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A National Study of Leadership in the Irish Primary Sector: STEM Education and Wellbeing during Crisis

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Doctorate of Education Degree

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DECLARATION

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DEDICATION

I dedicate this dissertation to my wonderful parents, Grace and Pearse, who instilled a love and appreciation for learning in me from an early age. Through support and encouragement, they have taught me to work hard for the things that I aspire to achieve.

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List of Abbreviations

BoM = Board of Management

CFA = Confirmatory Factor Analysis

CPD = Continuing Professional Development

CSL = Centre for School Leadership

DEIS = Delivering Equality of Opportunity in Schools

DES = Department of Education and Skills

DE = Department of Education

DfE = Department for Education

DeSeCo = Definition and Selection of Competencies

EFA = Exploratory Factor Analysis

EU = European Commission

FNBE = The Finnish National Board of Education

HR = Human Resources

HSE = Health Service Executive

ICC = Intraclass correlations

INTO = Irish National Teachers' Organisation

IPPN = Irish Primary Principals' Network

ICT = Information Communication Technology

LAOS = Looking at Our School

LDS = Leadership Development for Schools

NAP = Newly Appointed Principal

NCCA = National Council for Curriculum and Assessment

NCEE = National Centre on Education and the Economy

NCSL = National College for School Leadership

NCTL = National College for Teaching and Learning

OECD = Organisation for Economic Co-operation and Development

PA = Parents' Association

PDST = Professional Development Service for Teachers

RDS = Royal Dublin Society

SEF = Schools of Excellence Fund

SEM = Structural Equation Modelling

SESE = Social, Environment and Scientific Education

SSE = School Self-Evaluation

SPSS = Statistical Package for the Social Sciences (statistics software)

SMET = Science, Maths, Engineering and Technology

STEM = Science, Technology, Engineering and Maths

TRA = Teaching Regulation Agency

UK = United Kingdom

UNESCO = United Nations Educational Scientific and Cultural Organisation

US = United States

ABSTRACT

Principals are leaders in school communities and their role is becoming increasingly more autonomous. Specifically, the role of the principal is evolving given the continuous implementation of new reforms and policies. This dissertation seeks to explore the leadership role of principals in the context of STEM education and crisis management. By drawing on Ability, Motivation and Opportunity (AMO) Framework and Relational Coordination (RC) Theory, this dissertation makes an original contribution to knowledge by answering the following research questions: (1) How do principals influence or promote STEM education? (2) How does principal leadership influence their own wellbeing, and their school's performance during the Covid-19 crisis?

To do so, this research is organised into two studies. Study 1: *Leadership in STEM Education*, which builds on and contributes to knowledge in the influencing of and promotion of STEM education. For example, although studies have examined STEM education, limited research has explored how transformational leadership can be effective in influencing improved STEM implementation in school settings. Following this, Study 2: *Leadership during the COVID-19 Crisis*, contributes to existing literature supporting the importance of developing effective leadership in times of crisis. For instance, despite the number of studies focused on organizational leadership during crises, few have explored if transformational leadership is effective for organizational changes and crisis-management.

Overall, this dissertation contributes to knowledge around principals and policy or initiative implementation by offering new and original contributions to this field. Furthermore, the studies reveal current leadership practices and insights on STEM education and crisis management.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter commences with an overview of the research, followed by outlining the motivation, aims, and the overarching research questions of the dissertation. Next, the chapter provides an overview of each study included in the dissertation whilst justifying their significance within the context of STEM (Science, Technology, Engineering and Maths) education and crisis management. Finally, the structure of the thesis is presented, offering an outline of the contents of each chapter.

1.2 Overview

The researcher's experiences of teaching in a primary school, under the management of a National Principals' Representative for the Irish National Teachers' Organisation provided them with many opportunities to observe first-hand the multi-faceted, important role of principals. Additionally, as STEM coordinator of the school, the researcher was responsible for supporting the principal in their implementation of STEM activities and policies at a whole-school level. This included supporting the principal with the school's transition to a digital working environment during the Covid-19 pandemic.

Aside from duties within the school environment, the researcher has worked with numerous national STEM outreach projects and organisations on the development of teaching and learning resources and facilitating STEM showcases. Through this work, the researcher has interacted with a variety of stakeholders including principals, teachers, parents, students, universities, education centres, teachers' unions, professional development services for teachers and outreach providers. Collectively, these experiences allowed the researcher to

gain insights into the role of the principal as gatekeeper of new initiative implementation in schools, thus inspiring the focus of this research project.

The role of the primary school principal is critical and has a significant impact on school effectiveness (Leithwood and Montgomery, 1982). This is echoed by Portin et al. (1998) who define principals as: *“key individuals, as well as instructional leaders, initiators of change, school managers, personnel administrators, problem solvers and boundary spanners”* (p. 40).

As crucial figures in Irish society, principals are accountable for 3,241 primary schools in Ireland with 39,604 staff and 561,411 students (Department of Education and Skills, 2021). This places them as gatekeepers, with the responsibility for fostering an environment to promote inclusive, successful practices and for prioritising educational merit (Hargreaves & Fink, 2006; Hargreaves, 2005). Additionally, according to the Department of Education and Skills (DES), the day-to-day management of the school, including providing guidance and direction to teachers and other members of staff is the responsibility of the principal (DES, 2016a). Within this role, duties include creating, communicating, and delivering a leadership vision, delivering and developing high quality teaching and learning, resource management, human resource (HR) management, administration, policy formation and managing external relationships (Drea & O’Brien, 2003).

Interest in school leadership has grown in recent years for various reasons including the development of school-based management, whereby responsibility has been transferred from national or regional levels, to the individual school level (Huber & Muijs, 2010). Consequently, the role of the principal is becoming increasingly autonomous (Heffernan, 2018). For instance, in a paper on the exploration of the factors that have shaped principal identity, Sugrue and Furlong (2002) highlight that principals are blindsided and overwhelmed by new directives, reforms, and policies to implement. Furthermore, it is common for

implementation plans not to accompany policy documents (Ball, 1997; Ball et al., 2011; Skerrett et al., 2021), and policies and new directives are generally written by government agencies, without seeking input from crucial stakeholders (Ball, 2012). This leaves principals with the duties of reading, interpreting, and developing plans of action for any directive or policy released by government agencies.

1.3 Research Motivation and Aims

Preparing principals to navigate the challenges associated with the role is largely neglected in Irish educational research (Cuddihy, 2012). For example, an Irish national report compiled by Leadership Development for Schools (LDS) for the Organisation for Economic Co-operation and Development (OECD), explains that the leadership of learning is largely neglected when it comes to the role of the principal (Leadership Development for Schools, 2007). Likewise, a report from OECD confirms that a lack of literature was impeding the system's ability to address leadership support issues (Elmore, 2008). In addition to insights gathered by government agencies surrounding the lack of leadership training for principals, scholars also highlighted that principals' voices are rarely heard in the pool of education policy stakeholders (Surgue, 2005):

As such, research in the area of leadership is essential in order to comprehend social reasoning behind why certain practices present (Hallinger & Heck, 2002; Heck, 2012). Accordingly, a *'Review of the Irish School System'*, (Coolahan et al., 2017), addresses acknowledgement of the lack of focus on principalship and explores efforts and initiatives that are linked to international policy changes. Efforts that are being carried out to promote for an increased focus on leadership include: the introduction of policies at national level, changes within the organisation at school level and school leadership professional development provision (Harris et al., 2016; Murphy, 2019). Reflecting on the importance of

school leadership, Bush (2008) urges that we cannot leave the preparation and development of leaders to chance.

To fully understand the challenging and complex role of the principal (Pont et al., 2008), and how best to support them, this research focuses on primary school principals. Specifically, the research explores the relationship that various factors have on leader wellbeing and implementation of new initiatives. Furthermore, it investigates the concept of school performance, regarding school staff's proficiency, adaptivity and proactivity in carrying out the core parts of their job (Griffin et al., 2007). The research was carried out in the contexts of STEM education and crisis management. Whilst research relating to school leaders to date has focused on school performance in the context of student academic achievement in addition to social and emotional growth (Anderson, 2017; Harris & Townsend, 2007; Marks & Printy, 2003b), little research has been carried out on school leaders' implementation of specific policies and initiatives in relation to their communication with government agencies and their school communities. Therefore, this dissertation seeks to investigate principals as transformational leaders, and their navigation of new initiatives and organisational change by answering the following research questions:

- (1) How does principal leadership influence the adoption of STEM education in their school?
- (2) How does principal leadership influence their own wellbeing, and their school's performance during the Covid-19 crisis?

1.4 A Two-Study Approach

In exploring the role of the principal, this dissertation adopts a two-study approach. Study 1 is the study of Leadership (transformational leadership (ability), consultation (motivation), and access to specialist teachers (opportunity)) in relation to the adoption of

new initiatives, e.g., STEM (commitment, intention, implementation, participation). Study 1 draws on Ability, Motivation and Opportunity (AMO) Framework (Appelbaum et al., 2000).

Study 2 is the study of Leadership (transformational leadership in relation to school performance during crisis and work alienation during crisis mediated by relational resources (Employee Trust and Relational Coordination). Study 2 applies Relational Coordination Theory (Gittell, 2011). Together, these two studies provide insight into principals' perceptions, actions, and requirements regarding managing their school community and their own wellbeing. Table 1.1 presents an overview of the two studies in terms of research questions, theories, methods, and levels of analysis. Additionally, a summary of each study is presented below.

Table 1.1 Overview of the Two Studies

Study	Title	Research Question(s)	Theory	Method	Level of Analysis	Outcomes
1	Leadership in STEM Education	How does principal leadership influence the adoption of STEM education in their school?	Ability Motivation and Opportunity Framework	Survey to Primary School Principals	Individual Level	- Presented at the Irish Academy of Management (IAM) Conference 2021 - John Coolahan Irish Teaching Council Project 2021 - Presented at the 82nd Annual Meeting at the International Academy of Management (AOM) Conference 2022
2	Leadership During the COVID-19 Crisis	How does principal leadership influence their own wellbeing, and their school's performance during the Covid-19 crisis?	Relational Coordination Theory	Survey to Primary School Principals	Individual Level	- Presented at the European Academy of Management (EURAM) Conference 2021 - Presented at the 81st Annual Meeting at the International Academy of Management (AOM) Conference 2021 - Presented at the Irish Academy of Management (IAM) Conference 2021 - National Report and Launch (Fahy et al., 2020)

1.4.1 Study 1 - Leadership in STEM Education

This study explored Irish primary principals' experiences and perceptions of leadership in STEM education and aimed to systematically identify the key factors which affect principals' engagement with STEM education. Drawing upon the ability, motivation and opportunity (AMO) framework (Appelbaum et al., 2000; Boxall, & Purcell, 2003), the findings identify transformational leadership (ability), consultation with government agencies (motivation) and access to specialist teacher instruction (opportunity) as key drivers for principals' engagement with STEM education. Similarly, four outcomes on principals' engagement with STEM education are examined, including, (i) principal commitment to STEM education, (ii) principal intention to adopt STEM education, (iii) school implementation of STEM education and (iv) school participation in STEM weeks. The findings from descriptive and prescriptive analysis demonstrate that transformational leadership is significant in influencing principal commitment to STEM education, principal intention to adopt STEM education, school implementation of STEM education and school participation in STEM-related weeks. Additionally, consultation with government agencies was significant, with school participation in STEM weeks having a non-significant relationship. Similarly, access to specialist teacher instruction was found to be significant, with principal intention to adopt STEM education being non-significant. Furthermore, important findings emerged in relation to principals' positive experience and value of STEM education in addition to challenges including time pressures and resources.

1.4.2 Study 2 - Leadership during the COVID-19 Crisis

Originally the researcher had planned to hold a conference in April 2020 and carry out 20 focus groups based on the results of the Leadership in STEM Education survey with 200 principals and various STEM policy stakeholders. Following discussions with representatives

from the INTO and the Irish Teaching Council at the beginning of the Covid-19 lockdown in March 2020, it was decided to postpone the STEM-focused research to ensure that principals could focus instead on navigating the Covid-19 crisis. As such, the researcher decided to conduct a second study on principals and transformational leadership during crisis. This study built on the knowledge in the area of leadership retrieved from Study 1. It investigated the impact of transformational leadership which is hypothesized to influence principals' own wellbeing and their school's performance during the COVID 19 crisis. The study explored (i) principals' perceptions of leadership during COVID-19, (ii), their recommendations for improvement, (iii) the effect that transformational leadership has on school performance and work alienation during a crisis and (iv) the effect that relational coordination and employee trust have on the relationship between this relationship. Accordingly, the research question addressed in this study is: How does principal leadership influence their own wellbeing, and their school's performance during the Covid-19 crisis?

Study 2 builds on and contributes to work in developing effective leadership in times of crisis. Although studies in leadership have examined organisational leadership during crises, few have explored the extent of which, and how transformational leadership is effective for organisational changes and crisis-management. To address this issue, two relational resources which concern actions or strategies which promote the connection of people or things (Story et al., 2009) are proposed,. The relational resources explored in this study are employee trust and relational coordination, as mediators between transformational leadership and positive outcomes during a crisis. Using data from a unique sample of 634 leaders from Irish primary schools as they navigated through the COVID-19 crisis, this study analyses school principals' leadership on school performance and their work alienation through relational resources. Structural equation modelling is employed to test hypotheses developed in this study. Mixed findings emerged in relation to the mediating process of

relational resources for the impact of transformational leadership on school performance and on leaders' work-alienation. Findings also emerged in the areas of students and families with additional needs and digital learning. Implications are discussed.

Although the two studies focus on different contexts, the overall research aim was to gain insight into the onerous role of the primary school principal. As such, this dissertation takes a two-study approach, to highlight the evolving duties and responsibilities of principals emerging within the context of STEM education (Study 1) and the COVID-19 pandemic (Study 2). Both studies explore the concept of transformational leadership and its impact on school performance.

1.5 Significance of the Research

The research project focused on principals' roles in STEM education and crisis management and makes several significant contributions to education and leadership research as well as to policy and management practices. First, the research extends our understanding of principals as leaders in the education sector. In education research, existing international literature has largely focused on the indirect impact of school leadership on school performance (Coolahan et al., 2017; Day et al., 2016; Leithwood et al., 2008; Thien, 2019). In recent Irish education leadership literature, there has been an increasing focus on the concept of the onerous role and obligations that face principals and the development of leadership preparation programmes to address challenges associated with evoking change and building trust (Murphy, 2019; Surgue, 2003a, 2005). However, principals' perceptions of their relationships and communication with relevant stakeholders is largely overlooked in the literature, particularly in the primary school sector (Kitt, 2017). As such, by exploring primary school principals' perceptions of leadership, communication and school performance, this dissertation contributes to providing insight into the complexity of increasingly performative policy demands on principals (Surgue, 2005).

Second, the dissertation extends knowledge supporting the development and promotion of STEM education. Student and knowledge-centred, STEM contains elements of inquiry, discovery and integration, addressing relevant issues in students' lives, thus helping them to contextualise and recall knowledge. The skill of problem-solving to face 21st century societal challenges, requires social collaboration and the integration of more than one discipline (Royal Geographical Society, 2019). Thus, integrated STEM education can help students to collaborate and address such challenges because it has the power to *“restructure what we teach and what students learn”* (Herschbach, 2011, p. 98). Specifically, by investigating the roles of transformational leadership, consultation with government agencies and access to specialist teacher instruction and their importance in promoting principal commitment to STEM education, principal intention to adopt STEM education, school implementation of STEM education and school participation in STEM-related weeks. For example, the dissertation suggests that principals who are transformational leaders, regularly consult with government agencies, and have access to specialist teacher instruction are more likely to support the development and promotion of STEM education within their schools.

Furthermore, the study adds new insights within the context of school leadership, including the challenges associated with navigating STEM education. For instance, the dissertation identifies four complex and evolving challenges currently associated with STEM implementation including time pressure, lack of resources, schools with additional needs (lack of context-specific supports) and policy directives, all of which remain underdeveloped in the context of Irish education literature.

Third, the dissertation contributes to the development of leadership policy focused on crisis management. For instance, an outcome of this dissertation has been a national report titled 'Irish Primary Leadership during the COVID-19 Crisis' (Fahy et al., 2020). This report contains recommendations derived from investigating principals' experiences of leadership

during the COVID-19 pandemic. For instance, it provides a list of suggested actions that specific government agencies could take in the areas of isolating children, contact tracing, establishing regional helplines, sanitising equipment, substitution, administrative duties, the postponement of new initiatives and inspections, principal wellbeing, working digitally, professional development, collaborative learning & sharing communities (Fahy et al., 2020). By voicing primary principals' experiences and insights as leaders of their schools, this work can support the development of new policies that are centred around promoting effective transformational leadership and communication strategies across the school community. This is important because enhancing communication and leadership practices has been found to mitigate the likelihood of leader burnout (Gill et al., 2006). Furthermore, the research contributes to setting the foundation for further national and international education research concerning leadership. For example, given the broad focus of each study there is potential for further studies to be adopted for other subject areas as well as future comparative research with education systems globally.

1.6 Structure of the Dissertation

Chapter One introduces the overview of this dissertation which includes the objectives and general process of this dissertation. It outlines the significance of this research, especially with regards to the principal and Irish primary sector context. It also presents the research questions and outlines the thesis structure.

Chapter commences with the introduction of principals as leaders, the role of the principal in implementing policies, preparation for leadership, and the evolution of leadership styles. Next, an overview of the Irish education system is explored, followed by international and national changes in education. Following this, the evolution of STEM education is explored, with an explanation of what STEM is, how it has developed in an educational context, and professional development opportunities that exist for Irish educators in this area.

Finally, the chapter concludes with a summary of the research questions and the topics covered in the literature review.

Chapter Three presents a review of key literature and the development of hypotheses. Firstly, for Study 1, leadership in STEM education, key national and international education policies are critiqued and the work draws upon Ability, Motivation, Opportunity (AMO) framework (Appelbaum et al., 2000; Boxall, & Purcell, 2003). Within this framework, the researcher rationalizes transformational leadership as the ability, consultation with government agencies (motivation) and access to specialist teacher instruction (opportunity) as key drivers for principals' engagement with STEM education. Secondly, for Study 2, leadership during crisis, key research on transformational leadership during organisational change and crisis-management is critiqued. Two relational resources, namely employee trust and relational coordination, as mediators between transformational leadership and positive outcomes during crisis are explored.

Chapter Four outlines the philosophical basis of the research methodology used in this dissertation. It describes the appropriateness of a post-positivist approach which provides the support for survey-based research. Following this, a detailed outline of the research processes for each study is presented. Here, the sample is outlined, how the survey is designed using Chatterji's (2003) education research instrument design approach and how it is conducted by employing Dillman's (2011) Tailored Design Method. The survey variable measurements and their validity and reliability are presented.

Chapter Five explores the analysis of data from Study 1: Leadership in STEM Education. Within this chapter, the results of the data analysis are explored, and this includes a presentation of sample representativeness, support for data aggregation, common bias check, descriptive statistics, and structural equation modelling analysis of the study. Open

comment analysis is also presented. The chapter concludes with a synthesis of the qualitative and quantitative findings.

Chapter Six explores the analysis of data from Study 2: Leadership During the COVID-19 Crisis. Within this chapter, the results of the data analysis are explored, and this includes a presentation of sample representativeness, support for data aggregation, common bias check, descriptive statistics and structural equation modelling to test hypotheses developed in this study. Open comment analysis is also explored, and a synthesis of the qualitative and quantitative findings is presented.

Chapter Seven presents a discussion on the research findings. First, the research aims are re-stated and an overview of the findings in Study 1 and Study 2 is outlined. Following this, theoretical implications and implications for future practice are explored. Lastly, limitations and future research are discussed, and a summary is provided.

Chapter Eight provides a short and general conclusion. It reiterates the research aims, research models, findings, and implications from the overall research.

1.7 Chapter Summary

This chapter commenced with an overview of the research motivation and aims. Next, the two studies were introduced. Following this, the significance of the research was discussed. Finally, the structure of the dissertation was provided. The next chapter presents a review of the key literature relating to the research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the key literature relating to the dissertation. It commences with the introduction of principals as leaders, the role of the principal in implementing policies, preparation for leadership, and the evolution of leadership styles. Next, an overview of the Irish education system is explored, followed by international and national changes in education. Following this, the evolution of STEM education is explored, with an explanation of what STEM is, how it has developed in an educational context, and professional development opportunities that exist for Irish educators in this area. Finally, the chapter concludes with a summary of the research questions and the topics covered in the literature review.

2.2 Principals as Leaders

2.2.1 The Role of the Principal

In an exploration of the historical evolution of the role of the Irish Primary Principal, Sugrue (2014) outlines three key phases, the first pre-1971 depicts that the principals' role was predominantly administrative, followed by a shift from 1971-1989 towards largely managerial duties and the final stage, from the 1990s onwards illustrates an increasing emphasis on leadership in addition to pre-existing managerial and administrative responsibilities. For example, Sugrue and Furlong (2002) suggest that principals were blindsided by new reforms and policies. Similarly, Fullan (2005) heavily criticises the commencement of the stage in the 1990s, reporting the perils that principals faced including

increased leadership training and insufficient professional development. Consequently, Ireland saw a rise in early retirement and the emergence of teacher's negative associations around assuming principalship and its accompanying accountability (Fullan, 2005; Sugrue, 1999). Furthermore, it wasn't until the early 2000s that national attention was directed to clarifying the role and duties of a primary school principal.

For instance, an Irish Primary Principals' Network (IPPN) commissioned report explores policy and research to derive a clear and current definition for the role of principal in Ireland (Drea & O'Brien, 2003). The key duties are broad and could be applicable to most organisational or industrial managers. For example, the report suggests that principals face measurable duties such as managing resources and finances in addition to less measurable duties such as leadership provision and fostering of a positive work environment. Likewise, specific duties are listed including creating, communicating and delivering a leadership vision, delivering and developing high quality teaching and learning, resource management, human resource management, administration, policy formation, and managing external relationships (Drea & O'Brien, 2003). Moreover, given the high volume of duties that principals face coupled with principals' priorities and their realities, principals must prioritize their tasks and divide up their time accordingly (Chan & Pool, 2002).

In Ireland the role of principal can vary depending on the school context. For instance, there are two types of principals in Ireland, teaching and administrative principals. Due to the small nature of many schools in Ireland, 57% of Irish principals are teaching principals, whereby they perform their principal duties whilst also holding the role of a teacher. The remaining number of principals who manage larger schools perform administrative duties solely. Whilst the two roles are very different, literature and policy that inform the actions of principals does not differentiate between principal types, largely because they are identical, with the teaching principal assuming a second role on top (Stynes, 2014). Additionally, key

educational policy documents in Ireland often do not distinguish between teaching principals and administrative principals, often treating the roles as being equal in terms of the directives that are required of them (DES, 2017d; Government of Ireland, 2016). Regardless of the school size however, Irish primary principals work with a governance team, who support them in their decision making.

