown et al (2016), to achieve the learning objective in digital education age, digital leadership in the educational field focuses on directing the field through improving access, empowering peers, fostering innovation, and making informed decisions. In addition, from the comprehensive view of digital leadership, realizing that digital leadership in education does not take place in a

vacuum but rather as means to support and guide digital education and digital literacies (Brown et al., 2016). Yusof et al. (2019) defined digital leadership as incorporating digital technologies into the leadership practices of school leaders to achieve a long-term shift in the usage of technology in schools and it is a comprehensive leadership that combines leaders, resources, hardware, and technology. From the perspective of Sheninger (2019), digital leadership is a dynamic mix of mentality, behaviors, and abilities employed to transform and enhance school culture through the purposeful utilization of technology.

In this research, the argument for digital leadership would be strongly related to cultivating teachers' digital competency and digitalization in secondary schools. The definition of digital leadership in this study refers to principals combining resources, empowering teachers, and implementing digital devices into leadership practices in order to transform schools in the age of digitalization (Brown et al., 2016; Navaridas-Nalda et al., 2020; Yusof et al., 2019). Due to various our reliance on digital technology and the era we live in, leadership practices must evolve in order to create schools that can adapt to the most recent technological development. Developing individuals who can adapt to digital era have become the most crucial duty for today's school leaders. As a result, school leaders' digital leadership roles are now recognized as an important factor (Karakose et al., 2021). The importance of digital leadership in educational settings has been shown in earlier research. For example, Karakose et al (2021) research of the role of digital leadership from teachers' perspective has revealed principal leadership contributed to digital culture creation in schools, technologically driven professional development, and school digital transformation. School leaders also take responsibility for improving digital literacy during the COVID-19 pandemic

overwhelmed the educational system and forced instructors and students to acquire and utilize digital devices or systems (AlAjmi, 2022) .

1.2.4 Teachers' Digital Competency

Teachers' digital competency in this study is conceptualized with reference to the ISTE Standards for Teachers (2008). This framework identifies multiple dimensions, including facilitating and inspiring student learning and creativity, designing and developing digital-age learning experiences and assessments, modeling digital-age work and learning, promoting digital citizenship and responsibility, and engaging in professional growth and leadership. These dimensions will guide the discussion of teachers' digital competency in the educational context.

In the context of digitalization in the educational field, improving ICT skills of teachers has been a significant issue in teacher training and education (Ilomäki et al., 2016; Nganji, 2018). Therefore, a number of common ICT frameworks have been created using a variety of terminology, including ICT literacy, computer literacy, ICT competency, digital literacy, and digital competency (Fernández-Batanero et al., 2020; McGarr & McDonagh, 2019,). However, these early terms like “ICT literacy”, “computer literacy” and “ICT competency” are concentrating on the capability to conduct media devices and basic computer skills (Galanouli et al., 2004; Prendes et al., 2010). McGarr and McDonagh (2019) have noted that the terms digital literacy/competency have largely replaced ICT literacy have means that the meaning of the concept has from technical origins to encompassing broader dimensions.

However, the extent to which the terms "digital literacy" and "digital competency" refer to the same thing is a subject of discussion. Linguistically speaking, according to McGarr and McDonagh (2019), digital competency is more frequently utilized in educational settings, but digital literacy is more frequently used in European

policy and efforts linked to e-inclusion. They also contend that competency comprises a broader definition of education that considers knowledge, abilities, and attitudes related to digital technology. Refers to the connotations of the concept, teacher digital literacy has been defined as the capacity to effectively use and evaluate digital information, tools, and services and apply them to educational settings (Admiraal et al., 2017) . But digital competency is a broader concept that not only recognizes the significance of technical knowledge and skills, it also highlights the importance of understanding and reflecting on the wider impact of digital technology on individuals and society, embracing a more comprehensive socio-cultural perspective. (Falloon, 2020).