2.2.1.1 The Irish Principal and the Board of Management (BoM)

In Ireland, the local government plays a very small part in the governance of primary schools. In fact, the responsibility for governance of a primary school rests with the Board of Management (BoM) (Coolahan et al., 2017). The BoM is an important stakeholder that all schools must have (Government of Ireland, 1998). Furthermore, the BoM manages the school on behalf of the patron and is accountable to the patron and the Minister. Therefore, it is their responsibility to ensure provision of an appropriate education for every pupil in the school.

The Board is composed of one or two direct nominees of the patron, two parents of the school, one other serving teacher on the staff of the school, and two extra members proposed by those nominees in addition to the principal (or acting principal). The principal holds accountability for responsibility to the BoM in addition to the provision of leadership to members of the school community. Given the voluntary nature of the members' roles, meetings are generally scheduled outside of school hours. This puts the principal in the position of manager of the school with regards to day-to-day activities (Government of Ireland, 1998; Stynes, 2014). The Irish national school system which dates back as far as 1831, in the Victorian era was intentionally established with management hierarchy structures in mind however never was it intended that the principal teacher should assume the role of the manager (McDonald, 2008). Despite this, over time, managing the school has become a standard component of a principals' job. Additionally, in recent years, principals have become more autonomous with regards to school self-evaluation.

2.2.1.2 The Role of the Irish Principal in School Self-Evaluation (SSE)

School Self-Evaluation (SSE), is a key area of focus with regards to Irish leadership reformation (DES, 2017; DES, 2018). For instance, recent documents and policies in this area form part of an international drive to unify leadership and assessment strategies (Hult et al., 2016; Murphy, 2019; Schildkamp et al., 2012). This is demonstrated in a recent Irish publication, *'Looking at Our School'* (DES, 2016a), which outlines a leadership framework that School principals should use as a tool for self-reflection and amelioration. Malone and Caddell (2000) commend principals for their inspiring dedication to education and effecting change in schools. As managers of their schools, principals along with their leadership team are encouraged to adopt control of the leadership framework within the school: (i) Leading Teaching and Learning; (ii) Managing the Organisation; (iii) Leading School Development and (iv) Develop Leadership (Department of Education and Skills, 2017a).

When it comes to adopting and implementing new ideas, people are most likely to be influenced by the views and experiences of their colleagues (Mathews, 2010). For instance, staff are viewed as being less daunting, more practical, more realistic and more trustworthy than pursuing research-based practices (Carter & Wheldall, 2008; Landrum et al., 2002). With a strong emphasis on collegiality, the Looking at Our Schools (LAOS) document published by the inspectorate promotes for professional development within schools (DES, 2016a). However, this comes at the cost of increased demands on the school principal. Furthermore, it impacts on the development of government leadership policy revisions and hence contributes to the rise in distributive leadership practice in Irish schools (King & Nihill, 2019). With increasing freedom and autonomy continuing to be granted to principals (Government of Ireland, 2011), effective outlets to promote a safe and workable environment for their school community and indeed their own well-being are crucial in order to sustain effective education provision (Dempsey & Burke, 2020).

2.2.1.3 Managing Emotions and Relationships

Warr et al. (2018) highlight the positive link between work performance and principal wellbeing. They suggest that wellbeing is associated with faster mental processing, increased positive decisions, enhanced perseverance, increased positive expectations, improved optimism, greater exhibition of creativity and self-esteem and ameliorated cooperative relationships. There is an abundance of literature available on the formal role of the school principal, but less so on the informal aspects including managing relationships and the emotions associated with this practice (Cliffe, 2011; Kelchtermans et al., 2011).

However, the research that has been carried out on such informal aspects suggests that principals are faced with the challenging task of managing emotions, relationships, and interpersonal behaviour (Beatty & Brew, 2004; Crawford, 2007; Hanhimäki & Tirri, 2009; Kitt, 2017; Littrell et al., 1994; MacBeath & Myers, 1999). For example, in a study conducted by MacBeath and Myers (1999), stakeholders in the school community including parents, teachers and students depicted capacity for relationship building as the most important factor involved in successful principalship. Interestingly, all stakeholders held almost identical views on this topic centring mainly on relationships and personal qualities. Students elaborated on caring qualities and adults discussed the importance of empathy. This point is supported by Kelchtermans et al. (2011), who notes that emotional relationships are crucial for effective educational leadership also suggests that efficiency, performativity and formal results are often prioritised when it comes to measuring leadership success. Despite this, difficulties that arise relating to relationships still need to be addressed. For example, Malone and Caddell (2000) make reference to challenges facing principals including: dealing with immature staff members, encountering criticism from faculty and the school community as a result of their decision-making processes, resolving internal and external disagreements and taking responsibility for problematic situations, even when they do not concern the

principal. With regards to navigating challenges in this area, it is suggested that increased work experience of a principal can influence higher teacher self-efficacy (Fackler & Malmberg, 2016). This is supported by Mooney and Moles (2011), who claim that a principal's confidence is key to their effectiveness to lead. Additionally, whilst staff support is important for principals, as leaders they need to have the ability to provide self-recognition for their achievements (Malone & Caddell, 2000).

In summary, the role of the primary school principal is one that is challenging and complex (Pont et al., 2008). They are responsible for the management of the school including staff, students and the BOM (Condrón, 2011; Coolahan et al., 2017; King & Nihill, 2019), navigating new policies (Fullan, 2005), and School Self-Evaluation (DES, 2016a). Aside from the formal aspects associated with the role of the principal, they are also tasked with informal aspects including managing emotions, relationships, and interpersonal behaviour (Crawford, 2007; Hanhimäki & Tirri, 2009; Kitt, 2017).

2.2.1.4 School Leaders and School Performance

According to Anderson (2017), school leadership is a critical component for strong performance and student achievement. Leithwood et al. (2004) support this finding, suggesting that leadership plays a central role in school improvement. Furthermore, Berliner, (2006) highlights that improved student outcomes are sustainable and are most substantial and in schools where the principal exerts their influence. Leithwood and Jantzi (2000) elaborate on the importance of the principal and suggest that the majority of school restructuring initiatives rely heavily on individuals, in addition to whole organisations. Furthermore, they suggest that commitment and high levels of motivation are skills that are required to address significant problems linked to implementation of reorganising initiatives. In fact, it is suggested that unreasonable reliance is often placed on an individual leader (Hargreaves & Fink, 2006; Hulpia et al., 2012), as opposed to employing the concept of

collaborative leadership in lightening the load of principalship, promoting for wellbeing and work-life balance of principals (Harris & Townsend, 2007).

School leaders must strike a balance among politics, management and instruction in their individual school contexts in order to be deemed successful. Huber and Hiltmann (2010) support this notion, making reference to the importance of leaders' relationships with the social, economic and cultural changes and developments that take place in their respective national and local contexts. Moreover, literature suggests that expectations of school leaders are changing globally at an increasing pace as a result of both subtle and direct social, political and economic forces in society. In his exploration of theories of educational leadership and management, Bush (2003) suggests that organisations only exist to meet predetermined targets and claims that subjectivity exists amongst stakeholders as a result of their varying values, beliefs, interests and goals. It can be challenging therefore to assign internationally aligned directions for achieving success. Day (2007) supports this point, suggesting that whilst we know that there are successful principals globally, we have yet to decipher what success means, how it is measured and sustained within a variety of cultures and socio-economic domains.

2.2.1.5 Principal Attributes and Skills

The International Successful School Principals Project (ISSPP) is revolutionary in terms of exploring principal success internationally. Involving 25 countries project that captures multi-perspectives through case study explorations of principals who are deemed as being outstanding in their respective countries (Day & Leithwood, 2007; Gurr & Day, 2014; Moos et al., 2011; Ylimaki & Jacobson, 2011). This resulted in a detailed picture of the attributes, tactics and talents of effective school leaders from diverse socio-economic contexts in different countries (Day, 2015).

In exploration of this literature, it is claimed that effective school leadership is a crucial factor in student academic achievement (Fink & Brayman, 2006; Hallinger & Heck, 1998; Leithwood et al., 2008; Macmillan, 2000). Additionally, the majority of leaders who are deemed to be successful employ the same leadership skills and practices as one another (Bass & Avolio, 1994; Duke, 2004; Hallinger, 2003a; Harris & Chapman, 2002; Leithwood et al., 2008). Furthermore, the ways in which leaders employ these universal leadership techniques, not the practices themselves, reflect openness as opposed to dictation by the contexts that leaders work in (Harris, 2002; Leithwood et al., 2008; West et al., 2005).

Literature concerning implementation of leadership, suggests that the most powerful way that school leaders promote teaching and learning is indirectly, through motivating staff members, their dedication, and the working conditions that they set out (Day et al., 2003; Mascall & Leithwood, 2008). Furthermore, many studies have suggested that when school leadership is distributed widely (e.g. staff, parents, students etc. taking on leadership duties), it can have a stronger influence on school communities, without taking away from the authority of the principal as leader (Bass, 1985; Ensley et al., 2006; Kenneth Leithwood & Mascall, 2008; Malen, 1994). Finally, a large amount of the variance in leadership effectiveness can be attributed to a small amount of personal characteristics. For instance, most successful principals are open-minded, flexible, resilient and positive (Jacobson et al., 2005; Leithwood, 2006; Zaccaro et al., 2018).

The importance of principal attributes and skills is not a new phenomenon. For example, Sergiovanni (1987), a pioneering figure in the field of principalship research outlined a set of attributes that principals who are deemed as being successful in their roles possess. Firstly, Sergiovanni (1987) stated that rather than making the decision independently to become principals, that most are nominated or influenced to take on the role by other principals. Furthermore, the majority of principals express a genuine faith in their students

and have the capacity to work well with others on their behalf. Similarly, successful principals demonstrate enthusiasm, assume responsibility for, and strive for acknowledgement for their schools. For example, they are flexible in their approaches to ensure that their schools can function well. Finally, a good principal will carry out strategic planning, be devoted to attaining success in education (Sergiovanni, 1987).

In summary, key literature demonstrates the strong link between school leadership and school performance, i.e., the positive effects of school and its actors to attaining the goals, related to the academic achievement and personal development of students (Anderson, 2017; Berliner, 2006; Hallinger & Heck, 1998; Leithwood et al., 2004). Furthermore, specific principal skills and attributes are identified as contributing to school academic performance (Bass & Avolio, 1994; Day, 2015; Hallinger, 2003b; Leithwood et al., 2008; Sergiovanni, 1987).

2.2.2 Preparation of School Leaders

2.2.2.1 The Need for Preparation

Malone and Caddell (2000) suggest that constant public criticism, reform attempts, and demographic realities have led to a high demand for effective school principals. Similarly, Huber and Hiltmann (2010) suggest that increased attention is being placed on school leaders laying the foundations for an effective school. Furthermore, there is an international consensus that these leaders need to possess the skills required to enhance teaching and learning practices, in addition to improving overall student-development and achievement. Additionally, they explain that due to the demanding nature of the role, that suitable individuals need to be selected and prepared. Malone and Caddell, (2000) support this point, claiming that outstanding individuals are required but finding them can prove

challenging. Likewise, Pont et al. (2008) address this issue by suggesting that modernisation related to autonomy and accountability has caused a recruitment and retention crisis.

According to findings from an Irish Primary Principals' Network (IPPN) and National Association for Principals and Deputies (NAPD) national study, the role of the principal has been labelled as unattractive to high-calibre teachers, suggesting that it is "*an unwelcome distraction from their core educational interests*" (Coolahan et al., 2017, p. 184). In order to make the appointment of principal more appealing for prospective leaders and reach aspired Irish leadership quality aspirations, several issues require attention. First, restructuring of the role of the principal is called for and second, the delineation of responsibility posts in schools is required (Coolahan et al., 2017). King and Nihill, (2019) suggests that a reduction in posts of responsibility during the recession has left smaller schools struggling to find teachers willing to assume principalship. A smaller candidature pool of prospective principals could prove problematic and Huber and Hiltmann (2010) advise that careful initial selection and training of leaders is crucial for the long term success of schools. Moreover, leadership education can mitigate instances of substandard leadership, a situation that is challenging to navigate and often goes unaddressed (Huber & Hiltmann, 2010). Therefore, it is imperative that adequate supports are put in place (Coolahan et al., 2017).

It was not until the mid-1990s that global interest was shown in leadership preparation programmes (Hallinger, 2003b). As such, a lack of structure was evident within leadership programmes and leadership training was largely non-compulsory and uncommon (Bush & Jackson, 2002; Hallinger, 2003b). Revisiting the issue several years later, Bush (2008) highlights a rapid development in this area in the Western world. For example, countries including the United Kingdom (UK), France, the United States (US), Canada, Singapore, and South Africa have all piloted or established compulsory supplemental qualifications for teachers aspiring to be principals (Bush et al., 2007; Bush, 2008b).

2.2.2.2 A Brief History of Leadership Preparation in Ireland

In contrast to many other countries, despite being in a multi-faceted position with immense power, in Ireland, principals do not require any additional qualification to a teaching certification and five years of experience (DES, 2002). Many receive no formal managerial training pre-commencement however researchers have suggested that to improve schools, changes need to be made to management and leadership (Cuddihy, 2012; Sergiovanni, 1991). A transition from teacher to principal is a challenging and stressful one that requires tailored preparation (Fink, 2010). The aspect of principal preparation has been addressed by numerous studies, with many suggestions being provided for what leadership programmes should consist of. For example, Daresh (1999) suggests that principals require a myriad of practical and conceptual skills to carry out their duties and highlights the need for principal preparation programmes that provide extensive leadership training. He elaborates further, suggesting important topics for inclusion on such programmes as: fostering of teaching and learning, dedication to educational values, navigating change, liaising with internal and external groups and adoption of new skills and teaching approaches.

Within the Irish context, in 1991, the OECD and Irish Minister of Education concurred that whilst tentative efforts were being carried out in the area of preparation programmes for school leaders, that supports were not sufficient to meet the needs of perspective leaders (OECD, 1991). Almost two decades later, it was suggested that there was still room for improvement regarding Irish leadership training programmes (Sugrue, 2009b). Additionally, it was suggested that further research into the area of school leadership was necessary to enable the education system to address leadership support issues (Cuddihy, 2012; Elmore, 2008; Sugrue, 2003a, 2003b). Furthermore, research in the area of educational leadership can provide social reasoning behind why certain practices present (Hallinger & Heck, 2002; Heck, 2012). In reflection on the concept of consultation, Sugrue suggested that

“voices of school principals themselves are rarely heard amid the cacophony of the other”
(Surgue, 2005, p. 12).

2.2.2.3 Leadership Progression Support in Ireland

In terms of progression of leadership supports in Ireland, Bush (2008) urges that we cannot leave the preparation and development of leaders to chance. Significant efforts are being made to enhance the provision of leadership training programmes in Ireland, as exemplified in *‘Review of the Irish School System’*, (Coolahan et al., 2017). Whilst a lack of a focus on principalship is acknowledged, so too are efforts to bridge the gap (Coolahan et al., 2017), and many of these initiatives stem from international policy reform (Harris et al., 2016). Overall, recent Irish efforts to improve leadership supports have come in the form of new policies at national level, changes within the organisation at school level and school leadership professional development provision (Murphy, 2019). For example, the first formalised support programme for schools was the Leadership Development for Schools (LDS) programme. Established in 2002 and administered with the help and support of the Teacher Education Section of the DES, this programme was geared towards school leaders, particularly principals. Prior to the establishment of the LDS programme, the DES had provided financial aid to numerous projects targeted at the assistance of principals specifically through the professional associations, The National Association of Principals and Deputy Principals (NAPD) and the Irish Primary Principals’ Network (IPPN). The Professional Development Service for Teachers (PDST) assumed responsibility for the LDS programme in 2010 (Fitzpatrick Associates, 2018).

In an attempt to enhance Ireland’s policy and practice in school leadership, a working group was convened in 2014 by the DES. The group had two main objectives:

- (i) To derive a proposal for a model of support for professional development of school leaders, one which facilitates and empowers leaders at various stages of their careers via a focused mentoring programme with coaching support.
- (ii) Ensure that the model aligns with and expands on already established supports for school leaders, mirroring departmental guidelines on school leadership.

The culmination of this working group resulted in the Centre for School Leadership (CSL) being established in 2015, a collaboration between the DES, IPPN and the National Principal Network (NPN). This drive towards excellence in leadership instigated the initiation of a Professional Diploma in School Leadership (PDSL) in 2017, subsidised by the DES and CSL (Murphy, 2019). This programme is geared towards aspiring principals and provides participants with tuition from educational leadership scholars across a multitude of national universities in addition to practitioners with significant expertise in the area. This course includes both theoretical and practical teaching and learning modules that are specific to the Irish context including: Professional Growth and Development; Leading School Transformation; Mentoring and Coaching; Leading School Development: Continuity, Change and Capacity Building; Building Culture, Capacity and Teams (DES, 2018c).

The main leadership structure that is currently being researched by the CSL is a hybrid transformation and instructional model (King & Nihill, 2019). Furthermore, research has demonstrated that those who are deemed as being successful principals are influenced incongruously by aspects of both instructional and transformational leadership styles (Day et al., 2016). According to an OECD review, the CSL has met a number of its goals since its establishment. Prompting a dialogue about the strategic role and significance of school leadership, the CSL's, internationally influenced professional development supports have been deemed as being conducive for the Irish context by academics and practitioners.

Furthermore, mentoring programmes for newly appointed principals and coaching programmes received positive reviews from participants (OECD, 2019).

Whilst significant advances have been made, the OECD notes that the CSL and associated bodies will need to further-develop their policies and pilot programmes in order to achieve long term viability (OECD, 2019). Contextual reflection and ongoing development is imperative and there is no quick-fix, or one size fits all approach when it comes to leadership development (Boud & Walker, 1998; Fullan, 2002).

2.2.2.4 International Comparison of Leadership Progression

Internationally, the role of the principal is deemed challenging and complex, suggesting that a principal would benefit from training to face the broadened demands that face them (Pont et al., 2008). Lakomski (1999) raises the debate that context and circumstances have an impact on the definition of leadership. As such, the concept of leadership has different meanings for different people, depending on where they are from, the managerial training they receive, and their experience. Moreover, based on this assumption, Lakomski (1999) questions the value associated with leadership development programmes, noting their irrelevance in terms of general applicability. Gronn (2009) acknowledges this argument however disputes the concept of abandoning development programmes. Instead, Gronn (2009) offers the solution of reconceiving leadership definitions in a looser context, whereby setting-dependent variations can exist.

Leadership preparation and progression differs from country to country. Many countries have either compulsory additional qualifications that are required alongside a teaching degree for appointment purposes. Additionally, many countries also have continuing professional development programmes for serving principals. Table 2.1 below presents a comparison of qualifications and continuing professional development for a range of countries.

Table 2.1 International Comparison of Leadership Progression

Country	Requirements to Become a Principal	Non-Compulsory
Ireland	- 5- years of experience as a qualified teacher.	- Professional Diploma in School Leadership (PDSL). - Misneach PD for Newly Appointed Principals (PDST).
UK	- Obtain a licence issued by the Teaching Regulation Agency (TRA). Three stages: (i) Leading a team, a qualification for middle leadership, (ii) Leading across an organisation, for senior leadership (iii) aspiring to lead an organisation, a qualification for headship (principalship)	- National Professional Qualification for Senior Leadership. - National Professional Qualification for Headship.
Finland	- Qualified teacher status - At least one of three: - Certificate of Educational Administration - Completion of a program in Educational Leadership at a university - Proven experience in educational administration	- Professional development in Finland is context-specific, varying from locality to locality (Lahtero et al., 2019).
Canada	- At Least 5-years of experience as a qualified teacher - Two Specialist qualifications or a master's degree - Principal's Qualification Program (PQP) (NCEE, 2021)	- Continuing professional development differs from province to province.
USA	- Master's degree in school administration or equivalent practical experience. - Obtain and maintain a school administrator license valid in the state of appointment. - Pass a test or complete continuing education classes to maintain license.	- Continuing professional development differs from state to state.
Australia	- Degree-level teaching qualification.	- Professional certification through the Certified Practising Principal (CPP) award.

As seen above, with regards to appointment procedures for principals, Ireland has significantly fewer requirements than many of the other countries. It is most comparable to Australia, who do not require any qualifications or training beyond an initial teaching degree. Singapore, Canada, USA, UK and Finland all have pre-appointment requisites that involve a teacher completing additional study and/or testing procedures in order to progress to the role of principal. However, whilst the Irish selection and compulsory preparation requirements are not as rigorous as in other countries around the globe, Ireland does offer several continuing professional development programmes for principals. For instance, Misneach is a professional development programme for newly qualified principals. The programme is run by the PDST and is two years in duration. The programme takes place over five workshops, each two days in duration. During this programme, principals collaborate to explore modules geared towards the progression of their knowledge, attitudes and skills as they commence their journey as leaders of a school (PDST, 2020a).

2.2.3 Evolution of Leadership Styles

As explored above, principals are leaders who have the capacity to transform school environments or to maintain them (Firestone & Louis, 1999; Leithwood & Jantzi, 1999). To date, the majority of leadership definitions allude to social influence, with an individual or group exerting deliberate authority over another or others in an attempt to organise activities and connections within a group (Yukl, 1981, 2008). For example, an effective leader is “*a type of leader who paid considerable attention to the teaching and learning aspects of schools*” (Gumus et al., 2018, p. 29). Additionally, according to Gardner (2011), a leader is someone who has an impact on the thoughts, sentiments, and behaviours of a substantial number of people. Altogether, leadership is an essential aspect of schools and is depended on to mould fruitful futures by means of a process of self-renewal (Senge et al., 1999; Senge et al., 2012).

From the 1960s onwards, there has been a significant increase in studies which explore and review educational leadership (Wang, 2018). For example, many studies have explored methodology and research design (Hallinger, 2010, 2014; Hallinger & Heck, 1996b), some reflecting on educational administration being interdisciplinary (Hailer, 1968; Wang & Bowers, 2016), and others providing historical audits of the concept of educational leadership (Oplatka, 2010). Such examples have generated a theory of knowledge around the identity of the field of educational leadership, however, few have focused on the theoretical foundations of leadership styles (Wang, 2018). Within studies that have focused leadership styles, attention is mainly directed towards instructional, transformational and distributed styles of leadership (Wang, 2018).

2.2.3.1 Instructional Leadership

Instructional leadership has been a widely researched and practiced leadership style in the education sector from the 1980s until its decline in the early 2000s (Hallinger, 2010; Hallinger & Heck, 2002). The instructional leadership style depicts the position of the principal as someone who is powerful and necessary for a school to be effective (Dwyer, 1985; Hallinger, 2010; Harris, 2003). In discussing the instructional leadership role of the principal, Fullan (2014) details that they must view themselves as a lead learner. Elaborating further on the position of the principal as an instructional leader, Hoerr (2008) stated that this does not give rise to them being the most knowledgeable member of staff, but rather someone who must strive to ensure that high-quality teaching takes place within their school. Goal-driven, instructional leaders nurture and motivate others to achieve better standards for students (Barth, 1990; Bossert et al., 1982; Hallinger et al., 1996; Heck et al., 1990; Mortimore, 1993).