The context of this research will carry out under the educational digitalization in China. Digital teaching and learning work have very contextual and technological attributes. The “*Education IT 2.0 Action Plan*” required Chinese teachers have competency to confront the endless array of digital technologies and issues and challenges in different digital education situation (Zheng et al., 2019). This study will use the terms of “digital competency” because the concept is corresponding to the research background. To date, the concept of professional digital competency for teachers still seems vague and elusive and there is no widely agreed definition (Skantz-Åberg et al., 2022). However, by reviewing the existing literature, the content of teacher digital competency mainly including technology competency, content competency, pedagogical design competency, attitude, cultural awareness, and competencies in professional learning (Falloon, 2020; Lindfors et al., 2021; Skantz-Åberg et al., 2022). In general, teachers’ digital competency can be defined as a set of skills and abilities that enable teachers to use ICT as a methodological resource that is incorporated into the teaching and learning process (Touron et al., 2018; Zheng, 2019).

Improving teachers' digital competency in school is a complex process and the support from school leaders cannot be ignored. From the research of Blau and Shamir-Inbal (2017) emphasized the role of school leaders in enhancing teachers' digital competency and creating schools' ICT culture. Likewise, the study by Leong et al. (2016) on the connection between principal technology leadership and teacher ICT competency revealed that digital citizenship and systemic improvement are the two critical elements of leadership practices that strongly influence teachers' ICT skills.

1.2.5 Teachers' ICT Self-Efficacy

Teachers' ICT self-efficacy is approached in this study through the model developed by Hatlevik and Hatlevik (2018). Their research distinguishes between two dimensions of ICT self-efficacy, which, while conceptually different, demonstrate a strong correlation: one dimension reflects teachers' confidence in mastering and applying ICT, while the other reflects their confidence in adapting ICT to achieve pedagogical goals. These two dimensions provide the framework for analyzing teachers' ICT self-efficacy in the present study.

Self-efficacy is a psychological conception which put forward by (Bandura, 1977). In the educational section, teacher self-efficacy is one of the most popular topics among scholars. Since the 1980s, teacher self-efficacy is a common term that refers to A teacher holds the belief that they have the ability to make an impact on the conduct and academic performance of students, particularly those who face challenges or have low levels of desire towards learning (Friedman & Kass, 2002). However, the meaning of teacher self-efficacy has been broadened in the recent two decades. Researchers only focus on teacher self-efficacy in teaching but also on their self-efficacy in learning new instructional skills and building instructional strategies (Mannila et al., 2018). With the technology integration in schools, researchers start to embark on the influence

of self-efficacy on teachers' attitudes toward interactive technologies in the classroom. For example, Gomez et al.(2022) explored teachers' self-efficacy in technology use in classrooms in Southern California and found out a crucial implication that affected teachers' technology self-efficacy was the delivery of continuous professional development interventions. Hatlevik and Hatlevik (2018) indicates a connection between the integration of ICT in teaching and teachers' self-efficacy in utilizing these technologies. Additionally, the study differentiates between teachers' ICT self-efficacy and their overall sense of self-efficacy in instructional practices.

With this research, the term “teacher ICT self-efficacy” will be to refer to teachers' confidence in learning digital skills and improving digital competencies and in terms of belief in their capabilities to organize the classroom and achieve the instructional goal in the digital context. In earlier studies on leadership connected to ICT integration in schools, self-efficacy was an important factor. Ismail et al., (2021) study of principals' technology leadership found that teachers' self-efficacy can be revived if principals skillfully encourage them to use ICT. In terms of the research on digital leadership and teachers' reflection practice. Researchers proved that the mediating variable of teachers' self-efficacy contributed significantly between digital leadership and teacher work engagement and that also reveals because of the leaders who have digital character traits, teachers are inspired to think critically about what they've learnt (Agustina et al., 2020). In terms of previous studies of teachers' digital competency, researchers found that teachers' levels of digital competency were related to their sense of self-efficacy (Ogodo et al., 2021). Both variations in teachers' digital competency and their adoption of ICT in the classroom can be attributed to Teachers' ICT self-efficacy. This demonstrates how crucial it is for instructors to feel confident in their abilities when it comes to utilizing ICT in the classroom (Hatlevik, 2017).

1.3 Problem Statement

1.3.1 Level of Digital Leadership in China

In 2015, the Chinese Department of Teachers' Work of the Ministry of Education issued the "Standards of Information Technology Leadership for Primary and Secondary School Principals (Trial)". The Standards clearly state that "principals are the practitioners of IT in schools" and have the responsibility to "promote the deep integration of information technology and education teaching, and continuously improve the quality of education teaching" (Yang et al., 2018). With the process of the "Education IT 2.0 Action Plan", the digital construction of the school is based on the new intelligent digital technology, for instance, artificial intelligence and bigger datasets. It also a people-oriented plan which emphasizes teacher and student development to change information technology as an endogenous variable to support and lead systemic changes in education (Lei, 2018). In addition, In 2019, the China State Council announced China's Educational Modernization 2035 which indicates China's educational reform in the new era must concentrate on supporting and driving the modernization of education through educational informatization (Y. Wang, 2023). In terms of the policy for K-12 education, in 2023, the ministry of education of China has issued the "Action Plan for Deepening the Reform of Basic Education Curriculum Teaching" which emphasized that the use of smart education (national level) platform for elementary and secondary schools, promoting the use of digital tools in daily lessons. The plan highlights the significance of sharing digital applications in education and promoting standardized management (Yen, 2023).

Therefore, under the context, the content of principals' digital leadership in China also should shift the focus of investment from hardware construction to a more comprehensive aspect (Lei et al., 2021). However, there are no reports and data for

investigating the level of principals' digital leadership in Chinese secondary schools. Research on digital leadership in China is urgently needed because it is the demands of the age and policies.

1.3.2 Level of Teachers' Digital Competency in China

In terms of the research on teachers' digital competency in China. The government has promoted digital transformation in Chinese secondary schools. For example, the Ministry of Education has built several digital education cloud platforms(state level) in China like Smart Education Gateway, Smart Primary and Secondary School Education and Pilot Demonstration of Smart Education. in addition, China's educational information technology infrastructure has also advanced, with 100% internet connection on school and 99.5% of primary and secondary schools filled with multimedia classrooms. That also indicates that Chinese secondary schools have sufficient digital resources and facilities to assist with the development of digitization. However, some research emphasized that they have lacked training teachers in ICT practice and teachers are not completely ready to incorporate digital tools in their classrooms(Luo et al., 2021; Yang et al., 2022).

As a result, enhancing teachers' digital competency has emerged as a crucial aspect of China's educational digital transformation. Chinese government also carry a several of digital competency training programs to the secondary school teacher (Shi et al., 2023). However, there are limited reports or data from the literature concerned with the level of teachers' digital competency in Chinese secondary schools. The lack of exploring the level of teacher digital competency is not conducive to the development of digital transformation within Chinese secondary schools.

1.3.3 Level of Teachers' ICT Self-Efficacy in China

Different from the level of principal digital leadership and teachers' digital competency, there are several works of literature concerning the teachers' ICT self-efficacy in China and these studies often focus on the impact factors of teachers' ICT self-efficacy. For example, Zhang et al.(2023) examined the level of the teachers' ICT self-efficacy and investigated the association between preservice teachers' self-efficacy perceptions and their actual learning of ICT competencies via online self-regulated learning methodologies and discovered that ICT self-efficacy did not directly improve competency but was mediated by goal-setting procedures. Wang and Zhao (2021) investigated the ICT self-efficacy of preservice teachers at a Chinese normal university and discovered that it served as a key mediator in the relationship between university ICT support and TPACK. It can be seeming that these articles only focus on the level of ICT self-efficacy of preservice teachers.

In terms of the level of ICT self-efficacy of in-service secondary school teachers in China. Wu et al., (2020) explored the ICT self-efficacy of teachers in Chinese primary and secondary schools, revealing that both individual teacher characteristics and institutional factors play a role in shaping K-12 teachers' confidence in using ICT. However, the instrument for examining the level of teachers' ICT self-efficacy in this research lacks scientific logic because it is adapted from the scale of primary school pupils' ICT self-efficacy which was developed by Aesaert et al.,(2015). Therefore, this research will fill these gaps by employing a more logical instrument to assess the level of ICT self-efficacy among secondary school teachers in China.