Despite instructional leadership being advocated on a global scale, criticisms of the leadership style emerged regarding its sustainability as a prime paradigm to conceptualize

school leadership (Barth, 1986; Cuban, 1988). Criticisms of instructional leadership escalated in the 1990s, fuelled by a focus on school improvement (Leithwood, 1993a), and eventually research and practice moved towards a focus on transformational leadership and teacher leadership (Barth, 1990, 2001; Kenneth Leithwood, 1993a).

2.2.3.2 Distributive Leadership

A distributed leadership view has yielded widespread interest and seamlessly entered the dialogue regarding educational leadership and management (Spillane & Diamond, 2007). Research has shown that a traditional instructional, authoritative, approach was not proving efficient or effective (Harris et al., 2008). Hargreaves (2007), pinpoints distributed leadership as being a focal point in reconfiguring organisational structure, which demands lateral, creative decision-making practices. Surmounting evidence indicates a positive association between distributed leadership, organisational improvement, and student achievement (Hallinger & Heck, 2009; Leithwood & Mascal, 2008).

The term distributive leadership can be interpreted in several different ways (Harris, 2007), making it an appealing leadership style for many people. For example, this style allows for accessibility to leadership, with the assumption that a group of individuals within an organisation will assume leadership duties (Spillane et al., 2001). In addition, distributed leadership emphasises collaboration for leadership activities within and amongst organisations (Harris, 2007), and notes the importance of all individuals who participate in leadership activities regardless of whether or not they hold a formal leadership role (Spillane, 2012). Terms that are often associated with this leadership style are democracy, collaboration, and shared leadership (Harris, 2007; Spillane & Diamond, 2007).

With increased public interest in this leadership style, many educational researchers adopted a distributed leadership perspective with their work (Harris, 2013; Leithwood et al., 2009; MacBeath, 2008; Sergiovanni & Sergiovanni, 2001; Sugrue, 2014; Wenner &

Campbell, 2017). For example, a study by Harris (2013) explored the role of the formal leader within distributive leadership, identifying and reflecting on challenges faced by distributive school leaders. Whilst it is acknowledged that distributive leadership promotes collaboration, Spillane and Diamond, (2007) highlight that the principal is still the prominent leadership figure in a school. Moreover, they suggest that putting distributive leadership into effect requires a substantial amount of effort on the part of the principal. The principal must lay the foundations and carefully scaffold leadership initiatives in this leadership style and it is not assumed that all individuals are or should assume leadership (Harris et al., 2008; Spillane & Diamond, 2007).

Criticisms of distributive leadership are often set aside due to the popularity and positive outcomes of the style in practice (Lumby, 2016). One such criticism is that distributive leadership does not offer a map or method for administration (Spillane & Diamond, 2007). For instance, Sugrue (2009) questions the potential lifespan of the concept, with Lumby (2016) noting that many studies reflect on the fact that distributive leadership does not really embody any one leadership style, but rather a mixture of others. Further elaborating on this idea, Hallinger (2003) suggests that common traits of collaboration and shared devotion to organisational change are evident in both distributive and transformational leadership, and therefore, amalgamation or pairing of these styles could be considered.

2.2.3.3 Transformational Leadership

From 1970 onwards, researchers became invested in examining interest in leadership from the perspective of followers, particularly in the field of politics (Bass, 1985, 1990, 1997; Forester & Clegg, 1991; Leithwood, 1991; Northouse, 2018). As such, the concept of transformational leadership was established and depicted as being a complete transformation of form, a change in the identity or essence of something and an absolute change in exterior structure or interior persona (Forester & Clegg, 1991). School restructuring internationally

during the 1990s brought the concept of transformational leadership into the education sector, a concept that gradually overshadowed instructional leadership as the favoured model of leadership (Leithwood et al., 1996; Stewart, 2006).

Transformational leadership is less hierarchical than other historical forms of leadership (Hallinger, 2003b), where the leader fosters a collaborative vision and encourages and inspires employees to change and innovate during organisational transformations (Bass, 1985; Bass & Avolio, 1993; Bass & Riggio, 2006). Similarly, other studies paint transformational leaders as creative, charismatic and visionary leaders, who provide support and nurture their followers to flourish in their education and organisation-improvement endeavours (Bass, 1997; Leithwood, 1991; Northouse, 2018). Existing research has focused primarily on the importance of transformational leadership or explored the direct impact of transformational leadership on organisational performance (Maley, 2019; Malinen et al., 2019; Montani et al., 2019), and on employee outcomes including employee performance (Adamu et al., 2016) and employee resilience (Kennedy et al., 2016; Lester et al., 2018). However, little research has explored the relationship between transformational leadership and work alienation (Conway et al., 2018; Shantz et al., 2015). Transformational leadership is examined within this research and is explored in depth in the next chapter, hypotheses development.

2.2.3.4 From Instructive and Distributive to Transformative Leadership

The instruction leadership model was used globally and fuelled reflection at an international level around what it means to be an effective principal (Hallinger, 2003b). However, amidst the decline and almost abandonment of rigid and regimented leadership styles (e.g. instructional leadership), a strong predominant shift towards a range of shared leadership styles is evident (Lumby, 2013). As such, someone can be a principal but exist within a leadership vacuum (MacNeill et al., 2018). Furthermore, someone can enforce

change but once the temporary autocracy has been lifted, a person can revert to their previous way of operating. Therefore, school leadership can commence with an individual but must be nurtured so that an exceptional team can emerge (MacNeill et al., 2018). Distributed leadership in particular is one of the most promoted types of leadership for school improvement (Lumby, 2013), and other leadership styles are increasingly being integrated with this leadership style (Jackson, 2000). Notwithstanding the rise in shared leadership styles, researchers do question their abruptness of adoption by the education sector in addition to their suitability for school environments (Bush, 2015; Sugrue, 2009b).

Reimagining the hierarchical concept of instructional leaders, Glickman (1989) and Marks & Printy (2003), explore the concept of ‘shared instructional leadership’. For example, this involves an active partnership between the principal and their staff on curriculum, direction and assessment. The aim of the model is that the principal invites suggestions from teachers based on their intuition and unique skill sets and works alongside these teachers to achieve school improvement goals. Responsibility for staff professional development, curricular development and overseeing of direction-related tasks thus is less cumbersome for the principal, as instead of being the only leader, they assume the role of ‘leader of instructional leaders’.

Recent international policy changes have seen an adoption of a distributed leadership approach (Hallinger & Kovačević, 2019; Wang, 2018; Wenner & Campbell, 2017), which has ignited an international drive towards leader preparation (Murphy, 2019). With the role of the principal becoming increasingly autonomous, particularly regarding policy implementation (Heffernan, 2018), this shift towards a shared leadership approach within schools is a step towards making the pressurised role of the principal more manageable for leaders. The next section will provide an overview of Irish education. Specifically, key historical changes which underpin the above developments in leadership styles are explored.

2.3 A Review of Irish Education

Primary education in Ireland is for children aged 4 to 12, with nearly all five-year-olds enrolled. The primary school programme consists of eight years: Junior Infants, Senior Infants, First to Sixth classes and Special Education schools. State-funded primary education is available at all levels, however private schools are also operated. State-funded primary institutions include religious, non-denomination, multi-denominational and Gaelscoileanna (Irish Language-medium schools) (Coolahan et al., 2017).

At present, for historical reasons, a large proportion (over 90%) of primary schools are state-aided parish schools (national schools). Additionally, there is a variety of urban and rural schools and due to the religious historical context of education in Ireland, many of the schools in rural settings are small, parish-based institutions (Coolahan et al., 2017).

2.3.1 International and National Changes in Education

2.3.1.1 History of the Irish Curriculum

Over the course of the past century, the Irish primary school curriculum has been the subject of numerous revisions that have reflected changes in society, politics, and religion. (Walsh, 2005). Each subsequent revision of the curriculum brought with it changes to teaching and learning styles (Walsh, 2005). In discussing the concept of learning, Young (2015) suggested that it can be context-dependent and context-independent. For example, context-dependent learning requires little effort and relies on recall of information. In contrast, context-independent learning is structured, informed, and has paved the way for 'knowledge-building' possibilities and modernisation over the past two centuries.

However, long before this growth of context-independent learning, Dewey (1916) reported that a disconnect between school books and life experiences caused problems with desire to learn and indeed knowledge transfer. This disconnect was evident during the first

course of the 20th Century, where there was a strong focus on behaviourist theories, particularly on that of Thorndike (1874-1949) and Skinner (1904-1990) (Murphy et al., 2012). For example, this behaviourist focus saw the student assuming a passive role, with the teacher taking on a more authoritarian role, responsible for content instruction, evaluating lessons and questioning students (Murphy et al., 2012). The behaviourist approach was adopted by the Commission on Manual and Practical Instruction (CMIP), which originated in 1797, and was established by the Board of National Education. This group produced a report on the Primary School Education System, that was used to form the *Revised Programme in 1900* (Commissioners of National Education in Ireland, 1902).

The eradication of the Primary Certificate in 1967 and the implementation of a new primary curriculum in 1971 ushered in a new era of educational quality in Ireland's primary schools (Coolahan, 1981, p. 170). The Department of Education were primarily responsible for the development of the 1971 curriculum, a programme that was distinct from both the official "... *cultural nationalist*" emphasis of the post-independence era and the "... *traditional didactic*" emphasis of the pre-independence era (Coolahan, 1981, p. 170). The 1971 curriculum introduced teachers to the concept of students becoming more autonomous in their learning. Educators quickly embraced this change, and in the 1990s, society demanded a move away from the traditional lecturing style of teaching in favour of placing the student at the centre of their learning experience (Young, 2015). Consequently, this shifted education from a transmittal model to a more constructivist approach (Young, 2015). For instance, Matthews (1993) suggested that with a constructivist approach, students mature through cognitive development and deep understanding as opposed to learning behaviours and skills. However, the concept of teaching for understanding was not novel, and can be traced back to the ancient Greek philosophers. For example, teaching for understanding was

Plato's central focus, and Socrates' first step in his dialogues of confirming the ideas of his audience (Matthews, 1993).

Piaget (1964) also suggested that learners do not acquire an exact copy of their educator's knowledge, but instead acquire knowledge in an active process. Similarly, King (1993) elaborates further, suggesting that students are far more likely to remember and use information if they are active participants in processing and reconstructing it in personalised, significant ways. By the time the Irish primary school curriculum was revised in 1999, teachers had adopted experiential teaching and learning strategies. In addition, teachers had a strong presence on committees for curriculum development such as the National Council for Curriculum and Assessment (NCCA) (Coolahan et al., 2017). There is currently a review of the Irish primary curriculum taking place (NCCA, 2020). One area that has been the subject of reform in the Irish primary curriculum is science.

2.3.1.1.1 The Introduction of Science

The growth of science education in Ireland can be attributed to William Mayhowe Heller (1892-1894), a pioneer of science education, who influenced the creation of the first primary science curriculum and established science as a compulsory subject as part of the Revised Programme in 1900 (Commissioners of National Education in Ireland, 1902; Walsh, 2018). However, along with other practical-based subjects, science was often not implemented as per Department recommendations. This sub-optimal implementation was largely due to a lack of equipment, professional development, and facilities (Commissioners of National Education in Ireland, 1905). As such, science was removed as a subject when the curriculum was updated in 1922 (Hamilton, 2020). After an absence of over 50 years, science was reintroduced into the curriculum in 1971. The new curriculum mostly centred around encouraging curiosity and investigation of the local environment, in particular nature, as

opposed to the acquisition of large volumes of scientific factual information (Department of Education, 1971).

As previously mentioned, there was a shift from a behaviourist approach to favour constructivist models of teaching and learning towards the end of the 20th Century. This shift was influenced significantly by theorists Jean Piaget (1896–1980) and Lev Vygotsky (1896–1934) (Murphy et al., 2012). As a result, increased value was placed on science that was hands-on, centred around inquiry processes, enabling students to be active learners, and construct knowledge through relating to familiar experiences (Hamilton, 2020; Murphy et al., 2012). Moreover, constructivist, inquiry-based, problem-solving approaches to studying science are successful in improving students' scientific understanding and skills, as well as fostering students' interest in science, according to science educators, policymakers, and curriculum creators (Goodrum & Rennie, 2007; Lewis & Lewis, 2008; Murphy et al., 2012).

2.3.1.1.2 The Revised Primary Curriculum (1999)

As discussed, the revision of the Irish curriculum in 1999, reflects the shift towards a constructivist teaching and learning approach (Hamilton, 2020). The aim of this curriculum is to nurture the child in all aspects of their life – spiritual, moral, cognitive, emotional, imaginative, aesthetic, social, and physical. There are six main areas of study at primary school level: Language (Irish and English); Mathematics; Social, Environment and Scientific Education (SESE); Arts Education (including Visual Arts, Music and Drama); Physical Education and Social, Personal and Health Education (DES, 1999a).

Within this curriculum, a teacher guideline book for science education outlines the essence of science, how it blends into a child-centred curriculum, constructivist approaches to science education, and the value of developing scientific skills (Hamilton, 2020). It also includes curricular and organisational preparation recommendations for teachers, as well as suggestions for integrating with other curricular areas and methodologies to improve student

engagement and learning (DES, 1999b; Hamilton, 2020). Since this curriculum has been established there has been an evident shift from national to international policy. There is currently a review of the Irish primary curriculum taking place (NCCA, 2020).

2.3.1.2 A Shift from National to International Policy

In Irish schools, there has traditionally been a lack of legislation regulating policy and practice prior to the introduction of the Irish Education Act (Government of Ireland, 1998). Regardless of the historical absence of policy, the teaching profession in Ireland has historically been respected and trusted, with the Island often coined the “*Land of Saints and Scholars*” (King & Nihill, 2019, p. 1). However, such ‘trust’ did not exclude Ireland from international policy reviews and reformation.

For example, as part of a review of the National Education Policies in Ireland during the 1990s, the OECD claimed that Irish history still had an impact on societal morals and behaviours, suggesting that history served an important role in comprehending the country’s education system (OECD, 1991). Following further efforts to unravel the intricate web that is the Irish education system, the OECD (2008), depicted it as being “*fragmented, small – scale and voluntarily managed*” (p. 340). Elaborating further, it was suggested that the Irish system is an organisation disparate from that of most others in the OECD bracket, one where leadership implementation challenges would be conceivable (OECD, 2008). Key research confirms that leadership in the Irish primary context is in fact unique by international standards (Coolahan et al., 2017; Flood, 2011; Murphy, 2019; Sugrue, 2016), as it has been historically linked to religion and the influence of teacher unions (Lumby & Mac, 2020; Mac Ruairc, 2010).

Furthermore, it is difficult to grasp the significant effect that policy has on school leadership experience without connecting it to the larger socio-political context (Bell & Stevenson, 2015). For instance, the release of the OECD (1991) report ignited a new era of

policy change in Ireland in line with globalisation developments (Beck, 2018; Stiglitz, 2006; Sugrue, 2009a). These changes evolved rapidly, and were fuelled by a neo-liberal economic agenda and national policy reform agenda that became intertwined with and merged into international policy reform (Castells, 2000, 2004). According to Thody (1997), national leadership boundaries are non-existent, and variance in expectations and comprehension of leadership are proliferating the field. This is evidenced by a comparative study which analysed how school autonomy is implemented in 30 countries (Coghlan & Desurmont, 2007). Findings from the study demonstrated that some of the most significantly followed policies from the European Union (EU) and OECD, have had a profound influence on Irish national policy (Coghlan & Desurmont, 2007). One topic that is becoming more prevalent in both EU and National policy development is that of STEM education. For instance, STEM education and its related policies are now prominently featured in the most recent government Strategy Document for Education 2021-2023 (Department of Education, 2021a).

2.3.2 Evolution of STEM Education

2.3.2.1 The Origin of STEM

STEM is a relatively new concept that has garnered significant interest in the field of education in recent years (Takeuchi et al., 2020). This rise in popularity has been driven by a hive of uncertainty prompted by the global explosion of educational institutions, policy makers, industries, and businesses recognising that future technological attainments, economic development, security and social comfort rely heavily on educating high-calibre specialists in Science, Mathematics, Engineering and Technology (Caprile et al., 2015; Li et al., 2020). Scholars such as Dakers (2006), suggested that the disciplines should be combined to solve problems that face us in this increasingly changing world. Furthermore, Johnson, (2012) takes this concept a step further, and argued that to achieve global sustainability,

STEM must be accessible internationally and combine the arts and social sciences. The acronym STEM originated in the US in the 1990s when the US National Science Foundation made a significant investment in the area of science education (Kimbell, 2011; National Science Foundation, 1998). According to the '*STEM Taskforce Report*' (2014) from the Irish government, combining the four disciplines was a strategic decision by specialists in STEM fields to create a dominant political voice.

The European Commission followed suit with its endeavours to promote STEM and has placed a significant focus on developing STEM policy since the 1990s (Marginson et al., 2013). For instance, the '*Horizon Research and Innovation*' funding programme of the European Commission was established to fund STEM research to combat 'Societal Challenges' including food, energy, climate, and health. For example, from 2013-2020, the EU committed to a €95.5 billion programme, which has since been extended and will run from 2021-2027, with an additional €75.9 billion in funding (European Commission, 2021). Despite this significant funding directed into STEM, much ambiguity exists surrounding what exactly STEM is, and how it should be interpreted by educators.

2.3.2.1.1 STEM in the Context of Education

The acronym STEM is used to outline professional practices in education (McDonald, 2016). Focused on increasing numbers of students favouring STEM areas (Howell, 2015; Yakman & Lee, 2012), traditionally STEM subjects have been stand-alone and have "*established and steadfastly defended their sovereign territories*" (Sanders, 2008, p. 21). However, with time and increased discussion of STEM integration, the definition of 'STEM' is no longer universal (National Research Council, 2014). Instead, it encompasses different meanings depending on the context of study (Marginson et al., 2013). For instance, some educators integrate all areas of STEM, whereas others use the term 'STEM' for a class or topic, depending on its correlation with the course content and life's conundrums (Moore et

al., 2013). According to Bybee (2010) STEM is usually used when referring to science and mathematics, neglecting technology and engineering, suggesting this is something that needs to change. In contrast, others imply that it is the practice of teaching and learning whereby at least two STEM subject components are explored, or STEM subjects are integrated with additional subjects to enhance learning (Sanders, 2008).

In recent years, 'A' for arts has become an addition to the STEM acronym garnering increasing importance (Liao, 2015). Elaborating on this new acronym, key literature details that the addition of the arts is centred upon combining creative and innovative components with the integrated subject area (Herro et al., 2017; Hunter-Doniger, 2018). Furthermore, the recognition of STEM education through STEAM gives rise to interactive and participatory dialogic art; a juncture that allows for a judgement-free environment to develop centred around the aspect of inquiry. Within this environment, STEAM enables learners with the strength to be comfortable in a state of uncertainty, and a sensitivity to the process of discovery (Radziwill et al., 2015). However, regardless of the literature that promotes STEAM, challenges arise around educators and their integration of the subject area into the school curriculum (Mote et al., 2014; Quigley & Herro, 2016). This may be due to the simple acronym being provided without adequate methodology to accompany it (Piro, 2010).

Overall, despite a significant interest in research and practice, clear definitions and methods for STEM or STEAM education have yet to be established (Yata et al., 2020). However, regardless of a standardised definition and methodology, key literature demonstrates that literacy in STEM disciplines can enhance decision-making skills and enable one to comprehend and address different real-world problems with creativity, critical thinking, and problem-solving skills not only in STEM disciplines but also in arts areas such as economics, politics and society (Banks & Barlex, 2020).

STEM is progressive and free, open to interpretation with no universal set of rules for instructions (Dakers, 2006; Marginson et al., 2013; Moore et al., 2014). Student and knowledge-centred, STEM contains elements of inquiry, discovery and integration, addressing relevant issues in students' lives, thus helping them to contextualise and recall knowledge (Barlex & Pitt, 2000; Bransford et al., 2000). Furthermore, integrated STEM education can create a rich learning environment which permits for social interaction to take place, a crucial element in the learning process (Sanders, 2008). The skill of problem-solving to face 21st century societal challenges (e.g., climate change, deforestation, education, globalisation and geopolitics, air pollution, global health etc.), (Royal Geographical Society, 2019), requires social collaboration and the integration of more than one discipline. Thus, integrated STEM education can help students to collaborate and address such challenges because it has the power to *"restructure what we teach and what students learn"* (Herschbach, 2011, p. 98). Stepping away from prescribed learning, educators must explore the purposeful relationship between disciplines (Kuenzi, 2008; McNeil, 1990).

2.3.2.1.2 Subject integration in the Irish Primary Curriculum

The Irish primary curriculum promotes subject integration, yet, for young children, differentiating between subjects is not necessary (DES, 1999a). For example, according to the curriculum DES (1999a), children should experience a: *"coherent learning process that accommodates a variety of elements...to make connections between learning in different subjects"* (p. 16).

Over time, experience of subject integration broadens and enriches perspectives on the interconnectedness of knowledge and reinforces the learning process (DES, 1999a). In the context of Ireland, subject integration is promoted but a set criterion regarding the volume required and methodology for carrying this out in schools has not been established.

Therefore, each school must decide the level of subject integration that takes place. Ireland is experiencing a gradual transition towards the integration of STEM disciplines.

Whilst the Irish Primary Curriculum has not changed since 1999, there is increasing societal interest in the field of science. For instance, the Science Foundation Ireland (SFI) annual report highlights the ability that science has to improve society and achieve sustainable development (Science Foundation Ireland, 2015). For example, the report highlights numerous successful SFI projects that have enhanced our knowledge in areas such as health, food, business processes, materials, and ICT. Similarly, Johnson (2012) reports that if we want to have a chance at paving the way for meaningful progress towards global sustainability, that STEM education must be accessible to where the majority of the population is, in the primary and secondary sectors.

With regards to ‘STEM-related’ subjects, the current primary curriculum has numeracy and science components, as referenced to above. However, there has been an absence to date in engineering and technology curriculum documents or STEM as an integrated subject area in the Irish Curriculum. Despite this, the DES has acknowledged the Technology gap, in its series of planning/strategy documents dating from 2009 to present, resulting in the publication of: *‘Digital Strategy for Schools 2015-2020, Enhancing Teaching, Learning and Assessment’* framework (DES, 2015a). This framework aimed to provide educators and schools with guidelines regarding using ICT in teaching, learning and assessment, in line with the *‘UNESCO ICT Competency Framework for Teaching’* (UNESCO, 2018). As outlined in this framework, the DES has followed through in providing all schools with technology grants and additional funding for schools who can demonstrate that they are making efforts to establish a Digital Learning Plan and enhance ICT integration, as evident through the Grant Scheme For ICT Equipment Circular 0011/2018 (DES, 2018a). Overall, the documents address the importance of integrating Technology across all areas of

the curriculum in teaching and learning. This demonstrates a willingness from the DES to welcome integration of subject areas.