1.3.4 The Gap Concern to the Relationship Between Three Variables

Digital leadership is identified by previous studies as the crucial element in promoting ICT integration in school(Brown et al., 2016; Karakose et al., 2021;

Navaridas-Nalda et al., 2020; Yusof et al., 2019). Previous studies have implicated that the educational environment is going through a big change under the era of IR 4.0 (Himmetoglu, 2020; Lei, 2018; Utami et al., 2019). In the process of integrating ICT into schools, researchers implicated that improving teacher digital competency can enhance instruction, support lifelong learning pedagogy, and boost educational effectiveness (Blau & Shamir-Inbal, 2017).

However, digital competency would not benefit from being seen as a single occurrence at the individual level. Rather, it can be interpreted as an organizational process that is influenced and motivated by a variety of contextual factors that are ingrained in the broader school system. Therefore, the involvement of strategic leadership has been an impotent theme in improving the digital competency of teachers (Pettersson, 2018). Yuting et al.(2022) in their study on technology leadership and ICT competency have demonstrated teacher ICT competency and technology leadership are strongly correlated, and , and that every aspect of technology leadership had significantly improved teachers' ICT competency.

But these researchers are only concerned with the concept of technology/e-leadership and ICT/digital skills. In previous relevant studies of digital leadership, and teachers' digital competency, the relative importance of self-efficacy has been subject to considerable discussion.

It has been demonstrated that self-efficacy is a significant factor among these variables (eg: Liu & Hallinger, 2018; Santoso et al., 2019; Zheng et al., 2019; Agustina et al., 2020). For example, in the research of teachers' digital competency, researchers implicated that it is not enough for teachers to learn computing knowledge through discrete on-job training activities, they must instead get the confidence to study

autonomously and regularly what is new, what is relevant, and how to integrate digital competency into their teaching (Mannila et al., 2018).

Though previous studies have claimed that digital leadership contribute to teachers' digital competency. The study related to these variables is needed to explore in the context of China. This investigation will address a deficiency in the existing body of literature by examining the connection between digital leadership, teachers' ICT self-efficacy and teachers' digital competency and evaluating the level of these variables in Chinese secondary schools. That would contribute to improving the efficiency of policy implementation and advancing the digitalization of education.

1.3.5 The Gap Concern to the Perspective of Methodology

From the perspective of methodology, A gap exists because past research of the principal digital leadership, digital competency or teacher learning, or development has only provided a partial view by using quantitative approaches to concern one of these variables. For example, Al-Ajmi (2022) implemented a survey that was cross-sectional to evaluate the digital leadership levels of school principals in order to evaluate the impact of digital leadership on the integration of technology by teachers. Nevertheless, there is a need for a more complete understanding through comparing and synthesizing both data types, quan and qual, especially using qualitative data to interpret some specific problems revealed by quantitative data. These specific problems can refer to the embarking process of improving teachers' digital competency and the response of principals, teachers, and other shareholders. The combination of qualitative analysis can help us to identify the in-deep problems in the study of the relationship between principal digital leadership and teachers' digital competency.

In conclusion, the main issues that were identified in this study are:

There are limited studies concerning the level of digital leadership and teachers' digital competency in Chinese secondary schools.

There are limited studies concerning the relationship between principal digital leadership and teachers' digital competency in the China education context.

There are limited studies concerning the mediating effect of teachers' ICT self-efficacy among principal digital leadership and teachers' digital competency.

In terms of methodology, Previous researchers have focused on quantitative approaches to obtaining information about principal digital leadership, teachers' digital competency or teachers' ICT self-efficacy; However, this study will employ an explanatory mixed methods design, which means that qualitative data will be used to explain quantitative findings.