2.3.2.1.3 STEM in the new Primary Curriculum

A draft of the new Primary Curriculum Framework has clearly taken into account society's increased interest in STEM education. For example, there is a focus on subject integration within a new curricular area, Mathematics, Science and Technology Education (Hamilton, 2020). Elaborating further on this subject area, the NCCA explains that exploration of this subject area will improve a child's ability to comprehend and engage to the fullest of their potential with the world in which they are living (National Council for Curriculum and Assessment, 2020). Integrating STEM disciplines comes with sustaining the integrity of each of the disciplines. There can be a tendency for one or two of the disciplines to be fore-fronted with Mathematics, and sometimes other disciplines being used as tools instead of the disciplinary ideas being explicitly taught (Rennie et al., 2012). This is evident in the new draft curriculum, where a strong emphasis is placed on mathematics, specifically on working with patterns, connections and relationships in our lives (National Council for Curriculum and Assessment, 2020). The NCCA outlines that the goal is to develop a proficient standard in mathematics as this subject lays the crucial foundation for science and technology, two subjects that are fundamentally linked (National Council for Curriculum and Assessment, 2020).

The study of science and technology provides students with the opportunity to work with and acquire knowledge around conventional, modern and future technologies. In using such technologies, students will be afforded opportunities to engage in the exploration of new concepts and solutions through design, experimentation and investigation processes. It is also suggested that this will permit for students' enthusiasm and knowledge regarding the

physical, biological and material world to evolve through the investigation of scientific theory and procedures (National Council for Curriculum and Assessment, 2020).

2.3.2.2 Development of STEM Policy

2.3.2.2.1 PISA's Impact on International Policy

Accompanying the new prominence of incorporating 21st century skills into the curriculum and teaching, is an increasing requirement to evaluate students' aptitude for these skills on a larger scale (Lai & Viering, 2012). For instance, STEM policy is usually established in terms of human capital conditions. Therefore, attention to school and tertiary education are often driven by matters relating to the STEM employment pool; deemed crucial to economic expansion and wellbeing (Marginson et al., 2013). However, Winters (2014) argues that availability of data has so far prevented researchers from making direct connections to human capital externalities. Consequently, 'measuring' the standard of STEM education internationally, the OCED, Programme for International Student Assessment (PISA) test is making strides in data provision, with PISA results addressed by researchers and policy makers internationally.

A large volume of literature has been published by the OECD on PISA, the most comprehensive international assessment for school-age students. Administered across 72 countries, representing 80% of the world's economy, the results are influencing the examination practices of the Department of Education in Ireland (Ball, 2016). Commenced in 1997, the vision was to oversee the degree to which students approaching the end of obligatory education have learned the knowledge and skills to face real-life problems as opposed to the measuring the range of a particular school curriculum. Ananiadou and Claro (2009) explain that the OECD used the '*Definition and Selection of Competencies (DeSeCo)*', whereby students have to think independently and assume responsibility for their learning

and actions through the exploration of three branches of skills i) using tools interactively ii) interacting in heterogeneous groups and iii) acting autonomously, to establish theoretical foundations for the PISA examination. Self-proclaimed as an examination that focuses on the needs of society, it boasts uniqueness in policy orientation suggesting that in modern economies, people receive credit for how they utilise knowledge instead of for what they have learned (OECD, 2014).

According to Gorur (2008) governments are relying on PISA's declared intention of providing data to inform policy. Reflecting on this concept in the Irish neo-literalist context, Ball (2016), depicts PISA data as a powerful machine for transformation, suggesting that inadequate performance could promote changes which would otherwise be disregarded. Additionally, these policy patches run the risk of forming a disjointed education system (Ball, 2016). Further complicating matters, PISA appears to be serving as an international competition. For instance, high-profile publications such as the McKinsey Report (Barber & Mourshed, 2007), only contribute to urgency to conform. This could lead to expedient changes in an attempt to climb the rankings within each three-year cycle. Black and Wiliam (2013) caution however that a quick fix is not possible when it comes to policy and education. Therefore, the high frequency of PISA testing and the haste interpretation of results at governmental level demands denote increased attention from researchers.

2.3.2.2.2. Research and policy development in STEM education in Ireland

Expedited changes that commenced in the 1990s in the areas of technology, social, employment and demographic led to economic growth in Ireland, with the era being coined the 'Celtic Tiger' (Mac Ruairc, 2010). With an influx of international STEM giants establishing their European headquarters in the country's capital, Dublin quickly became known as an international tech hub, the 'Silicon Docks' of Europe (Roberts et al., 2015). This coupled with the competitive international STEM race to combat a shortage in the STEM

workforce (Xue & Larson, 2015), has hastily generated interest in STEM education research and policy development in Ireland.

Overall, the Department of Education and Skills is making efforts to meet international high-stakes assessment ideals, which Sjøberg (2017) claimed are: *"a political project...to be understood as an instrument of power"* (p.1).

Whilst the primary sector does feature in early Irish STEM policy documents, this is somewhat overshadowed by concepts such as high stakes examinations in post primary level, and progression to careers in third level. For instance, the 2016 report, *'STEM Education in the Irish School System'*, heavily focuses on Mathematics, emphasising high-stakes assessments (Junior and Leaving Certificate). The overall emphasis that is placed on the primary sector is minimal. Notably absent is information pertaining to the role of primary school principal as a leader in STEM promotion within the Irish education system. Despite these gaps, positive reference is made relating to external stakeholder projects e.g., the Royal Dublin Society (RDS) Primary Science Fair, applauding their contribution to research in the field of Irish STEM education.

Another report: the *'STEM Education Implementation Plan 2017-2019'*, has a very strong ideal for where Ireland should be headed: *"... to have the best education and training service in Europe by 2026, Ireland will be internationally recognised as providing the highest quality STEM education experience for learners"* (DES, 2016b, p. 12).

Following this confident proclamation, two main issues at primary level are addressed within the document. First, that the department will carry out an audit of pupils' perspectives at primary level. Second, that establishment of new STEM projects will require teachers to develop their current STEM learning experiences and knowledge. Similar to prior policies and reviews, , an absence of projected Department of Education scaffolding to facilitate

principal and teacher professional development is evident in the '*STEM Education Implementation Plan 2017-2019*'.

2.3.2.3 STEM Education Policy Statement 2017-2026

The '*STEM Education Policy Statement 2017-2026*', reiterates the message of previous policies, that the Irish Government strive to make Ireland the best country in Europe in the area of STEM by 2026. This goal has stemmed from the concept that fulfilling careers, creative enterprises and ultimately economic progression are the products of STEM-excellence (DES, 2017e). Furthermore, much of the information that is communicated in this policy document is in line with international research in STEM education.

For example, the Irish document explains that Science, Technology, Engineering and Maths are areas that are prevalent in all aspects of life and society. Additionally, it outlines that people who are employed in STEM fields are innovatively changing the world as we know through medical and technological advancements that can protect us as citizens. The Irish Department of Education recognises their responsibility in providing students with the knowledge, expertise and mentality to execute change and advancement in the field of STEM (DES, 2017e). Furthermore, there is a strong national ambition within this policy document to strengthen STEM education and engagement at societal level (DES, 2017e). A suggested implementation strategy is provided, outlining a three-phase plan from 2017-2026, to enhance, embed and realise STEM in society. Contrary to previous Irish policy documents (DES, 2016b; The Stem Education Review Group, 2016) that focused largely on the senior stages of a student's STEM journey, this new national STEM policy, highlights the significant role that STEM plays in early years education, emphasising that strong leadership is imperative at this early stage.

The '*STEM Education Policy Statement 2017-2026*' (DES, 2017e), highlights that an extensive amount of work is already being carried out in STEM concerning curriculum

development and evaluation reform, educator professional development and the use of digital technologies throughout day-to-day school activities. Additionally, the new STEM policy draws influence from and makes reference to several existing national education policies including the '*Action Plan for Education 2016-2019*' (Government of Ireland, 2016), '*Ireland's National Skills Strategy*' (DES, 2015c), the '*Digital Strategy for Schools 2015-2020*' (DES, 2015a), the '*Arts in Education Charter*' (Department of Arts Heritage and the Gaeltacht, 2012) and the '*National Strategy: Literacy and Numeracy for Learning and Life*' (DES, 2017d). Grouping together these additional policies, the '*STEM Education Policy Statement 2017-2026*' (DES, 2017e), reflects on a range of established goals and objectives for four levels: early childhood themes, primary priorities, junior and senior cycle (National Council for Curriculum and Assessment, 2009b, 2009a, 2012a, 2012b).

Increased government recognition of the importance of involving stakeholders in school implementation of STEM education is more prevalent in this document than prior directives. For instance, it is reported that systematic support from both the Department of Education and external stakeholders holding an interest in STEM is required in order to create a STEM culture in which a wide array of skills can be covered (DES, 2017e). Additionally, the policy document suggests that every early years and school setting will be provided with support to develop relationships with relevant STEM providers. In reflection on defining what STEM experiences should encompass, the document outlines that experiences can be informal or formal in nature e.g., in a home environment, at museums, in business and industry, interactive coding projects and through 3rd Level institutions. Furthermore, given that stakeholders outside of the education sector have a crucial role in the STEM ecosystem, collaboration is strongly recommended, and recognition is given to enthusiastic teachers who often drive these partnerships without any additional remuneration (DES, 2017e). This concept of collaboration to achieve change is also evident in other

STEM-related government directives. For example, in launching the *'Digital Schools of Excellence Fund (SEF)'* (DES, 2017c) the minister of education stated that:

“Truly transformative change does not come from the centre but from the ground up, schools and teachers working together and sharing good practice” (p. 1).

2.3.3 STEM Educator Professional Development

2.3.3.1 Initial Teacher Education

Numerous international studies and pre-service programmes are attempting to increase the capability of their prospective teachers to provide sufficient instruction in STEM areas (DCU & Growth Through Diversity, 2019; Prinsley & Johnston, 2015; Wilhelm & Fisher, 2019). For example, an Australian study by Prinsley and Johnston, (2015) highlights the potential benefit of a prestigious national public-private scholarship to enable students to pursue a degree in a STEM discipline followed by adequate pedagogical training and subsequent employment as STEM specialist teachers. These scholarships could be offered as loans, with repayment based on the number of years spent teaching in primary schools, with the goal of attracting top performers and subject specialists to schools.

Another similar project in the US has the goal of creating a larger, better-prepared pool of elementary teachers that are equipped to teach STEM as part of the full curriculum (Wilhelm & Fisher, 2019). This study involved selecting undergraduate elementary pre-service ‘STEM Fellows’ and providing them with the opportunity to work with an academic professor from a STEM discipline on a research project that addressed a societal problem. The project involved the fellows being exposed to in-depth STEM learning with an emphasis placed on cross-disciplinary methods of comprehending physical phenomena, whereby they acquired quantitative, qualitative and mixed-methodologies data collection skills. Results suggested that participants in this 9-month project exhibited improved STEM knowledge and

were confident in their abilities to integrate STEM into their generalist elementary school curriculum (Wilhelm & Fisher, 2019). This research demonstrates the positive effect that exposure to working with STEM experts can have on inspiring and educating student teachers.

In the Irish context, the Department of Education in Ireland showcases an Irish STEM Teacher Internship programme that is geared towards students in initial teacher education settings (DCU & Growth Through Diversity, 2019; Department of Education, 2021b). Aligning with other key research on the importance of high-quality teachers in STEM education, the Programme Coordinator, Professor Deirdre Butler suggests that engagement in such relationships is important because what teachers know and can do has the greatest effect on what students learn. The importance of developing STEM competencies in teachers cannot be overstated, particularly because teacher quality as opposed to funding, is the determining factor among the conditions that sustain the success of the world's best education systems (Centre for the Advancement of STEM Teaching and Learning, 2021). The programme aligns with the '*STEM Education Policy Statement 2017-2026*' guidelines regarding the fostering of industry-education links to enhance STEM education in Ireland (DES, 2017e). The Irish STEM Teacher Internship is a 12-week paid role in a STEM industry position (e.g., tech/pharma/finance) that was initiated to address a lack of students, particularly females in both choosing STEM subjects and entering STEM careers.

It was thought that in providing teachers with deep knowledge and experience in STEM, that they could in turn inspire innovation and creativity in teaching and learning in STEM education. The programme was piloted in 2016 with the DCU Centre for the Advancement of STEM Teaching and Learning (CASTeL) research centre, Accenture and the 30% club and has grown to involve 30 host industry partners and over 70 pre-service teachers annually (CASTeL, 2021; DCU, 2019). Initial teacher education programmes such

as the American, Australian, and Irish programmes explored above are actively equipping pre-service teachers with the skills and knowledge required lead innovative and creative STEM education programmes within the schools that they will end up working in, thus sharing their knowledge with future generations (CASTeL, 2021; National Research Council, 2011; Prinsley & Johnston, 2015).

Whilst the Irish government praises the involvement of outreach organisations in public STEM education (The STEM Education Review Group, 2016), it is necessary to reflect on the agendas of these investing partners. For instance, in their discussion of private investment in public STEM education, Bencze et al., (2018) suggest that many private investors in STEM education support neoliberal capitalism and invest to promote private sector gains. As such, it is imperative that the Irish government carefully consider the potential partnerships that they are promoting to schools, taking into account the level of input that they might have, in addition to their agenda for involvement.

2.3.3.2 Continuing Professional Development

Integrated STEM education is something that some teachers may never have experienced during their own education and teacher training journey. However, King (1993) outlines that students are more likely to remember and use information as active participants in processing and reconstructing it in personalised, significant ways. Similarly, in a study of third level educators in STEM disciplines, it was found that:

“faculty do not only model their teaching after previous instructors, but also draw upon a varied repertoire of knowledge and prior experiences” (Oleson & Hora, 2014, p. 29).

Therefore, in expecting teachers to be effective facilitators of learning (Wiliam, 2010), it is important that the teachers experience learning in the subject area. Accordingly, Black and Wiliam (2013) caution that raising standards is no magic bullet suggesting that

instead it is a slow process, whereby improvement only comes about via focus on current good practices and further professional development training for teachers.

Allowing the school to become a learning community for both students and teachers is the most practical choice for a stable and dynamic school environment for pupils (Barth, 1990). For example, given training, a teacher could become a facilitator for learning, directing attention instead towards providing thorough explanations, goal setting and focusing on task-specific details. Teaching teachers to engage in a constructivist approach to teaching STEM could help students consolidate real connections with information and awaken a thirst for further study, the foundation on which to provide them with '21st Century Skills (creativity, critical thinking, collaboration and communication)' (Dumont & Istance, 2010).

Controlling CPD content and time allocation within schools (DES, 2016a), principals are gatekeepers to prioritising and nurturing STEM education. Many of the outreach programmes that are available to schools in Ireland offer sponsored or low-cost co-teaching and professional development opportunities for primary schools. These programmes are run by government bodies e.g., the Professional Development Service for Teachers (PDST), universities, national education centres, SFI, and industry partners.

2.3.3.2.1. Professional Development Service for Teachers (PDST)

The Primary STEM Team provides a range of professional development experiences for teachers. For example, this team hosts training sessions online, in addition to in-person workshops which are tailored to the individual needs of schools. Schools can request to be partnered with a STEM facilitator, who liaises with school management to inform the content of their workshops (Professional Development Service for Teachers, 2020b). Additionally, the PDST STEM team work closely with the PDST Leadership Team, ensuring that leadership development capacity is at the core of all professional development workshops

(Professional Development Service for Teachers, 2020b). While the PDST is a government-funded service that is available cost-free to Irish schools, it does not feature in the '*STEM Education Policy Statement 2017-2026*' (DES, 2017e).

These are just two examples of the many STEM professional development opportunities that schools can avail of in Ireland. However, school engagement with such services is often contingent on principals as line managers having the capacity, interest, and commitment in developing STEM education within their school community.

2.4 Principals in Irish Education

2.4.1 Principals' Leadership in Irish Education

The principal has an autonomous role with a significant level of responsibility (Heffernan, 2018). They must navigate conceptualising policies and directives to effect school improvement (Heffernan, 2018; Kenneth Leithwood & Jantzi, 2008). This can be a challenging process, due to insufficient policy implementation instructions and a lack of consultation with government agencies during the policy formation process (Ball et al., 2011; Skerritt et al., 2021; Sugrue & Furlong, 2002b). Two areas that have been significant concerning the dissemination of policy and directive releases in recent years are STEM education and COVID-19. This research explores the concept of principal leadership in each of these contexts.

2.4.2 Principals' Leadership in STEM Education

One area that has received significant attention from the Irish government in recent years, is that of STEM education. Key literature explored has demonstrated that STEM relates to the subject areas of science, technology, engineering, and maths and can incorporate the arts. Whilst different acronyms and definitions exist, this research applies the

acronym STEM in line with Irish policy in this area (DES, 2016b, 2017d; The Stem Education Review Group, 2016).

Key research in this area has demonstrated that STEM education can enrich student learning and enhance problem-solving and creativity skills. Additionally, STEM education is viewed as a tool to develop a skilled workforce and improve the economy. Policy documents and directives that have been released in this area in recent years discuss the primary school sector, however little emphasis has been placed on the concept of school leadership and implementation strategies (DES, 2015a, 2017d, 2016b). Therefore, this research addresses the following research question:

RQ1: How does principal leadership influence the adoption of STEM education in their school?

2.4.3 Principals' Leadership in Irish Education during the COVID-19 Crisis

Due to the rise in uncertainty associated with the COVID-19 pandemic, there has been an unprecedented increase in job demands for principals (Burke & Dempsey, 2020; Dempsey & Burke, 2020; Fahy et al., 2020). Following guidelines from the National Public Health Emergency Team (NPHE), Irish schools closed on 12th March 2020 in an attempt to reduce the spread of COVID-19. This initial (3-week) closure was extended through to the end of the academic year. Principals, who would usually have time off during normal school closure periods (e.g., Easter and summer), were instead faced with an increased volume of challenging work demands as a result of the unforeseen COVID-19 crisis.

During the COVID-19 crisis, governments in different countries provided guidelines to move schooling online. This was also the case in Ireland. The first document issued to principals on 2nd April, 2020 suggested that principals use their: “*professional expertise to decide upon appropriate online resources that match intended learning*” (DES, 2020b, p. 5).

This initial document also suggested that school leaders would: face challenges; continue to monitor teachers' work in an effort to provide education to every student throughout the timeframe of the school closure; have regular meetings with teaching staff and maintain staff, student and parent relations; and strive to promote wellbeing within the school community (DES, 2020b).

The follow-up 18-page directive (DES, 2020c), released on 28th May echoed the concepts as explored above, this time in a more detailed nature, with the additional duty of coordinating a return for staff to work in the school building. Whilst the above reports were targeted at all school types, specific guidelines were established for navigating the crisis for students with special educational needs (DES, 2020a). The initial set of guidelines for schools to reopen were published on 27th July, with a follow-up amendment on 12th August (DES, 2020).

From the time of school closure on 12th March, 2020 (DES, 2020), to the reopening of schools in late August, principals faced a period of six months with increased job demands. As the pandemic is still ongoing, these demands are ongoing. Accordingly, given the changing demands and shift in the new way of working (including teaching remotely, communicating with staff via online platforms and planning for a safe return to school), many school principals have experienced a significant level of stress (Fahy et al., 2020). Based on this context of principals and their role in managing schools during the COVID-19 crisis, the following research question has been developed

RQ2: How does principal leadership influence their own wellbeing, and their school's performance during the Covid-19 crisis?

2.5 Chapter Summary

This chapter has presented important literature relating to developments in the Irish education system and the concept of school leadership in the areas of STEM education and

crisis. It opened with an overview of the Irish Education system, followed by international and national changes in education. Next, an evolution of STEM education was provided, with an explanation of what STEM is and how it has developed within the context of education. Following this, the concept of the principal is introduced, and topics including role, policy implementation, preparation for leadership and the evolution of leadership styles are explored. Finally, the research questions are introduced with regards the principals' role in STEM education and during the COVID-19.

The next chapter will present the development of Hypothesis for Study 1: Leadership in STEM Education and Study 2: Leadership During the COVID-19 Crisis based on the research questions.

CHAPTER THREE

HYPOTHESES DEVELOPMENT

3.1 Introduction

This chapter presents the development of hypotheses for the two studies featured in the dissertation, (i) Leadership in STEM Education and (ii) Leadership during the COVID-19 Crisis. First, the Ability, Motivation and Opportunity (Appelbaum et al., 2000) theoretical framework is introduced and explored within the context of the implementation of STEM education. Hypotheses are presented within this framework surrounding the effectiveness of transformational leadership, consultation with government agencies, and access to specialist teacher instruction in promoting STEM education within school settings.

Second, the concept of Leadership during a Crisis is introduced. Here, the role of the principal during the crises is explored. Hypotheses are formulated based on Relational Coordination Theory and the theoretical model linking effectiveness of transformational leadership in promoting improved school performance and reducing leader work alienation, mediated by relational coordination, and staff trust is presented.

3.2 Study 1: Leadership in STEM Education

3.2.1 Overview

This study explores principals' perceptions of leadership in STEM education in addition to their role as leaders within their schools. The study investigates this concept drawing upon the AMO (Ability, Motivation, Opportunity) framework and aims to systematically identify the key factors which affect principals' (i) intention to adopt STEM, (ii) commitment to STEM and (iii) engagement with STEM within their schools.

The following research questions are addressed: How do principals influence or promote STEM education? *And are Transformational leadership, consultation with government agencies and access to specialist teacher instruction significant factors in predicting (i) principal commitment to STEM education, (ii) principal intention to adopt STEM education, (iii) school implementation of STEM education and (iv) school participation in STEM weeks?*

Transformational leadership was included as key literature suggested that it is an effective leadership style for evoking change (Fullan, 2011; Herold et al., 2008). For instance, Bass and Riggio (2006) outlined the change-evoking traits of transformational leaders stating that they:

“commit to a shared vision and goals for an organization or unit, challenging them to be innovative problem solvers and developing followers’ leadership capacity via coaching, mentoring and provision of both challenge and support” (p. 4).

Additionally, Consultation was selected as a result of an extensive literature review and exploratory interviews with focus groups on the topic of educational policy (Ball, 2012; Beck, 2018; Stiglitz, 2006; Sugrue, 2009a). Finally, Access to Specialist Teacher Instruction was selected based on the review of other educational studies relating to practical subject areas, several professional development STEM outreach programmes and government STEM-related policy documents (Bowe, 2014; DCU & Growth Through Diversity, 2019; Harris, 2007; Prinsley & Johnston, 2015).

3.2.2 Ability, Motivation, Opportunity (AM) Framework

This research draws on AMO framework (Appelbaum et al., 2000; Boxall & Purcell, 2003; Fu et al., 2017) to explore primary school principals as line managers and their ability, motivation and opportunity to adopt and commit to STEM education, a relatively new initiative within their schools. Assuming responsibility for a myriad of performance

management duties such as goal-setting and providing performance feedback, principals act as line managers and are gatekeepers to the implementation of new initiatives in schools (Kinicki et al., 2013).

Accordingly, the study expects that these three factors (i.e., transformational leadership, consultation with government agencies, and access to specialist teacher instruction) contribute to the effectiveness of STEM implementation. For example, principals should have the necessary knowledge and skills (i.e., ability) to understand, for example, how to implement or delegate implementation of STEM. Second, principals need sufficient consultation with government agencies to be willing to conceptualise and implement STEM policy (i.e., motivation). Third, principals should experience sufficient opportunity to fulfil their STEM implementation responsibilities through having access to specialist teachers. This implies that their role in implementing STEM should be compatible with their other organisational roles. Hence, the researcher focuses on role conflict as an indication that principals lack the opportunity to implement STEM adequately in their schools. In addition to the exploration of principals' ability, motivation and opportunity to implement STEM, it is also necessary to explore the relationship between their overall job, demands and resources, taking into account the high level of responsibility that the school principal has (Kitt, 2017), in addition to the importance that their own wellbeing plays in the smooth running of a school (Dempsey & Burke, 2020). Taking into account the AMO framework, as explored above (Van Waeyenberg & Decramer, 2018), this study suggests that principals must have the ability, motivation, and opportunity to implement STEM education effectively in their schools.

3.2.3 Promoting STEM Education via School Leaders

3.2.3.1 Transformational Leadership and STEM Education

School restructuring internationally during the 1990s brought about the concept of transformational leadership into the education sector and this concept gradually overshadowed instructional leadership as the favoured model of leadership (Leithwood et al., 1996; Stewart, 2006). Transformational leadership is a complete transformation of form, a change in the identity or essence of something, an absolute change in exterior structure or interior persona (Forester & Clegg, 1991). Less hierarchical than other historical forms of leadership (Hallinger, 2003b), within the transformational leadership model, the leader fosters a collaborative vision and encourages and inspires employees to change and innovate during organisational transformations (Bass, 1985; Bass & Avolio, 1993; Bass & Riggio, 2006).

Moreover (Bass, 1997; Leithwood, 1991; Northouse, 2018) paint transformational leaders as being creative, charismatic, and visionary in their approaches of transforming their followers. Furthermore, transformational leaders provide support and nurture their followers to flourish in their education and organisation-improvement endeavours. Existing research has focused primarily on the importance of transformational leadership or finds the direct impact of transformational leadership on organisational performance (Maley, 2019; Malinen et al., 2019; Montani et al., 2019), and on employee outcomes including employee performance (Adamu et al., 2016) and employee resilience (Kennedy et al., 2016; Lester et al., 2018).

Key research has reported that transformational leadership in educational settings is positively linked to achievement of goals, developing school culture and enhancing teacher development activities (Jacobson et al., 2005; Leithwood et al., 2002, 2008; Leithwood & Jantzi, 2005). A recent study reports that transformational leadership is often evident in

STEM-focused US high schools (Denaker et al., 2020). However, research in the area of transformational leadership and STEM education is rare, and there is a gap in literature when it comes to exploring this concept in the Irish context, particularly at primary level. Therefore, this study seeks to explore the impact that transformational leadership has on principal and school commitment to and implementation of STEM education.

Hypothesis 1. Transformational leadership is positively associated with principal commitment to STEM education (1a), principal intention to adopt STEM education (1b), school implementation of STEM education (1c), and school participation in STEM weeks (1d).

3.2.3.2 Consultation and STEM education

Madariaga et al. (2017) report that from a government perspective, principals are key stakeholders of information products and services, which government agencies deliver to school communities in an effort to achieve equity and quality in education. With increased accountability for those in leadership roles and the gatekeeper role that principals play in policy implementation within their schools, (Conway & Murphy, 2013; Hislop, 2011; King & Nihill, 2019), it is important to explore principal perceptions of consultation with government agencies, and the relationship that such consultation has on STEM implementation.

Given the significant role that principals play in implementing new government policy (Madariaga et al., 2017), it is important to reflect on the consultation practices between these parties, and consequent potential implications on principal wellbeing. In this instance, the government serves as the manager, and principals as their employees. Whilst Irish government STEM education strategies and policies (DES, 2016b, 2017e, 2017b) are ambitious and place the principal in the position of gatekeeper, there needs to be a core focus on principals' lived experiences of enacting this change (Harney et al., 2018a). Furthermore, the necessity of exploring principals' perceptions is heightened because managerial

perceptions of organisational experiences, in this case government agencies, have a tendency to be positively skewed, and often differ from those reported by employees (Geare et al., 2014). In contrast, employee perceptions, in this case those of principals, can provide a more rounded way of assessing government Human Resource Management (HRM) interventions (Bowen & Ostroff, 2004), thus offering more accurate benchmarks of attitudes, behaviour, and wellbeing (Wood & De Menezes, 2011). As such, this study seeks to explore the impact that consultation with government agencies has on STEM implementation.

Hypothesis 2. Consultation with government agencies is positively associated with principal commitment to STEM education (2a), principal intention to adopt STEM education (2b), school implementation of STEM education (2c), and school participation in STEM weeks (2d).

3.2.3.3 Access to Specialist Teachers and STEM Education

International researchers are cognisant of what is required to improve STEM education and report that primary school intervention should be the first priority (Marginson et al., 2013; Prinsley & Johnston, 2015). The Irish primary school sector has a generalist teaching model, where teachers provide instruction for a wide range of subjects (Clohessy et al., 2020).

Research demonstrates that despite an overall generalist approach internationally, specialist teaching is an increasingly more common occurrence in the primary sector (Angus et al., 2007; Ardzejewska et al., 2010). Moreover, Lowery (2002) reports that professional experiences that are content-specific can enhance teacher confidence and competence. This is enacted via the provision of more opportunities to explore subject area and pedagogical content as well as teaching strategies at deeper levels.

An approach to specialist teacher instruction that is favoured internationally is appointing a teacher as a subject leader, to serve as a mentor in that area for other teachers in

the school (Langbort, 2001). Irish primary schools are allocated posts of responsibility including Principal, Deputy Principal and Assistant Principal I and II. The principal, in consultation with the staff, decide on the duties that post holders will encompass, based on the needs of each individual school (Government of Ireland, 2021). Therefore, posts can be awarded to teachers who have additional qualifications or specialties to lead in a specific subject area(s). However, additional funding is required to either employ an additional staff member or provide a higher salary for the lead teacher who mentors others (Birky et al., 2006). An alternative, less costly approach, is when teachers are allocated teaching roles whereby the majority of their time is spent teaching subject areas that they excel in, thus reducing prescribed instruction time in areas of weakness (Piechura-Couture et al., 2006).

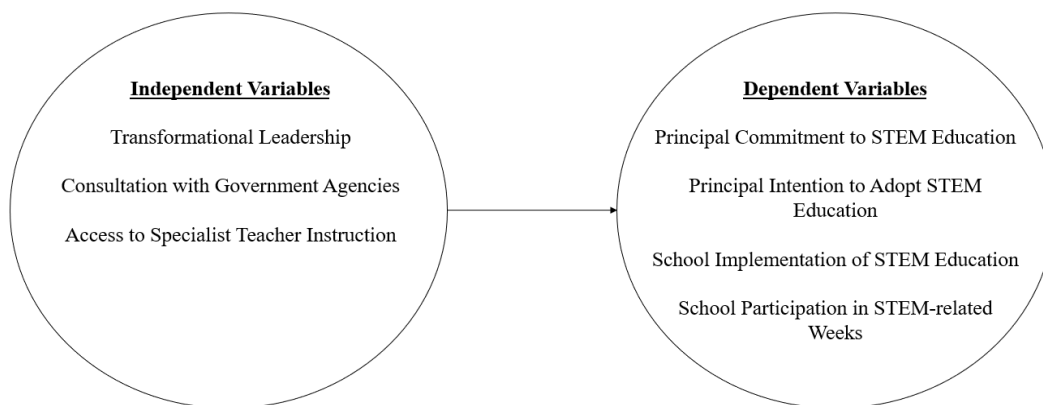
The McKinsey Reports outline that high quality teaching has been reported as surpassing any other factor with regards to overall successful school performance (Barber & Mourshed, 2007) and Mervis, (2011) supports this claim with regards to the subject area of STEM, detailing that the person who teaches the STEM programme in a school is key to its success. Exploring the concept of successful STEM implementation further, research from the National Research Council of Washington reports that a person's knowledge and academic background in STEM significantly impact their ability to teach the subject area (National Research Council, 2011). This is particularly relevant in a primary school setting, whereby teachers receive a general education, and the minimal amount of preparation in STEM fields during initial teacher education can lead to reduced confidence in teaching in this practical area (Goldhaber & Brewer, 1998; Posamentier & Maeroff, 2011). For example, Reys (2003) suggests that it is not realistic to expect primary teachers to hold specialist knowledge in the subject area of maths, as well as sufficient knowledge for all other subject areas in the curriculum.

Overall, research has demonstrated that specialist experiences can enhance teacher confidence and competence (Lowery, 2002), and there are an increasing amount of STEM specialist professional development government and outreach supports that are accessible to principals. Therefore, this study seeks to investigate the potential impact that having access to specialist teacher instruction has on principal and school commitment and intention to adopt STEM education.

Hypothesis 3. Access to specialist teacher instruction is positively associated with principal commitment to STEM education (3a), principal intention to adopt STEM education (3b), school implementation of STEM education (3c), and school participation in STEM weeks (3d).

The access to specialist teacher instruction scale that is employed in this study was adapted from Bowe, s (2014) study on leadership in music education, and is centred around the frequency that schools have access to specialist teacher instruction. The hypotheses for Study 1: Leadership in STEM Education are illustrated in Figure 3.1 below.

Figure 3.1 Conceptual Model for Study 1: Leadership in STEM Education



3.3 Study 2: Leadership During the COVID-19 Crisis

3.3.1 Overview

This study builds on data and knowledge in the area of leadership retrieved from Study 1. It further investigates the impact of transformational leadership which is hypothesized to influence principals' and their school's performance during the COVID-19 crisis. This study investigates (i) principals' perceptions of leadership during COVID-19, (ii), their recommendations for improvement (iii) the effect that transformational leadership has on school performance and work alienation during a crisis, and (iv) the effects that relational coordination and employee trust have on the relationship between this relationship. Therefore, the following research question addressed in this study: How does principal leadership influence their own wellbeing, and their school's performance during the Covid-19 crisis?

3.3.2 Leadership During Crisis

3.3.2.1 The Role of the Principal During a Crisis

This national study focuses on principals as managers and leaders of school communities during crisis. Principals are leaders who directly lead and influence staff, students, and parents during crisis (DES, 2020a; Fahy et al., 2020). They are crucial figures for establishing and fostering an environment which promotes successful practices, making them gatekeepers, to prioritise what is educationally and culturally of merit (Hargreaves, 2005; Hargreaves & Fink, 2006).

Principals, as school leaders, had an important role during the COVID-19 crisis, ensuring that schools were running online and that schools met the educational, social and emotional needs of their students (DES, 2020e, 2020a). This crisis has forced education

systems across the globe to move online and is likely to transform what teaching and learning looks like in the coming years (Fahy et al., 2020).

3.3.2.2 Leaders, Leadership and Crisis Management

Leaders and their relationship with organisational performance has been given great attention by academia and practitioners (Anderson, 2017; Thien, 2019). Rincon-Gallardo, (2020) suggests that global trends including human activity-related disasters make transformation in organisations more urgent than ever. Given the challenges that arise in times of crisis such as COVID-19, leaders experience a significant increase in demand. This occurs as the breadth and depth of their responsibilities intensify and the pressure of executing decisions under extreme time pressure mounts at a rapidly increasing rate (Ash & Smallman, 2018). Research on leadership during crisis reveals that it is essential that leaders exhibit a specific set of skills and competencies that will aid them in navigating through the crisis (Boin *et al.*, 2010; Kapucu and Ustun, 2018; Liu *et al.*, 2020; Wooten and James, 2008). For example, Boin and Hart (2005) suggest that there are five core tasks associated with crisis leadership including sense-making, decision-making, meaning making, terminating, and learning. Similarly, Wooten and James (2008) suggest that leaders during crisis should have competence in decision making, communication, creating organisational capabilities, sustaining culture, and developing human capital.

The research on leaders' competencies and skills required during crisis management is helpful for leaders to understand and gain the specific skills to lead their organisations during crisis. However, it is difficult for leaders to develop all of these skills, and these skills are also context-dependent (Williams et al., 2017). Another theme of research is the effectiveness of leadership styles (Alkharabsheh et al., 2014; Bhaduri, 2019; Stam et al., 2018; Stoker et al., 2019). Among the research, transformational leadership has been found to be very effective during crisis (Alkharabsheh et al., 2014; Haddon et al., 2015).

Transformational leadership offers employees intellectual guidance, encourages and motivates employees to change and to achieve innovation within the organisation, whilst simultaneously supporting and empowering staff as partners in making decisions (Bass, 1985; Bass and Riggio 2006; Conley & Goldman, 1994; Leithwood, 1993). Transformational leaders are capable of working with their followers, to extend beyond self-interest and to engender enthusiasm for the sake of their staff and organisation. They also encourage and motivate employees to participate in the change, enhance their experience and enable them to achieve more than they had set out to (Miner, 2005; Windlinger et al., 2020). Transformational leadership is a critical component for strong organisational performance (Anderson, 2017). Based on the conceptualisation and existing empirical support, this study suggests that transformational leadership will be positively linked to school performance.

Hypothesis 1a. Transformational leadership is positively associated with school performance during the COVID-19 crisis.

The Transformational leadership scale that is used in this study was adopted from Carless et al. (2000). The items in this scale are centred around a principal's approaches to leadership including elements such as clear communication, support and encouragement. Additionally, the school performance scale that is employed in this study was adopted from (Griffin et al., 2007). The items in this measure focus on school's proficiency, adaptivity and proactivity in carrying out the core parts of their job during the crisis.

Aside from school performance, this study also focuses on the leaders' experience with people and work during the lockdown. In reviewing varied concepts, this study chooses the concept of work alienation to study the leaders' experience with work. Unlike the positive psychology in management, the waning of interest in the topic of alienation may have been subject to its dismal nature, making it too disheartening for both researchers and practitioners alike (Seeman 1959). After a long period of absence of this concept in literature, Nair and

Vohra, (2010), explore the re-entry and growth of alienation within contemporary research. Alienation is defined as the: “*estrangement or disconnect from work, the context or self*” (Nair & Vohra, 2009, p. 296).

Furthermore, people experiencing alienation often express feelings of:

“*powerlessness, meaninglessness, normlessness, isolation, and self-estrangement*” (Seeman, 1959, p. 783).

Recently, work alienation has attracted increasing attention by scholars to examine the consequences of alienation including decreased job satisfaction, wellbeing, task performance, and increased levels of emotional exhaustion (Chiaburu et al., 2014; Conway et al., 2018b; Shantz et al., 2015; Truss et al., 2014). The antecedents of alienation found in the literature include job design and HR practices that focus on building relationships with others (Conway et al., 2018; O’Donohue & Nelson, 2014).

Transformational leaders have the ability to restructure their work which denotes a sense of ownership and pride in both the end result and the process involved (Bass & Avolio, 1990, 1994; Niehoff et al., 1990). Transformational leadership emphasises the connection between leaders and others around them by sharing visions, intellectually stimulating others, providing guidance and getting them involved in decision making. Such efforts and behaviours help leaders to develop and maintain strong relationships with others. Therefore, transformational leaders may be less likely to experience work alienation. During the COVID-19 lockdowns, some managers have taken the time to share their knowledge with others. One example is the CEO of Microsoft, Satya Nadella, who constantly shares key messages within and beyond his organisation (Nadella, 2020). Through building connections in the virtual environment introduced by COVID-19, leaders can manage their organisation by mobilising resources required during these uncertain times. This leads to leaders experiencing lower levels of isolation and powerlessness. Therefore, it is expected that a

negative relationship between transformational leadership and leaders' work alienation during the crisis exists.

Hypothesis 1b. Transformational leadership is negatively associated with work alienation during crisis.

The work alienation scale that is used in this study was adopted from Shantz et al. (2014, 2015). This scale explores principals' connection with staff members and enthusiasm about their work.

3.3.2.3 The Importance of Relational Resources During Crisis

Relational resources concern actions or strategies which promote the connection of people or things (Story et al., 2009). The development of social capital suggests that relationships are a valuable resource for individuals and organisations (Bourdieu, 1986; Burt, 1992, Coleman, 1988). Building relational resources is critical both generally and during crisis situations. When this study took place, most countries were in a lockdown, and employees were working from home. In this situation, colleagues do not see one another in person. Consequently, building relationships with people at work became a challenge.

Trust is a critical element with respect to a positive experience at work. Similarly, according to Frandsen and Johansen (2016, 2020) timely, clear communication, and coordination about work and structure changes is even more important during times of crisis. Drawing upon the relational perspective, this study identifies two types of important relational resources, namely employee trust and relational coordination during the crisis. These resources are proposed as the mediators between transformational leadership with school performance and work alienation. This research aligns with Kelloway et al., (2012), who suggest that employee trust in leadership is a component of the quality of the relationship between the leader and their employee. Similarly, Rousseau et al., (1998) define employee trust as “*a psychological state comprising the intention to accept vulnerability based upon positive*

expectations of the intentions or behaviour of another'' (p. 395). Elaborating on this definition, Rousseau et al., (1998), suggest that when followers believe leaders' intents to be positive and their intentions and behaviours to be honest, higher-order relationships will emerge. Leaders who do so not only communicate to staff the importance of their work, but also their values in doing the "right thing." This indicates the leader's concern for the employees' well-being, which builds trust in the leader.

For employee trust, a number of studies have found it as a mediator between transformational leadership and outcomes (e.g. Kelloway *et al.*, 2012; Liu *et al.*, 2010). According to Kelloway (2012), transformational leaders act as role models who consider the interests and wellbeing of their followers. In turn, this leads to a mutually beneficial relationship with increased follower trust. Similarly, Zhu *et al.* (2013) argue that behaviours of transformational leaders allow leaders to develop close and personal relationships with their followers, leading to higher levels of employee trust.

Consistent with social exchange theory (Blau, 1964; Gouldner, 1960), employees' experiences with supportive and transformational leadership lead them to reciprocate by increasing their motivation at work. For example, during the crisis, transformational leaders share their vision, stimulate employees, and guide them through uncertain times. When employees are motivated, they are more likely to work hard to complete their duties and be involved in the activities supporting their organisations. In addition, employee trust will also help leaders to reduce their work alienation. Consistent with existing research, the dissertation suggests that employee trust is a mediator in the relationship between transformational leadership and school performance as well as work alienation.

Hypothesis 2. Employee trust mediates the relationship between transformational leadership and school performance (2a) and work alienation (2b) during crisis.

The employee trust scale that was used in this study was adapted from Langfred (2004), and measures principals' perceptions of the trust that their employees have for them. The second relational resource that is explored in this study is relational coordination and is defined as:

“a mutually reinforcing process of interaction between communication and relationships carried out for the purpose of task integration” (Gittell, 2002a, p. 300).

Relational coordination is a relational resource that describes high quality work relationships and communications among varied parties. Specifically, relational coordination refers to how shared goals, knowledge, and mutual respect aid in promoting frequent, timely, accurate, and problem-solving communication between workgroups and organisations (Gittell, 2002a, 2002b; Gittell et al., 2010). According to Gittell and Suchmann (2013), relational coordination can assist the development of strategically important outcomes including service quality, organisational efficiency, and customer satisfaction. An increasing number of studies have provided empirical evidence for the impact of relational coordination on performance outcomes during the last decade. They include: performance of airports e.g. improved on-time performance, better baggage-handling performance, fewer customer complaints, shorter scheduled gate times and higher staff productivity (Gittell, 2002a, 2002b); innovation in professional service firms (Fu, 2015); as well as patients perceived quality of care and reduced lengths of hospital stay (Gittell et al., 2010).

During the crisis, relational coordination with key stakeholders allows the leaders and organisations to have clear and timely communication in building shared and collective goals and relationships, thus enabling organisations to function and survive during the crisis. The well-connected relationships with key stakeholders will also help leaders to feel associated and linked with people and work. As such, a positive impact of relational coordination on

school performance and a negative impact of relational coordination on leaders' work alienation.

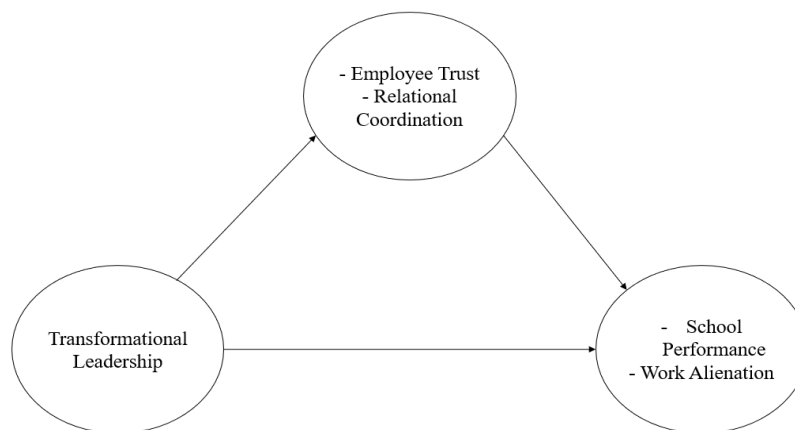
In terms of antecedents of relational coordination, existing research has found that a system of high-performance people management practices involves participation in cross-functional teams (Gittell et al., 2010) and relational routines (Fu, 2015). These antecedents of relational coordination have one shared feature which is the focus on building work relationships. Transformational leadership encourages and inspires employees to innovate via promoting a collaborative climate. Transformational leaders are expected to initiate relational coordination with key stakeholders in order to increase the awareness of crisis and gain resources from varied parties to help organisations to cope with the crisis. Therefore, a positive relationship between transformational leadership and relational coordination is proposed.

Based on the above discussed relationships between transformational leadership and relational coordination, as well as between relational coordination with school performance and leaders' work alienation, this study proposes that transformational leadership influences school performance and leaders' work alienation via relational coordination.

Hypothesis 3. Relational coordination mediates the relationship between transformational leadership and school performance (3a) and work alienation (3b) during crisis.

The relational coordination scale that was employed in this study was adopted from (Gittell et al., 2010). This scale is centred around principal communication between the school and relevant stakeholders such as teachers, parents, and the board of management. The hypotheses for Study 2: Leadership During the COVID-19 Crisis are illustrated in Figure 3.2 below.