1.4 Objectives of Research

From the aforementioned research issues, the following objectives are set for this research:

1. To evaluate the level of principal digital leadership, teachers' digital competency and teachers' ICT self-efficacy in the context of Chinese secondary schools.
2. To examine the significant influence of principal digital leadership on teachers' digital competency within the context of Chinese secondary schools.
3. To examine the significant influence of teachers' ICT self-efficacy on teachers' digital competency within the context of Chinese secondary schools.
4. To examine the significant influence of principal digital leadership on teachers' ICT self-efficacy within the context of Chinese secondary schools.
5. To examine the significant mediating role of teachers' ICT self-efficacy on the

relationship between principal digital leadership and teachers' digital competency within the context of Chinese secondary schools.

6. To explain the role of principal digital leadership in promoting teachers' digital competency in the teaching and learning process within the context of Chinese secondary schools.

1.5 Research Questions

This research seeks to address the following questions:

1. What is the level of principal digital leadership, teachers' digital competency and teachers' ICT self-efficacy in Chinese secondary schools?
2. Is there a significant influence of principal digital leadership on teachers' digital competency in Chinese secondary schools?
3. Is there a significant influence of principal digital leadership on teachers' ICT self-efficacy in Chinese secondary schools?
4. Is there a significant influence of teachers' ICT self-efficacy on teachers' digital competency in Chinese secondary schools?
5. Does teachers' ICT self-efficacy mediate the relationship between principal digital leadership and teachers' digital competency in Chinese secondary schools?
6. How is the role of principal digital leadership in promoting teachers' digital competency in the teaching and learning process within Chinese secondary schools?

1.6 Research Hypotheses

H1: Principal digital leadership has a positive significant influence on teachers' digital competency in Chinese secondary schools.

H2: Teachers' ICT self-efficacy has a positive significant influence on teachers' digital competency in Chinese secondary schools.

H3: Principal digital leadership has a positive significant influence on teachers' ICT self-efficacy in Chinese secondary schools.

H4: Teachers' ICT self-efficacy mediates the relationship between principal digital leadership and teachers' digital competency in Chinese secondary schools.

1.7 Significance of Study

The significance of this research has been divided into the significance for the government, the significance for the educators and the significant for the society:

Limited research exists on digital leadership in China and how it affects teachers' work behaviors in IR4.0. In the process of educational digitalization in China, this research would help government or organization have a better understanding of digital integration in teaching and learning in secondary schools and help to improve the process of educational policy implementation in educational practices. Additionally, this study will increase knowledge of this topic and improve comprehension of encouraging digital leadership and expertise in implementing the Education IT 2.0 Action Plan in China.

This research provides an exciting opportunity to improve principals' and teachers' knowledge and understand the notion of digital competency. For principals, this study would help to realize their level of digital leadership and comprehend the notion of their role in digitalization in their schools. It also offered some valuable references for principals to implement the educational digitization policies in the context of Education IT 2.0 in China. In terms of teachers, this study would provide a comprehensive perspective for teachers to understand their level of using digital technology in their teaching practices and realise how their mental activity and confidence affect their teaching job with ICT.

This study offers some important insight into the popularization of digital competency in secondary schools, which contributed to the efficiency and quality of education and was considered by other shareholders like the community, students, and parents. Therefore, the research will concern with the benefit to the public and remarkable social significance. Moreover, the sample schools of this research will be selected from the east region in Guangdong Province, China, which is a typical underdevelopment region in China. This work will contribute to the advance of digital competency and leadership development in less developed area.

This study provides significantly to the theory of educational leadership by offering views on the dynamics of digital leadership in Chinese secondary schools. The study's emphasis on principal digital leadership gives a deeper understanding of how leadership theory can be used in the context of technological integration, with implications for both leadership practices and the broader educational landscape. Furthermore, by investigating the mediating effect of teachers' ICT self-efficacy in the relationship between principle digital leadership and teachers' digital competency, the study is consistent with theories that emphasize the importance of individual beliefs and attitudes in educational leadership. This adds dimensions to existing leadership frameworks by recognizing the complex relationships between leadership practices, teacher self-efficacy, and digital competency.

1.8 Limitation

This study faces several limitations. First, the sample is limited to selected secondary schools in the east region of Guangdong Province, which may affect the generalizability of the findings to other regions in China. Second, due to practical constraints, the study could not include a sufficient number of principals as participants.