Figure 3.2 Conceptual model for Study 2: Leadership during the COVID-19 Crisis



3.4 Summary of Hypotheses for a National Study of Leadership in the Irish Primary Sector

Hypotheses were centred around leadership in two contexts: (i) STEM education and (ii) during the crisis. In addition to the work explored in chapter 2, literature on AMO framework, transformational leadership, consultation with government agencies, and access to specialist teacher instruction informed the hypotheses for Study 1: *Leadership in STEM Education*. Furthermore, additional research on the role of the principal during a crisis, leadership and crisis management and the importance of relational resources informed the hypotheses for Study 2: *Leadership during the COVID-19 Crisis*. Table 3.1 below provides a summary of the hypotheses in this research.

3.5 Chapter Summary

In this chapter hypotheses were developed in line with key literature. Additionally, a summary of the hypotheses for Study 1 and Study 2 was provided. The next chapter will present the methodology that is explored in both Study 1, *Leadership in STEM Education* and Study 2, *Leadership During the COVID-19 Crisis*.

Table 3.1 Summary of Hypotheses for a National Study of Leadership in the Irish Primary Sector

Study	Hypothesis
Study 1: Leadership in STEM Education	• <i>Hypothesis 1. Transformational leadership is positively associated with principal commitment to STEM education (1a), principal intention to adopt STEM education (1b), school implementation of STEM education (1c), and school participation in STEM weeks (1d).</i> • <i>Hypothesis 2. Consultation with government agencies is positively associated with principal commitment to STEM education (2a), principal intention to adopt STEM education (2b), school implementation of STEM education (2c), and school participation in STEM weeks (2d).</i> • <i>Hypothesis 3. Access to specialist teacher instruction is positively associated with principal commitment to STEM education (3a), principal intention to adopt STEM education (3b), school implementation of STEM education (3c), and school participation in STEM weeks (3d).</i>
Study 2: Leadership during the COVID-19 Crisis	• <i>Hypothesis 1a. Transformational leadership is positively associated with school performance during the COVID-19 crisis.</i> • <i>Hypothesis 1b. Transformational leadership is negatively associated with work alienation during the COVID-19 crisis.</i> • <i>Hypothesis 2. Employee trust mediates the relationship between transformational leadership and school performance (2a) and work alienation (2b) during the COVID-19 crisis.</i> • <i>Hypothesis 3. Relational coordination mediates the relationship between transformational leadership and school performance (3a) and work alienation (3b) during the COVID-19 crisis.</i>

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This section explores the philosophical basis of the research methodology that is employed in two studies: Study 1 (Leadership in STEM Education) and Study 2 (Leadership during the COVID-19 Crisis). It discusses the appropriateness of a post-positivist approach to best address the research questions. Next, the methodologies for each study are addressed in the following areas. First, details on sampling and survey design as per Chatterji's (2003) guidelines are outlined. Next, the procedure to conduct the survey by employing Dillman's (2011) Tailored Design Method discussed. Following this, the variable measurements in the survey, as well as their validity and reliability are presented. Finally, the coding method for the open comment section of the survey is outlined.

4.1.2 Research Philosophy

A research paradigm can be described as a set of fundamental assumptions and beliefs regarding the way the world is perceived, thus serving as a thinking framework to guide the researcher's behaviour (Jonker & Pennink, 2010). Exploring research philosophy can provoke the researcher to question and think in a more detailed way about the topic that they are considering (Crossan, 2003). Easterby-Smith and Thorpe (2002) suggest that an understanding of research philosophy can help to refine, specify, and evaluate research methods. Therefore, it is crucial to evaluate the research paradigm that will be applied before research is carried out as it will have a significant impact on how phenomena are explored and interpreted (Berry & Otley, 2004; Creswell & Creswell, 2017; Neuman, 2011; Saunders et al., 2009). Two core philosophical domains to discern research paradigms are ontology and

epistemology, relating respectively to the nature of knowledge and its development (Kalof et al., 2008; Laughlin, 1995; Saunders et al., 2003). Hallinger and Heck (2002) suggest that in terms of epistemological bearings within the context of education leadership research, that there are roots in theories of knowledge including positivism and constructivism.

Researchers Polit and Beck (2008) report that a positivist research philosophy lends itself to quantitative research studies. Furthermore, positivism aligns with the empiricist view that knowledge is derived from human experience and only factual knowledge that is yielded through observation, including measurement, is reliable and exists (Steen & Roberts, 2011). For example, according to Collins (2018) advocates of positivism view the world as a variety of observable constructs that interact with each other and are quantifiable and give rise to statistical analyses. Moreover, the researcher's role is only applicable to the collection of data and its interpretation in an objective way. Constructivism, on the other hand, proposes that the participants and their subjective perspectives shape the meaning of phenomena (Creswell & Clark, 2017; Molina-Azorin et al., 2017). Similarly, constructivism asserts that there are various realities, making it hard to distinguish entire cause and effect relationships since the participant is the only source of reality (Johnson & Onwuegbuzie, 2004).

Whilst positivism remains the most dominant quantitative paradigm within education research, there has been a shift towards post-positivism (Hunter & Leahey, 2008). Appropriately, post-positivism offers a revised metatheoretical stance acknowledging the critiques of positivism while offering a balance between the extremes of both positivism and constructivism (Bergman, 2016; Popper, 2002). In terms of ontology, post-positivism aligns with a critical realist ontological perspective whereby reality is assumed to exist and can be measured, however reality can never be truly known, only imperfectly (Wahyuni, 2012). With regards to epistemology, researchers taking an objectivist stance, argue that knowledge is known through facts that can be empirically measured, generalised, confirmed or rejected.

Likewise, knowledge is independent of the researcher and cannot have perfect objectivity or truth as with positivism, but can progress close to truth (Guba & Lincoln, 1994; Levers, 2013; Wildemuth, 2016). Within post-positivism or methodological-plurism (Morris et al., 2009), the paradigm that the researcher decides on determines what research methodology is employed and it is centred around the concept that not everything is knowable (Krauss, 2005). In other words, post-positivism gives rise to the concept that “*reality is multiple, subjective and mentally constructed by individuals*” (Crossan, 2003a, p. 10).

Accordingly, a post-positivist philosophy can be applied to both quantitative and qualitative research designs and is methodologically defined by the research question (Guba & Lincoln, 1994; Levers, 2013; Sköldberg, 2009). Therefore, this study adopts a post-positivist stance to answer the research questions by drawing on mixed methods through the triangulation of quantitative results and the qualitative component of the survey instrument. This research aims to provide evidence which will impact policy and practice on improving leadership in the areas of STEM education and crisis or change management. Policy research needs to have a high technical quality with regards to the standard of research design and the subsequent process (Hutchinson, 1995).

4.1.2 Overview of Processes in Study 1 and Study 2

The first step in conducting the two studies was to perform exploratory interviews with principal representatives. The survey for Study 1 (Leadership in STEM Education), was developed and piloted with advisory principals (non-participants in the survey) drawing on their expertise to refine the instrument. The survey-based method was employed to collect data, which was subsequently analysed permitting hypotheses to be tested, in triangulation with the qualitative data collected in the survey. This approach allowed the researcher to test for the role of the principals, i.e., transformational leadership (ability), consultation

(motivation), access to specialist teachers (opportunity), in promoting and implementing STEM education in their schools when controlling for variables such as school size, type etc.

Study 2 (Leadership During the COVID-19 Crisis) commenced in May 2020, during the COVID-19 pandemic to better understand the increasing demands placed on school principals and their influence on principal wellbeing. As with Study 1, a survey-based method was employed and data was collected which permitted the researcher to further investigate the concept of Irish primary school principals as leaders, this time focusing on the relationship between transformational leadership, relational coordination, and work alienation.

4.1.3 Overview of Data Analysis Strategies

Both studies involve quantitative data collected from the survey scales and qualitative data collected from the responses to the open question at the end of the surveys. For quantitative data in both studies, firstly a sample analysis was carried out. Next, descriptive statistics are introduced including the correlation between variables. Following this, structural equation modelling (SEM) analysis was carried out to test the hypothesised statistical models. Next, qualitative data was thematically analysed. Finally, the qualitative and quantitative findings were synthesised.

4.2 Study 1: Leadership in STEM Education

4.2.1 Research Process

The Irish primary education sector was chosen as the focus of this study. Ethical approval for the project was sought by the researcher and granted by Trinity College Research Ethics Board (refer to Appendix A). To better understand the context the researcher conducted three semi-structured interviews, one with a teaching principal, one with an

administrative principal and one with a National Principals' Representative from the INTO (Irish National Teachers' Organisation) (refer to Appendix B). The topics of the interview centred around the role of a principal, in addition to their knowledge relating to STEM education and implementation (refer to Appendix C). During the survey design for Study 1 (Leadership in STEM Education), the researcher piloted the survey with educational and STEM stakeholder experts to improve both its face and content validity.

When the sample had been established and pilot studies were completed, an adaptation of Dillman's (2011) Tailored Design Method was employed to conduct the survey. Consisting of 5 steps, this method includes, the issuing of an invitation letter, cover letter with questionnaire, thank you, reminder, in which include invitation letter, cover letter with questionnaire, thank you and reminder postcard, letter with the first replacement of questionnaire, and final letter with the second replacement of questionnaire. The survey replacement steps were substituted by reminder emails, given the online nature of the survey. Additionally, hard copies of the surveys were posted with self-addressed envelopes to 700 principals, who had school email addresses that were listed incorrectly on the DES website. Each step in the procedure is described in more detail in table 4.1 below.

Table 4.1 Study 1 Research Processes

Step	Explanation
Invitation letter	First, an invitation letter was emailed to all the respondents to inform them about the survey.
Cover letter with questionnaire	Two weeks later, a cover letter and a link to the online questionnaire on the platform Qualtrics (Appendix D) were emailed out to principals.
Thank you and reminder email	Four weeks later, an email was sent out to thank the respondents and to remind non-respondents.
Replacement survey (postal) for schools unreachable by email.	Hard copies of the surveys were posted with self-addressed envelopes to 700 principals, with incorrect emails on the DES website. These responses were entered manually to the data set.

In order to increase the response rate for the survey, several techniques were employed including displaying well-known education agency logos and promoting it via principals' internal communication channels. The RDS STEM Learning Programme logo was used as part of the cover letter, as this organisation assisted with the survey design and many primary schools are involved with this initiative. Additionally, the National Principals' representatives of the INTO disseminated information about the survey at their district group meetings. National education centres, the Teaching Council, the IPPN, the DES, the NCCA and other stakeholder groups were also asked to help to raise awareness via newsletters, emails and verbal broadcasts at conferences and events. In all emails and mailings, the respondents were promised complete confidentiality regarding the data provided by them. Figure 4.1 presents a flow chart of the data collection process in detail.

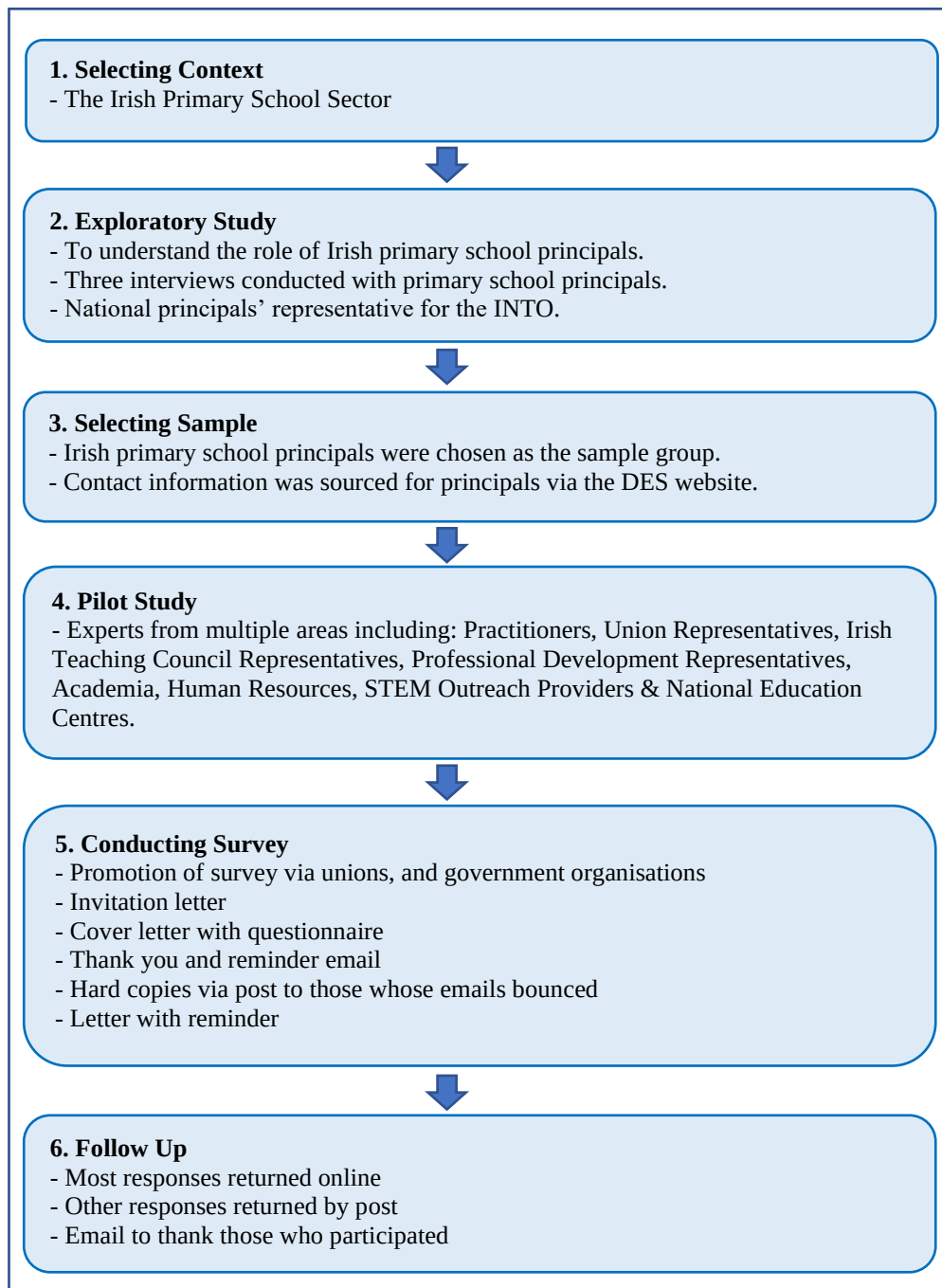
4.2.2.1 Sampling

The target population for the survey consisted of all Irish primary school principals (3,231). A national approach was chosen to provide an overview of how STEM education is implemented and valued within Ireland, and to yield results which would hold rigour in creating applicable national implementation policy documents. Principals were selected as the participants as they are responsible for implementing Department of Education policies and can provide an overview of what is happening in each school (DES, 2017a).

A list of all Irish primary schools along with their contact details was obtained from the Department of Education and Skills website in April, 2019. Emails were cross-checked with schools' websites to maximise the potential of the questionnaire reaching the principals (Dillman et al., 2014). Principals were contacted via the distribution of invitation emails, the dissemination of information through the RDS STEM Learning platform and through speaking at the *'INTO National Principals' Representatives Conference'*, in May, 2019. The researcher also asked national principal representatives to disseminate the information about

the study in regional meetings, prior to sending the invitation email to the target sampling group.

Figure 4.1 The Data Collection Process



4.2.2.2 Survey Structure

The source of the data used in this study was the Survey of STEM Education in Primary Schools: Principals' Perspectives 2019. Chatterji's (2003) iterative approach was selected to design a web-based, self-report instrument using the online GDPR-compliant platform, Qualtrics. An identically worded paper form of the online questionnaire was also established using Microsoft Word. This questionnaire contained Likert scale statements, demographic information about the principals and their schools and a qualitative, open question. It was clearly structured and designed.

Chatterji's (2003) instrument design guidelines discuss the importance of identification of sections with regards to notable responses, behaviours, tasks or performances. To functionally establish these sections, several steps were taken. First, exploratory interviews with principals were incorporated in the design process of the questionnaire to elicit concerns and experiences of the potential participant cohort (Arsel, 2017; Gower, 1993). Next, a literature review was carried out. The survey aimed to capture principals' perceptions of leadership in STEM education. It included the key constructs such as leadership, intention to adopt, commitment, consultation with government agencies, specialist teacher instruction and participation in STEM weeks. The scales used in the survey were derived from well-established and validated measures from academic literature, in addition to contributions from principals and key STEM stakeholders.

The Survey of STEM Education in Primary Schools: Principals' Perspectives, 2019 instrument has five sections, as elaborated on in table 4.2 below.

Table 4.2 Study 1 Survey Sections

Section	Subject Matter
Section 1	Your views on STEM Education (general questions about STEM education).
Section 2	STEM in your School (the existing profile of STEM in the school regarding curricula and scheduling; engagement with STEM outreach programmes, staffing, facilities and budget).
Section 3	Communication from relevant Educational Bodies.
Section 4	About your Work Experience.
Section 5	About You and Your School (demographic information).

4.2.2.3 Survey Format

A combination of paper and online questionnaires was selected as it is reported to be the most successful method of implementation (Börkan, 2010; Couper et al., 2007; de Bernardo & Curtis, 2013).

Online questionnaires are often used as an additional method of administration to traditional modes where response rates are tending to decline (De Heer & De Leeuw, 2002; Evans & Mathur, 2005). In the case of this study, an online questionnaire served as a primary method of administration in conjunction with the traditional, paper-based questionnaire. There are many advantages associated with online surveys, in particular: speed and timeliness; convenience; ease of data entry and analysis; low administration cost; ease of follow-up; ease to obtain a large sample; flexibility in questionnaire design; control of answer order; knowledge of respondent vs. non-respondent characteristics, and required completion of answers (Couper et al., 2007; Creswell, 2003; Dillman, 2011).

The following were potential issues with the online questionnaire that could have arisen in this study: non-response (Couper, 2000); the issue of perception of junk mail and respondent lack of online experience/expertise (Evans & Mathur, 2005). Cross-referencing of

emails was carried out and participants were notified of the email address, subject line and dissemination date to avoid it being perceived as spam and increase the response rate.

Paper-based questionnaires were distributed as part of a second-round call to all principals whose email addresses were not listed correctly on the Department of Education website database (750 schools). Common issues related to postal paper-based surveys include: postal costs, (Archer, 2003); unclear instructions, non-responses and incomplete/brief answers (Greer et al., 2000; Jussaume Jr & Yamada, 1990). The issue of postal costs was addressed and was subsidised by the Trinity Business School, Trinity College Dublin. Attention was directed towards instructions and question layout during piloting to ensure maximum efficiency and ease for principals who may wish to participate. With regards to non-response, this approach targeted those who did not have the opportunity to participate in the online version of the survey.

4.2.2.4 Pilot Study

The questionnaire was piloted by a diverse group of experts in order to improve its overall validity (Robson, 2002). The pilot test in the target population is a crucial aspect of the design process and questionnaires have been revised according to feedback from pilot participants (Iarossi, 2006). Pilots were carried out with principals who were not involved in the designing process. These pilots proved very valuable, highlighting language that principals would be most familiar with, and raising concerns regarding both content that needed further elaboration and equally removal from the survey. STEM education and leadership experts reviewed the survey to ensure that the content was relevant for the target group. Statistical input and formatting advice was yielded from experts in the survey design field. The survey was revised a total of 20 times before dissemination. Table 4.3 below presents some of the pilot participants and their suggested revisions.

Suggested revisions were implemented where appropriate. An effort was made to include as many stakeholders in STEM as possible to maximise the impact that the survey could have for STEM advancement in Ireland. Key pilot study revisions included: reduced volume of text on the introduction; increased font size; addition of 'other' boxes where relevant, to allow for alternative responses; re-wording of items specifically relating to the role of the principal in order to make the questions more appropriate for the target audience; insertion of initiative overload questions; reframing of the consultation section; change in layout to prevent participants missing questions; replacing close-end questions with more Likert questions, moving demographic questions from the beginning to the end of the survey and shortening the length of the survey from 20 to 10 minutes.

During piloting, most principals had suggested that they liked the Likert scale questions best, and that they were easy to follow, promoting fluidity in the survey. Therefore, questions that took other forms (e.g., qualitative and ranking), were replaced with Likert questions where possible. The most important issue that was addressed was that of the concept of the principal as manager of their school. This is something that prompted many deep discussions with the research team and experts from further afield. All agreed that it was very relevant with regards to its potential impact on the implementation of STEM education in a school, however it was challenging to try and frame it in a way that would empower the principal and encourage them to share their experiences. In order to address this issue, the initial suggested constructs were revisited, including only those which allowed the principal to demonstrate the impact that they could be making in their role and indeed, to express the idea of work-overload if they so desired. Following these changes, the survey was then piloted one final time prior to administration by the INTO National Principals' and Deputy Principals' Committee.

Table 4.3 Study 1 Pilot Participants and Sample Suggested Revisions

Pilot Participant	Sample Suggested Revisions
Principals	• Suggested inclusion of questions relating to principal's value and intention to implement STEM. Suggestion to reduce volume of qualitative questions in favour of increased volume of Likert questions, renaming and re-wording of questions to suit the target audience.
Academics	• Suggested omission of certain scales to reduce length, re-wording and re-formatting.
Survey Design Specialists	• Formatting and wording of questions. Inclusion of logos to increase uptake.
RDS STEM Learning Committee	• Suggested inclusion of participation in STEM events questions.
INTO National Principals' Committee	• Suggested re-ordering of sections (moving demographic questions from the beginning to the end of the survey), re-wording of certain questions, increasing survey uptake (e.g., inclusion of logos and union support)
DES, Planning and Enterprise Engagement Unit Representative	• Suggested revision of consultation scale.
SFI Discover Project Lead	• Suggestion on exploring principals' opinions on investment into a nationally coordinated, accessible primary STEM infrastructure for all schools.
Google Representative	• Suggested revision of questions relating to engagement with specialists from industry and inclusion of specialist teacher instruction scale.
Initial Teacher Educators	• Suggested revision of subject integration questions.
PDST STEM Team Representative	• Suggested inclusion of scale relating to implementation of STEM and questions on the use of resources.

4.2.3 Measurements

This section describes how the variables were measured in this study. To help ensure the survey's validity, most of the items were adopted from measures that had been used in previous studies. Multiple-item scales were employed. Additional items were derived by stakeholder groups including principals, unions, and outreach STEM providers. A confirmatory factor analysis (CFA) was also conducted on all survey items to show that the items loaded on their respective scales.

4.2.3.1 Dependent Variables

There were four dependent variables in the model on the adoption and implementation of STEM education. They included: principal commitment to STEM education, principal intention to adopt STEM education, school implementation of STEM education, and school participation in STEM weeks.

Principal commitment to STEM education. In order to measure principal commitment to STEM education, six items were adapted from (Herscovitch & Meyer, 2002). One of the most significant factors involved in the support that people have for change initiatives is commitment (Armenakis & Bedeian, 1999; Coetsee, 1999; Conner & Patterson, 1982). Respondents answered on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Example items include: *“Introducing STEM education serves an important purpose”* and *“I believe in the value of STEM education for primary school students”*. The reliability was assessed by calculating Cronbach's alpha. The alpha coefficient was .90, much higher than the cut-off point of .70 (Nunally & Bernstein, 1978), thus showing internal consistency of the principal commitment to STEM education measures.

Principal intention to adopt STEM. The principal intention to adopt STEM education variable comprised of two items, which were adapted from (Teo et al., 2003). A

number of researchers have conducted studies (Chwelos et al., 2001; O’Callaghan et al., 1992; Premkumar et al., 1994; Teo et al., 1995) centred on the diffusion of innovations perspective (Rogers, 1995, 2010). The two items were: *“I would like to introduce more STEM activities into my school over the next 12 months”* and *“I am contemplating increasing the prevalence of STEM in my school”*. Respondents answered on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The Cronbach’s alpha was .86.

School implementation of STEM education. In order to measure this variable, eight items were adapted from Bowe (2014), who researched Irish post-primary principals’ perspectives on music education. The researcher chose to adopt this variable from this study due to its similarities both in terms of the leadership aspect and the practical nature of the subject-area in question. As with Bowe’s (2014) study, the target population, principals were involved in the establishment of this variable in addition to STEM stakeholders. Respondents answered on a five-point Likert scale ranging from 1 = not at all adequate to 5 = very adequate. Example items include: *“Adequacy of Promoting STEM in your School: Scheduling (Curricular time/timetable)”*, *“Adequacy of Promoting STEM in your School: STEM-related opportunities for students”*, and *“Subject prioritization in school self-evaluation”*. The reliability coefficient was .86.

School participation in STEM weeks. This variable was measured via four items which were derived in consultation with principals and STEM stakeholders. They were: *“science week”*, *“maths week”*, *“engineering week”*, and *“combined STEM week”*. Respondents answered on a five-point Likert scale ranging from 1 = never to 5 = always. The Cronbach’s alpha was .76, showing internal consistency of the measures.

4.2.3.2 Independent Variables

There were three independent variables: transformational leadership, consultation with government agencies and access to specialist teacher instruction.

Transformational leadership. Seven items were adopted from Carless et al.'s (2000) study, 'A Short Measure of Transformational Leadership', which explores the evolution of a short transformational leadership measure: the '*Global Transformational Leadership scale*' (GTL). Example items included: "*I communicate a clear and positive vision of what we want for our school*", and "*I treat staff as individuals, support and encourage their development*". Respondents answered on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. A Cronbach's alpha of .87 showed internal consistency of the Transformational Leadership measures.

Consultation with government agencies. There were no suitable measures found in educational literature on the concept of principal interaction with government agencies. Therefore, a four-item variable was adapted from a study by Harney et al. (2018), which focuses on the concept of the impact of organisational restructuring on employee wellbeing. Example items include: "*I am consulted when action is taken that will have an impact on my post*", and "*If changes to my role are made, I am given the reason(s) why*". Respondents answered on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. A Cronbach's alpha of .83 showed internal consistency of the consultation measures.

Access to specialist teacher instruction: Five items were adapted from Bowe, (2014)'s study on Irish Post-Primary Principals' Perspectives on Music Education. Example items include: "*How often does your school employ or bring in specialist teachers in the following areas: science*", and "*How often does your school employ or bring in specialist teachers in the following areas: maths/numeracy*". Respondents answered on a five-point Likert scale ranging from 1 = never to 5 = always. Cronbach's alpha was .84.

4.2.3.3 Control Variables

Two sets of variables are controlled in the analysis which are relevant to individual or school characteristics since they may influence STEM education outcomes.

Individual characteristics. These include principal gender, principal tenure, and principal role. Gender was coded as a binary variable (1 = female and 0 = male). Principal tenure was measured by the years of service in the primary education sector. Principal role was coded as a binary variable (1 = teaching principal and 0 = administrative principal).

School characteristics. These include school structure, school gender, school patronage, school economic status and school language. Gender was coded as a binary variable (1 = female and 0 = male). Additionally, School Patronage was coded as a binary variable (1 = Catholic and 0 = multi-denominational). School economic status was also coded as a binary variable (1= DEIS and 0 = Non-DEIS). Finally, School Language was coded as a binary variable (1 = Gaelscoil and 0 = English).

4.2.3.4 Qualitative Data Collection and Analysis Strategy

Qualitative data was collected via the following open-ended comment section at the end of the survey: *“Please feel free to share any additional thoughts you may have about STEM education in the Irish primary sector”*. NVivo was the platform selected for project analysis due to its ability to organise and manage large volumes of data, documents and visually model results (Edhlund & McDougall, 2019; Hilal & Alabri, 2013). The Excel spreadsheet containing survey response data was loaded into NVivo to establish cases for analysis.

Thematic analysis was carried out on the data as this method can yield a high level of detail and allows for precise qualitative analysis of the meaning of the data in context (Braun & Clarke, 2006; Joffe & Yardley, 2004). Additionally, this method allowed for identification and classification of themes and patterns through the use of a systematic coding process (Alhojailan, 2012; Boyatzis, 1998; Braun & Clarke, 2006). Braun and Clarke's, (2006) six-phase model was used. Firstly, the researcher familiarised themselves with the data by reading each comment in detail. Next, initial codes were generated through the identification of

keywords and statements. Following this, the researcher searched for commonalities between codes to establish themes. These themes were then reviewed, defined and named. Following this, a report of the findings was produced.

To ensure the reliability, accuracy and consistency of the coding method applied (Bernard, 1995; Ryan, 1999), three researchers independently coded each survey response. Inter-coder reliability (ICR) was measured whereby the reliability of every code is a function of the number of coding agreements among coders against the number of coding agreements and disagreements (Carey et al., 1996; Kurasaki, 2000). This process yielded an ICR of 85%, indicating that an appropriate reliability rating was evident (Carey et al., 1996; O'Connor & Joffe, 2020).

4.3 Study 2: Leadership during the COVID-19 Crisis

4.3.1 Research Process

During COVID-19, most governments around the world provided guidelines on moving schooling online, however, a detailed policy and procedure on how to do enact this change was not provided to Irish principals. As previously mentioned, Ireland has 3,240 primary schools, employing 37,839 staff and educating 559,365 students (DES, 2019). Therefore, given the leadership and influences that principals had during the COVID-19 crisis, testing the proposed model in among them is appropriate. The research process in this study, Study 2: Leadership during the COVID-19 Crisis, is the same process that was followed and explored previously in Study 1. When the sample had been established and pilot studies were completed, an adaptation of Dillman's (2011) Tailored Design Method was employed to conduct the survey. First, an invitation letter was emailed, and following this, a cover letter was sent with the questionnaire. Finally, thank you and reminder emails were

sent. Following this, the survey was promoted by the IPPN, INTO, NCSE, National Education Centres and other organisations.

4.3.2 Data Collection

4.3.2.1 Sampling

To evaluate the impact of leaders' leadership on school performance and their work alienation via the relational resources, this study approached principals in primary schools based in Ireland. Principals are leaders who directly lead and influence the staff, students and parents during the crisis. The procedure for sampling that has been explored in Study 1: Leadership in STEM Education, was mirrored in this study. As part of this procedure, contact information for all Irish primary principals was retrieved from the Department of Education website.

Additionally, at the time of sampling, many schools had ceased their use of Eircom email addresses, however new school email addresses had not all been updated on the DES website. Therefore, the researcher cross-checked the DES school contact document with email addresses sourced from individual school websites. This increased the number of correct school email addresses for the researcher to send the survey to.

4.3.2.2 Survey Structure

The source of the data used in this study was the Survey of Leadership during a Crisis (Primary) 2020. A web-based, self-report instrument was designed employing Chatterji's (2003) iterative approach and the online platform Qualtrics was selected. This survey was clearly structured and designed, containing Likert scale statements, demographic information about the principals and their schools, and a qualitative, open question.

Chatterji's (2003) instrument design guidelines relating to the importance of identification of survey sections were followed. For instance, to functionally establish these

sections, several steps were taken. Firstly, when schools first closed due to COVID-19 (March 2020), exploratory interviews with principals were carried out to elicit concerns and experiences of the potential participant cohort (Arsel, 2017; Gower, 1993). Next, an extensive literature review was carried out. The survey aimed to capture principals' experiences and expectations during the COVID-19 crisis and beyond. It included the key constructs such as leadership, support, communication, participation, wellbeing, and performance. The scales used in the survey were derived from well-established and validated measures from academic literature.

The Leadership during the COVID-19 Crisis survey instrument has six sections, as elaborated on in table 4.4 below.

Table 4.4 Study 2 Survey Sections

Section	Subject Matter
Section 1	Leadership (relating to school management leadership styles during the COVID-19 crisis).
Section 2	Staff Members in your School (relating to principal views on staff performance and trust during the crisis).
Section 3	Communication (relating to principal communication with the Department of Education during the crisis to date).
Section 4	Response to the Crisis (relating to experience of being in a management position during the crisis).
Section 5	Effectiveness of Using Online Learning
Section 6	About You and Your School (demographic information).

4.3.2.3 Survey Format

The research was carried out between May and July 2020. The primary method of completing the survey was on-line, with the option of obtaining a paper-based version directly from the researchers. Reasoning behind this choice of dissemination is explored in full in Study 1. In summary, key literature suggests that an online format was preferable to

other methods of dissemination for reasons such as: speed and timeliness; convenience; ease of data entry and analysis; low administration cost; ease of follow-up; large sample easy to obtain; flexibility in questionnaire design; control of answer order; knowledge of respondent vs. non-respondent characteristics, and required completion of answers (Couper et al., 2007; Creswell, 2003; Dillman, 2011).

Prior to the dissemination of the survey, an invitation letter was issued by the research team to all relevant stakeholders to advise them about the survey and encourage their support (e.g., IPPN, INTO, NCSE, PDST, TC National Education Centres etc.). Following this, an online survey was sent out to 3,240 principals in all Irish primary schools listed on the national www.education.ie. Three reminder emails were issued to principals, followed by a thank you email and the featuring of the survey on an IPPN newsletter. Following the administration of the survey, tests of validity and reliability were carried out to check for the robustness of each scale among the sample. These tests re-established the validity and reliability of each scale used.

4.3.2.4 Pilot Study

In line with the piloting approach explored in Study 1, the instrument was designed in conjunction with principals and reviewed by principals, education centres and other relevant stakeholders. To improve the overall validity of the survey, it was piloted with a diverse group of experts (Iarossi, 2006; Robson, 2002). Pilots were carried out with principals who were not involved in the designing process. These pilots proved very valuable, highlighting language that principals would be most familiar, with and raising insights regarding the relevance and irrelevance of certain scales. Leadership experts reviewed the questionnaire and advice was sought from experts in the area of survey design regarding the appearance of the survey and formatting. Furthermore, academics helped to re-word the survey items and

eliminate unnecessary scales. Table 4.5 below presents some of the pilot participants and their suggested revisions.

Following consultation with relevant stakeholders suggested revisions were implemented where appropriate. Significantly less revisions were required for this survey in comparison to the pilot stages of Study 1. This is largely due to the fact that a very similar approach was taken for the structural design of the Leadership During COVID-19 survey, based on advice that was yielded from Study 1. Suggested revisions from the pilot were implemented where appropriate. The main areas of revision included: shortening the survey from 10 minutes to 5 minutes, removing scales related to principal mental health as these were deemed by principals as being too invasive, rewording items and reformatting.

Table 4.5 Study 2 Pilot Participants and Sample Suggested Revisions

Pilot Participant	Sample Suggested Revisions
Principals	Suggested removal of certain scales relating to principal mental health. Suggestion of shortening survey from 15 minutes to 5 minutes.
Academics	Suggested reduction of the number of measurements used.
Survey Design Specialists	Suggested formatting and re-wording of questions.
INTO National Principals' Committee Representative	Suggested re-ordering of sections and re-wording of questions.
PDST Representative	Suggested exploration of transition to working digitally.
National Education Centres	Suggestions to improve face validity.

4.3.3 Measurements

This section describes how the variables were measured in this study. As already explored in Study 1, to help ensure the survey's validity, the items were adopted from

measures that had been used in previous studies. Multiple-item scales were employed. Additional items were derived by stakeholder groups including principals, and teachers' unions. A confirmatory factor analysis (CFA) was also conducted on all survey items to show that the items loaded on their respective scales. All measurements were based on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), unless otherwise noted.

4.3.3.1 Dependent Variables

School performance. Given the research context of primary schools as organisations, the primary goal that they had was to keep students learning during the lockdown period. To reflect such nature, nine items were adopted from (Griffin et al., 2007) with a focus on working roles and tasks, measuring their proficiency, adaptivity and proactivity. Given the knowledge of principals about their schools, they were asked to rate these items: *“Overall as a school during the COVID-19 closure, we have carried out the core parts of our job well”* (proficiency), *“... adapted well to changes during the crisis”* (adaptivity), and *“come up with ideas to improve the way in which core tasks are completed”* (proactivity). The reliability coefficients were .85 for proficiency, .81 for adaptivity and .84 for proactivity. School performance was operationalised as the mean score of these three dimensions based on the statistical support from factor analysis in the results section.

Work alienation. Three items were adopted from Shantz et al. (2014, 2015) who adapted the original scale by Nair and Vohra, (2009, 2010). Adding the COVID-19 context, respondents were asked to evaluate their experience with these three items. Two example items include: *“Working at home, I often wish I were doing something else”*, and *“I do not feel connected to my staff members when working from home”*. Cronbach's alpha for the scale was .74.

4.3.3.2 Independent Variables

Transformational leadership. Six items were adopted from de Poel et al. (2012) who validated a short version of the transformational leadership scale by Podsakoff et al. (1990). These six items represented the six dimensions of transformational leadership and each item had the highest factor loadings in the respective dimension. Two example items include: *“I communicate a clear and positive vision of what we want for our school”*, and *“I treat staff as individuals, support and encourage their development”*. Cronbach’s alpha for the scale was .79.

4.3.3.3 Mediating Variables

Employee trust. Four items measuring the perception of trustworthiness that team members have about one another and the leaders themselves, were adopted from Langfred (2004). One example item was *“During the crisis, my staff members in school trust each other a lot”*. The reliability of the scale was .88.

Relational coordination. Seven items were adopted from (Gittell et al., 2010) including timely, accurate, frequent and problem-solving-based communication, shared goals, shared knowledge and mutual respect. The construct of relational coordination was originally developed by (Gittell, 2002a) as a single factor and has been operationalized at the organizational level (Fu, 2015; Gittell et al., 2010). Respondents were asked: *“During the period of school closure, how well does your school communicate with the Board of Management (BoM) and Parents’ Association?”* in relation to the seven items based on a four-point Likert scale (1 = Rarely to 4 = Always). The Board of Management (BoM) and Parents Association are two very important stakeholders for the school. The BoM manages the school on behalf of the patron and is accountable to the patron and the Minister. The Parents’ Association also works with the principal to improve the school. Whilst parents’ associations are present in the majority of primary schools, they depend on the goodwill of

volunteer parents to coordinate their activities (Phádraig, 2010). Therefore, the majority of principals were able to respond to this scale, however several principals reported an absence of such a group in their school community. The Cronbach's alphas was .83 for relational coordination with the BoM and .81 for relational coordination with the Parents' Association. Based on the commonly used aggregation method in relational coordination (Gittell et al., 2010), these two scales were aggregated to create an overall construct – relational coordination, used in the data analysis. The detailed confirmatory factor analysis will be presented to test the validity of relational coordination as well as all other variables in the results section.

4.3.3.4 Control Variables

In this study, the researcher controlled for gender (0 = male, 1 = female), age (1 = < 30 years old, 2 = 30 – 39 years old, 3 = 40 – 49 years old, 4 = 50 – 59 years old, 5 = 60+ years old), tenure (the years the respondents have held a management position for), and school size (the number of students), all of which may have an influence on school and principal's work experience.

4.3.3.5 Qualitative Data Collection and Analysis Strategy

Qualitative data was collected via the following open-ended comment section at the end of the survey:

“Please feel free to elaborate on your answers, share any additional thoughts that you might have and detail supports that you would like to see put in place for school management teams below”.

NVivo was the platform selected for project analysis due to its ability to organise and manage large volumes of data, documents and visually model results (Edhlund & McDougall,

2019; Hilal & Alabri, 2013). The Excel spreadsheet containing survey response data was loaded into NVivo to establish cases for analysis.

Thematic analysis was carried out on the data as this method can yield a high level of detail and allows for precise qualitative analysis of the meaning of the data in context (Braun & Clarke, 2006; Joffe & Yardley, 2004). Additionally, this method allowed for identification and classification of themes and patterns through the use of a systematic coding process (Alhojailan, 2012; Boyatzis, 1998; Braun & Clarke, 2006). Braun & Clarke's (2006) six-phase model was used. Firstly, the researcher familiarised themselves with the data by reading each comment in detail. Next, initial codes were generated through the identification of keywords and statements. Following this, the researcher searched for commonalities between codes to establish themes. These themes were then reviewed, defined and named. Following this, a report of the findings was produced.

To ensure the reliability, accuracy and consistency of the coding method applied (Bernard, 1995; Ryan, 1999), three researchers independently coded each survey response. Inter-coder reliability (ICR) was measured whereby the reliability of every code is a function of the number of coding agreements among coders against the number of coding agreements and disagreements (Carey et al., 1996; Kurasaki, 2000). This process yielded an ICR of 90%, indicating that an appropriate reliability rating was evident (Carey et al., 1996; O'Connor & Joffe, 2020).

4.4 Chapter Summary

This chapter has described the research methodology that was used to address the research aims, to explore Irish primary school principals' perspectives on STEM education and leadership during the COVID-19 crisis. It commenced with an exploration of the concept of research philosophy, outlined the researcher's post positivist view and explained how this was relevant to the research study.

This research adopted a survey-based method to collect data to test the proposed models in both studies. The quantitative questionnaire instrument was discussed in detail and its appropriateness for addressing the research question was highlighted. Criteria for selection of participants and their recruitment was discussed. Key constructs of the survey instruments were explored and the importance of carrying out pilot studies was noted. Methods of administration and data collection were also discussed.

The next chapter (Chapter Five) will provide an analysis of the results for Study 1, Leadership in STEM Education. Sample representativeness, profile of the respondents, individual item descriptive analysis and descriptive statistics are presented. Following this, hypotheses are tested via structural equation modelling (SEM) analysis. Finally, an analysis of the open comments of the survey is presented, followed by a summary of the findings from the study.

CHAPTER FIVE

RESULTS OF STUDY 1: LEADERSHIP IN STEM EDUCATION

5.1 Introduction

This chapter presents and discusses the research results from Study 1 - *Leadership in STEM Education*. The layout of the chapter is as follows. First, the sample representativeness is outlined along with a breakdown of the profile of respondents (e.g., gender, tenure etc.). Next, descriptive statistics are introduced including the correlation between variables. Following this, the results of SEM analysis and the qualitative thematic analysis are presented. Finally, a synthesis of the quantitative and the qualitative findings are outlined.

5.2 Sample Representativeness

Determining sample size and dealing with non-responsive bias is imperative in a quantitative research study (Bartlett et al., 2001). Additionally, the sample size can impact on the identification of significant differences, relationships, or interactions (Peers, 2006). The range to which the results of a study can be generalized to other situations and people is crucial in questionnaire research, and therefore it will be important to yield a representative sample from the target participants. Educational research studies generally use a significance level or p value of .05 or .01 (Ary et al., 1996). If a sample size of 10% of the target population is achieved in a web-based survey (Hill, 1998; Rea & Parker, 1997), there would be enough accuracy to state that correct inferences could be drawn and related to a larger population (Alreck et al., 1995; Creswell & Creswell, 2017).

Surveys were emailed to 3231 principals who had email addresses registered with the Department of Education. Of the total emails that were sent, 721 emails bounced, and

subsequent principals were posted a hardcopy of the survey. After survey emails and reminders, replacement surveys, 474 surveys in total (15%) were returned in the form of hard copy (147) and online (327). Of this total, 91 surveys were incomplete and were therefore excluded. The valid response rate was 12% (383/3231). Therefore, the final sample for this study consisted of 383 Irish primary school principals.

To examine the sample representativeness (Wilcox et al., 1994), an ideal way to investigate the non-response bias through the comparison of demographic and contextual variables of the respondents with the values that were known from the population, checking to see if there was a difference with regards to the available data (Armstrong & Overton, 1977; Guthrie et al., 2009). In this study, demographic information for the non-responses could not be obtained. A comparison analysis was conducted on the characteristics amongst early and late responses, web responses and hard copy responses which has been used in other studies (e.g., Fu et al., 2017). Within this survey, early respondents were considered those who submitted a response following the initial email/ mailing and late respondents were outlined as those who submitted a response after reminder emails had been sent out. Web respondents are those who completed the survey online and hard copy respondents are those who returned a hard copy of the survey via post.

A one-way ANOVA was carried out using SPSS to explore representativeness. The results in Table 5.1 showed that there was no significant difference between the early and late responses. One significant difference that did arise between the web response and the hard copy response was regarding gender, whereby the male hard copy response rate was much higher than the online response rate. This can be attributed to the fact that the bounced email list (target population for the hard copy survey) contained a higher proportion of males to females than the overall list.

Therefore, no major concerns arose regarding the sample representativeness and non-response bias in this survey. As a result, the full sample was used for analysis purposes and the profile of participating principals was considered to be representative of primary principals in Ireland.

Table 5.1 ANOVA Results from Comparison Analysis

Items	Early response v late response		Web response v hard copy response	
	F	Sig	F	Sig
Gender	2.686	.102	6.886	.009
Respondents' Age	.008	.928	.259	.611
Respondents' Role	1.164	.281	.982	.322
School Patronage	.000	.996	1.548	.214
School Structure	.545	.461	.297	.586
School Gender	.000	.996	.029	.865
School Economic Status	.509	.476	2.616	.107
School Language	.010	.919	.199	.655

5.3 Profile of the Respondents

Among the respondents, 28% were female and 72% were male. With regards to Irish national statistics, 67% of primary principals are female and 33% are male (Government of Ireland, 2021). In terms of age, 1% of respondents fell into the 30 years old and below category, 16% of respondents were aged 30-39, 29% of respondents were aged 40-49, 46% of respondents were aged 50-59 and 8% of respondents were aged 60 or above. With regards to the breakdown of role type, 57% of respondents were administrative principals whereas 43% of respondents were teaching principals.

Respondents' school patronage was broken down into 91% denominational and 9% multi-denominational. With regards to school structure, 6% of respondents were principals of junior schools, 8% of respondents were principals of senior schools and 86% of respondents were principals of vertical schools. The breakdown of respondents' school gender is as follows: 88% of respondents were from mixed-gender schools, 6% of respondents were from all-boys schools and 6% of respondents were from all-girls schools. Respondents' school economic status was broken down as follows: 22% of respondents were from DEIS (Delivering Equality of Opportunity in Schools) schools and 78% of respondents were from non-DEIS schools. In terms of the language medium of the respondents' schools, 7% were from Gaelscoileanna and 93% were from English-speaking schools. Finally, in terms of respondents' school fee-paying status, 100% of respondents were from non-fee-paying schools and 0% of respondents were from fee-paying schools.