Consequently, the evaluation of principal digital leadership relies primarily on teachers' perceptions rather than direct input from school leaders. Finally, time and resource constraints restricted the researcher from expanding the data collection to a broader range of schools and participants, which may limit the comprehensiveness of the findings.

1.9 Operational Definition

This research contains three variables. The independent variable is principal digital leadership. The dependent variable is the teacher's digital competency. Teachers' ICT self-efficacy will be a role mediating variable. The following paragraphs describe the operational definition of these variables.

1.9.1 Digital Leadership

Digital leadership in the educational field is a new concept which has been put forward in the context of the digital age (Arnold & Sangrà, 2018). In this study, the term "digital leadership" refers to the leadership style used by principals in secondary schools to transform schools into digital environments where all aspect of the educational process—including management, teaching, and learning—is conducted utilizing contemporary technological platforms (ISTE, 2009). The principals' digital leadership has been divided into five dimensions which put forward by ISTE standards for Administrators (2009) and those standards also will adopt to measure principals' digital leadership in this research.

Based on the opinion of the ISTE Standards for Administrators (ISTE, 2009), digital leadership have divided into five aspects: visionary leadership, digital age learning culture, excellence in professional practice, systemic improvement and digital citizenship. The specific meaning of these five dimensions is elaborated as follows:

1. Visionary leadership: Principals are expected to motivate and cultivate a shared vision for meaningful change among stakeholders, ensuring the effective utilization of digital-age tools to enhance learning outcomes, strengthen teaching practices, and elevate the performance of both school and district leadership. Taking part in an ongoing process to create, implement, and share strategy plans that use technology and remain in line with a shared goal. Advocate at the local, state, and national levels for policies, programmes, and funds that will help put a strategy and strategic plan in place that includes technology (ISTE, 2009).
2. Digital age learning culture: This dimension required principals should continuously improve digital age learning through instructional innovation. Modeling and encourage regular and effective learning technology usage and meet all students' various requirements in learner-centered environments with technology and instructional tools. In addition, should ensure effective technological study and curricular integration and participate in local, national, and worldwide learning communities that foster creativity, innovation, and collaboration in the digital age (ISTE, 2009).
3. Excellence in professional practice: This element emphasises the need for principals to provide enough time, resources, and opportunity for professional development in technology literacy and integration. They should create learning communities that encourage, support, and empower administrators, educators, and staff to successfully accept and use technology. Furthermore, principals should educate stakeholders in using digital technologies for communication and cooperation. In addition, also should maintaining current knowledge of educational research and technological trends and promote examination of new technologies to increase student learning (ISTE, 2009).

4. **Systemic improvement:** Principals are in charge of establishing quantifiable goals, collecting and analysing data, evaluating outcomes, and sharing insights to enhance both staff and student education. Furthermore, they should draw in and keep competent personnel who use technology creatively to achieve academic and institutional goals. Strategic collaborations foster systemic improvement. Build and sustain a comprehensive technological infrastructure with integrated, interoperability systems for administration, operation, teaching, and learning.
5. **Digital citizenship:** this dimension refers to principals should give all students equal access to digital tools and resources. Promote, model, and build digital information and technology rules for safety, legality, and ethics. Encouraging and demonstrate appropriate technology and information usage in society. Furthermore, it is essential to encourage and facilitate cultural awareness and global participation by utilizing digital communication and collaboration strategies (ISTE, 2009).

1.9.2 Teacher Digital Competency

For this study, consider excluding the factor of teacher with limited teaching experience. teachers' digital competency defines as a set of skills and abilities that enable teachers with more than 1 year teaching experience to use ICT as a methodological resource that is incorporated into the teaching and learning process and consists of five main dimensions of competencies which have been put forward in the ISTE standard for teachers and that also will be used in measure teachers' digital competency in this study.

The specific meaning of these five dimensions is elaborated as follows:

1. **Facilitate and Inspire Student Learning and Creativity:** This dimension required teachers apply their expertise in the field of teaching, and technological skills to