5.4 Analysis of Quantitative Data

5.4.1 Individual Item Descriptive Analysis

This section includes a summary of the respondents' perceptions of a variety of items that were outlined in the survey including: dependent variables (principal commitment to STEM education, principal intention to adopt STEM education and school implementation of STEM education) and independent variables (transformational leadership, consultation with government agencies and access to specialist teacher instruction). These variables were included to reflect principals' perceptions on current policy directives in Ireland with regards to leadership in the Irish primary sector and its relationship with STEM education in Ireland.

5.4.1.1 Dependent Variables

Principal commitment to STEM education. Table 5.2 illustrates the breakdown of respondents' replies on attitudinal items relating to their commitment to STEM education.

Respondents were asked to respond to 5 statements on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The average score for the principal commitment to STEM education scale was 4.64, indicating that overall, the principals who responded to these items (n = 380) agreed that STEM education is necessary and should be provided at primary level.

Overall, 98% of participants believe in the value of STEM education for primary school students. Additionally, 96% of principals agreed that introducing STEM education into primary schools is a good strategy. Furthermore, 91% of participants agree that STEM opportunities should be provided within the curriculum timetable. With regards to the concept of STEM serving an important purpose, 95% of principals agreed, and 94% of principals believe that STEM is very necessary in society currently.

Table 5.2 Principal Commitment to STEM Education

Principal commitment to STEM education (average, SD)				4.64	.55
Items	Disagree	Neutral	Agree	Mean	SD
I believe in the value of STEM education for primary students.	1%	1%	98%	4.75	.54
Introducing STEM education into primary schools is a good strategy.	1%	3%	96%	4.68	.62
STEM opportunities should be provided within the curriculum timetable.	3%	6%	91%	4.47	.76
Introducing STEM education serves an important purpose.	1%	4%	95%	4.67	.64
Introducing STEM education is very necessary in today's society.	2%	4%	94%	4.65	.67

Note: N = 383

Principal intention to adopt STEM education. Table 5.3 displays results of responses of principals' attitudes relating to principal intention to adopt STEM items are explored below. The average score for the principal intention to adopt STEM scale was 4.36,

indicating that overall, the principals who responded to these items (n=381) agreed that they would like to adopt and increase the prevalence of STEM in their schools.

Concerning principal intention to adopt STEM education, the majority of principals were in agreement with this concept. Overall, almost 90% of principals agreed that they would like to introduce more STEM activities in their school over the next twelve months, and 82% agreed that they are contemplating increasing the prevalence of STEM in their school.

Table 5.3 Principal Intention to Adopt STEM Education

Principal intention to adopt STEM education (average, SD)				4.36	.78
Items	Disagree	Neutral	Agree	Mean	SD
I would like to introduce more STEM activities into my school over the next 12 months.	3%	8%	89%	4.75	.54
I am contemplating increasing the prevalence of STEM in my school.	4%	14%	82%	4.68	.62

Note: N = 381

School implementation of STEM education. Principals were asked a series of eight attitudinal statements relating to their school's adequacy in promoting and facilitating STEM, as reported in Table 5.4. The average overall score for this set of items collectively was 3.17, indicating that of the principals that responded (n = 372), that the majority remained relatively neutral, neither disagreeing or agreeing that their schools were in a position to promote STEM adequately.

Regarding the issue of curricular time, approximately 53% of principals agreed or strongly agreed that their schools were able to allocate adequate time to STEM. Similarly, 62% of principals agreed or strongly agreed that the STEM programme curricular offerings at their school were adequate. In terms of access to lesson plans and schemes of work, 53% of respondents agreed or strongly agreed that adequate levels were in place in their schools.

Similarly, 61% of respondents agreed or strongly agreed that their schools were able to provide adequate STEM-related opportunities in their schools.

Noticeable lower ratings of adequacy are reported with teacher-related items. For example, only 35% of principals reported adequacy in their teachers' confidence in teaching STEM, 44% reported adequacy in the number of teaching staff at their school for promoting STEM and only 28% deemed that the initial teacher education that their teachers received was adequate to promote STEM within their schools. Only 34% of principals reported that their school's subject prioritisation in school self-evaluation was adequate for promoting STEM, a finding that is in line with that of principals' reporting of the prevalence of initiative overload in the primary sector.

Table 5.4 School Implementation of STEM Education

School implementation of STEM education (average, SD)				3.17	.75
Items	Disagree	Neutral	Agree	Mean	SD
Scheduling (Curricular timetable).	24%	23%	53%	3.31	1.06
Curricula (school's STEM programme offerings).	20%	18%	62%	3.43	1.01
Access to lesson plans/schemes of work.	25%	22%	53%	3.36	1.08
STEM-related opportunities for students.	18%	21%	61%	3.49	.96
Teacher confidence in teaching STEM subjects.	38%	27%	35%	2.95	1.06
Number of teaching staff.	32%	22%	28%	2.65	1.16
Initial teacher education in STEM subjects.	50%	24%	44%	3.10	1.11
Subject prioritisation in school self-evaluation.	28%	38%	34%	3.09	.98

Note: N = 372

School participation in STEM weeks. Table 5.5 below demonstrates responses from principals to statements relating to their school's frequency of participation in STEM-week events. Of the principals that responded (n = 364), the average score was 3.55, indicating that the majority of schools sometimes or often participate in STEM-related weeks. With regards to school participation in science week, 74% of principals indicated school participation. Similarly, maths week had a total of 80% of principals indicating their school's participation. Noticeably lower with regards to participation were engineering week with 42% and combined STEM week with 23% of principals indicating their school's participation.

Table 5.5 School Participation in STEM Weeks

School participation in STEM weeks (average, SD)				3.55	.92
Items	Disagree	Neutral	Agree	Mean	SD
Science week.	8%	18%	74%	4.11	1.04
Engineering week.	30%	26%	42%	3.28	1.35
Maths week.	5%	15%	80%	4.25	.92
Combined STEM week.	53%	24%	23%	2.49	1.31

Note: N = 364

5.4.1.2 Independent Variables

Transformational leadership. Table 5.6 lists the results relating to principals' responses to seven items based on their transformational leadership practices. The average score for the principals' transformational leadership practices scale was 4.56, a high rating, indicating that overall, the principals who responded to these items (n=374) agreed that they exhibit strong transformational leadership characteristics. There were 89% of principals who agreed that they communicate a clear and positive vision of what they want for their school. Even higher, 98% of participants agree that they treat staff as individuals, support and encourage their development. Additionally, 97% of principals agree that they give their staff encouragement and recognition, with an equal percentage also agreeing that they foster trust,

involvement, and cooperation among their staff. Likewise, 96% of principals encourage their staff to think about problems that face them in new ways and an equal percentage are clear about their values and practice them at work. Furthermore, 90% of principals agree that they instil pride and respect in others.

Table 5.6 Transformational Leadership

Transformational leadership (average, SD)				4.56	.44
Items	Disagree	Neutral	Agree	Mean	SD
I communicate a clear and positive vision of what we want for our school.	2%	9%	89%	4.26	.69
I treat staff as individuals, support and encourage their development.	0%	2%	98%	4.72	.54
I give encouragement and recognition to my staff.	0%	3%	97%	4.71	.53
I foster trust, involvement and cooperation among my staff.	0%	3%	97%	4.72	.53
I encourage my staff to think about problems that face us in new ways.	0%	5%	96%	4.49	.60
I am clear about my values and practice them at work.	0%	4%	96%	4.66	.51
I instil pride and respect in others.	0%	10%	90%	4.36	.67

Note: N = 374

Consultation with government agencies. Table 5.7 Displays the results relating to principals' responses to four items based on their consultation with government agencies. Respondents were asked to respond to statements on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The average score for principals' communication with relevant agencies was 2.28, a relatively low rating, indicating that overall, the principals who responded to these items (n=373) disagreed that they were receiving adequate consultation with relevant agencies about their role. For example, 68% reported that they are not consulted

when action is taken that will have an impact on their post. Similarly, 63% of principals reported that if changes are made to their role, they are given the reason(s) why. Furthermore, 47% of principals disagreed that suggestions that they make are taken on board by government agencies, and an equal percentage of principals disagreed that if they are consulted before decisions are made, there is attention paid to their views or opinions.

Table 5.7 Consultation with Government Agencies

Consultation with government agencies (average, SD)				2.35	.92
Items	Disagree	Neutral	Agree	Mean	SD
I am consulted when action is taken that will have an impact on my post.	68%	16%	16%	2.10	1.20
If changes to my role are made, I am given the reason(s) why.	63%	24%	14%	2.21	1.08
Suggestions that I make are taken on board by such agencies.	47%	40%	13%	2.48	1.03
If I am consulted before decisions are made, there is attention paid to my views or opinions.	47%	30%	23%	2.61	1.20

Note: N = 373

Access to specialist teacher instruction. Table 5.8 below demonstrates responses from principals to statements relating to access to specialist teacher instruction in STEM-related subjects in their schools. Out of the principals who responded (n = 376), the average score was 2.34, indicating that the majority of principals rarely bring specialist instruction into their schools in STEM-related subjects overall. Specifically, 60% of respondents either sometimes, often or always bring in specialist teacher instruction in the area of science, 45% in literacy, 36% in maths/numeracy, 44% in technology, and 40% in engineering.

Table 5.8 Access to Specialist Instruction

Access to specialist teacher instruction (average, SD)				2.34	.77
Items	Disagree	Neutral	Agree	Mean	SD
Science	40%	46%	14%	2.55	1.00
Literacy	55%	28%	17%	2.32	1.12
Maths/Numeracy	64%	28%	8%	2.09	1.00
Technology	56%	36%	8%	2.26	1.02
Engineering	60%	34%	6%	2.16	.96

Note: N = 375

5.4.2 Descriptive Statistics of Variables

Internal consistency reliability scores were investigated using Cronbach's Alpha. This was carried out to make sure that attitudinal items and scales were reliable, meaningful and accurate. A Cronbach's Alpha value of .70 or above is deemed acceptable, stipulating that 70% or higher of the observed score variance is attested to the true score and not a result of an error (Bland & Altman, 1997; Chatterji, 2003), in other words, the scales from the multiple Likert questions that are contained in this particular survey were able to be deemed reliable or not. Item quality was assessed using item analysis statistics, internal consistency and inter-item correlation (Chatterji, 2003; Elliott & Woodward, 2007). Findings from a correlation analysis using aggregated data are presented below.

Table 5.9 contains descriptive statistics including the means, standard deviation, and inter-item reliabilities, for the independent and dependent variables. Table 5.10 contains descriptive statistics including the correlation among all variables. For example, significant correlation coefficients were found between principal commitment to STEM and principal intention to adopt STEM ($r = .62, p < .01$), between access to specialist teacher instruction and school implementation of STEM ($r = .24, p < .01$), and between consultation with government agencies and principal intention to adopt STEM ($r = .15, p < .01$).

Table 5.9 Descriptive Statistics of Dependent and Independent Variables

	Variables	Operationalisation	N	Mean	S.D.	Alpha
1	Principal commitment to STEM education	Average score of 5 items	383	4.64	.55	.90
2	Principal intention to adopt STEM education	Average score of 2 items	383	4.35	.78	.86
3	School implementation of STEM education	Average score of 8 items	382	3.17	0.75	.86
4	School participation in STEM weeks	Average score of 4 items	382	3.55	0.92	.76
5	Transformational leadership	Average score of 7 items	381	4.56	.43	.87
6	Consultation with government agencies	Average score of 4 items	381	2.35	.92	.83
7	Access to specialist teacher instruction	Average score of 5 items	383	2.28	0.80	.84

Table 5.10 Correlation Matrix of the Study Variables

	Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Principal commitment to STEM education	4.65	.54														
2.	Principal intention to adopt STEM education	4.37	.77	.62**													
3.	School implementation of STEM education	3.17	.75	.20**	.01												
4.	School participation in STEM weeks	3.56	.91	.27**	.12*	.46**											
5.	Transformational leadership	4.56	.43	.13*	.13*	.13*	.22**										
6.	Consultation with government agencies	2.34	.92	.15**	.10	.16**	.05	.00									
7.	Access to specialist teacher instruction	2.28	.79	.12*	.08	.24**	.28**	.09	.10								
8.	Principal gender	.72	.45	-.05	.02	.05	.00	.10	-.02	.03							
9.	Principal tenure	26.27	9.35	.01	-.05	.15**	.14**	.13*	-.03	.04	-.03						
10.	Principal role	.56	.50	.12*	-.02	.06	.15**	.16**	-.03	.12*	-.01	.29**					
11.	School structure	.86	.35	.06	.08	.11*	.11*	-.05	.01	.06	.02	-.11*	-.14**				
12.	School gender	.88	.33	.04	.06	.09	.01	-.05	.08	.02	.01	-.13*	-.18**	.31**			
13.	School patronage	.91	.29	-.04	-.08	-.09	-.06	-.03	-.12*	.00	-.07	.07	-.05	-.07	-.12*		
14.	School economic status	.22	.41	.01	.04	-.09	-.10	.01	.08	.03	.06	.04	.01	-.13*	-.11*	.07	
15.	School language medium	.08	.27	-.07	.02	-.12*	-.03	.01	-.09	.00	.09	.03	.01	-.03	.08	-.05	.05

Note: ** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).
Listwise deletion method was employed to deal with missing data which reduced sample size from 383 to 365.

5.4.3 Measurement Models

This study had seven main variables, i.e., principal commitment to STEM education, principal intention to adopt STEM education, school implementation of STEM, school participation in STEM weeks, transformational leadership, consultation with government agencies, and access to specialist teacher instruction. A full measurement model was tested with first order confirmatory factor analysis. The seven-factor model showed a good model fit ($\chi^2/df = 1023.34/538 = 1.90$, $p < .001$, CFI = .93, RMSEA = .05 and SRMR = .05).

Since all variables in the study were collected from a single source, it was essential to check whether common method bias was present in the data. To address the potential concern of common method bias, several recommendations made by (Podsakoff et al., 2003, 2012) are followed, both the research design and analysis stages. During the research design stage, the survey has been tested, revised, and retested several times among a group of experienced researchers and principals, including the wording and order of the questions. During the distribution stage, clarification was provided to the respondents concerning the confidentiality of the survey and data.

Secondly, a series of confirmatory factor analyses were carried out to test for common method bias and to establish the discriminant validity of the scales (Podsakoff et al., 2012). Sequential χ^2 difference tests between the alternative factor model to the full measurement model were tested as shown in Table 5.11. The comparison shows that the fitness of the alternative models was significantly worse compared to the full measurement model (all at $p < .001$). fit ($\chi^2/df = 1023.34/538 = 1.90$, $p < .001$, CFI = .93, RMSEA = .05 and SRMR = .05).

Table 5.11 Fit Statistics from Measurement Model Comparison

Models	χ^2 (df)	CFI	RMSEA	SRMR	$\Delta\chi^2$	Δdf
Full	1023.34(538)	.93	.05	.05		
Model A ^a	1587.70(544)	.84	.07	.09	564.36	6***
Model B ^b	1666.78(544)	.83	.07	.08	643.44	6***
Model C ^c	2167.08(544)	.75	.09	.12	1143.74	6***
Model D ^d	2695.44(549)	.67	.10	.12	1672.10	11***
Model E ^e	2172.75(549)	.75	.09	.10	1149.41	11***
Model F ^f	3854.32(553)	.50	.12	.15	2830.98	15***
Model G ^g	4841.06(559)	.35	.14	.16	3817.72	21***

Notes: ***p<.001; χ^2 = chi-square discrepancy, df=degrees of freedom; IFI = Incremental Fit Index; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardised Root Mean Square Residual; $\Delta\chi^2$ = difference in chi-square, Δdf = difference in degrees of freedom. All models were compared to the full measurement model.

^a= Consultation and access to specialist teacher instruction combined into a single factor

^b= Consultation and transformational leaderships into a single factor

^c= Intention to adopt and implementation into a single factor

^d= Consultation, commitment to STEM, and implementation, into a single factor

^e= Consultation, transformational leadership, and intention to adopt into a single factor

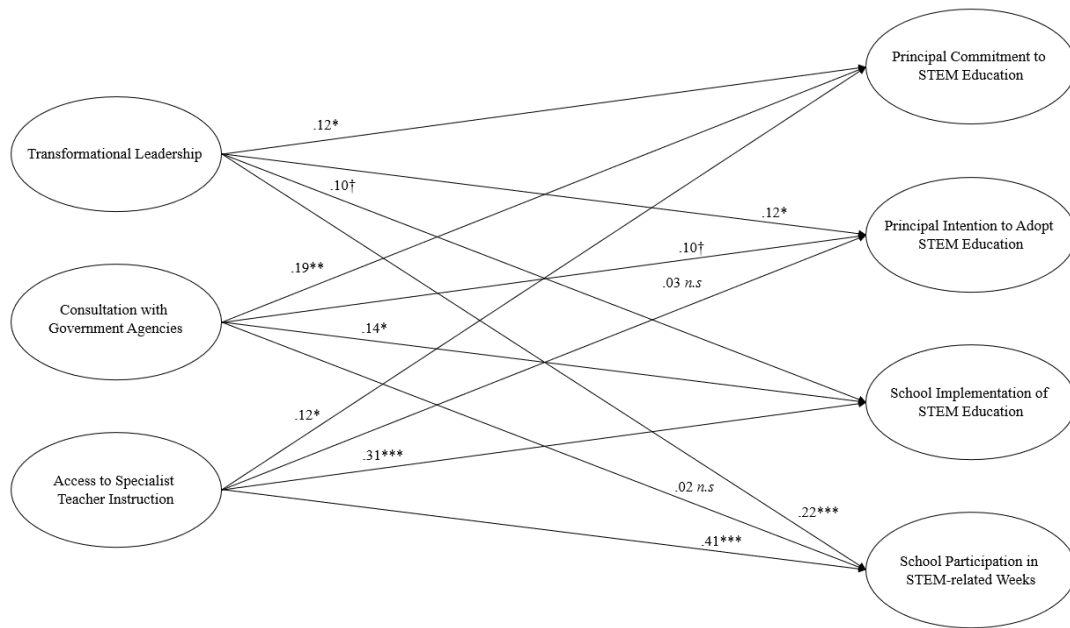
^f= Transformational leadership, consultation, specialist teachers, commitment into a single factor

^g= All factors combined into a single factor

5.4.4 Structural Model and Hypotheses Testing

Figure 5.1 presents the Structural Equation Modelling results for Study 1: Leadership in STEM Education.

Figure 5.1 Structural Equation Modelling Results for Study 1



Note: N= 134 (listwise) *** $p < .001$ ** $p < .01$ * $p < .05$ † $p < .10$

Hypothesis 1 proposed that transformational leadership would be positively associated with principal commitment to STEM education (1a), principal intention to adopt STEM education (1b), school implementation of STEM education (1c), and school participation in STEM weeks (1d). Results in Figure 5.1 show that after entering control variables, that transformational leadership was positive and significant in predicting principal commitment to STEM education ($\beta = .12, p < .05$), principal intention to adopt STEM education ($\beta = .12, p < .05$), marginally significant in predicting school implementation of STEM education ($\beta = .10, p < .10$), and significant in predicting school participation in STEM weeks ($\beta = .22, p < .001$). Therefore, Hypothesis 1 was supported.

Hypothesis 2 proposed that consultation with government agencies would be positively associated with principal commitment to STEM education (2a), principal intention

to adopt STEM education (2b), school implementation of STEM education (2c), and school participation in STEM weeks (2d). Results in Figure 5.1 show that after entering control variables, that consultation with government agencies was significant in predicting principal commitment to STEM education ($\beta = .19, p < .01$), marginally significant in predicting principal intention to adopt STEM education ($\beta = .10, p < .10$), significant in predicting school implementation of STEM education ($\beta = .14, p < .05$), and not significant in predicting school participation in STEM weeks ($\beta = .02, n.s.$). Therefore, Hypothesis 2 is partially supported.

Hypothesis 3 proposed that access to specialist teacher instruction would be positively associated with principal commitment to STEM education (3a), principal intention to adopt STEM education (3b), school implementation of STEM education (3c), and school participation in STEM weeks (3d). Results in Figure 5.1 show that after entering control variables, that access to specialist teacher instruction was positive and significant in predicting principal commitment to STEM education ($\beta = .12, p < .05$), not significant in principal intention to adopt STEM education ($\beta = .03, n.s.$), significant in predicting school implementation of STEM education ($\beta = .31, p < .001$), and significant in predicting school participation in STEM weeks ($\beta = .41, p < .001$). Therefore, Hypothesis 3 is partially supported. The results from the SEM are summarised in table 5.12 below:

Table 5.12 Summary of Hypotheses and Empirical Results

Hypothesis		Ability	
1	Transformational leadership	Principal commitment to STEM education	√
		Principal intention to adopt STEM education	√
		School implementation of STEM education	√
		School participation in STEM weeks	√
Hypothesis		Motivation	
2	Consultation with government agencies	Principal commitment to STEM education	√
		Principal intention to adopt STEM education	√
		School implementation of STEM education	√
		School participation in STEM weeks	X
Hypothesis		Opportunity	
3	Access to specialist teacher instruction	Principal commitment to STEM education	√
		Principal intention to adopt STEM education	X
		School implementation of STEM education	√
		School participation in STEM weeks	√

5.5 Analysis of Qualitative Data

5.5.1 Overview of Main Findings

Through the open comment section in the survey, 254 comments were received. Given the volume and the relevance of the content in relation to the study's focus on leadership in STEM the comments were deemed necessary to analyse. To do so, thematic analysis was the chosen method of analysis. The thematic analysis yielded 391 references and 19 codes and together, were classified into six distinct themes, in two topics. The first topic – Perceived Challenges includes: (1) Time Pressure, (2) Lack of Resources, (3) Schools with

Additional Needs and (4) Policy Directives. The other topic – Perceived Opportunities, includes: (5) Positive perceptions of STEM and (6) STEM Implementation.

5.5.2 Perceived Challenges

5.5.2.1 Time Pressure

Time pressure was the most referenced theme with two subthemes: Curriculum/ Initiative Overload and Increasing Principal Job Demands. Overall, within this theme, many principals expressed that whilst they valued STEM, they struggled to allocate sufficient time to it. One area that was referenced to by principals, was that there are too many subject areas in the current primary school curriculum, and that there is not enough time to address everything. For example, one principal stated:

“I feel STEM education is very important. The big issue is curriculum overload. Something has to give. There is not enough time in the school day to cover everything that is required” (Principal Comment, Q12. Survey 263).

Similarly, another participant discussed the necessity of the curriculum changing to accommodate STEM time constraints:

“I firmly believe that STEM education is so important in our schools and that the curriculum needs to change and accommodate this. STEM allows for so much integrated learning however at times it has to be limited due to time constraints” (Principal Comment, Q12. Survey 322).

Also expressed within the theme of time constraints, is the concept of increasing job demands. For instance, many participants made references to an increase in the amount of time required for planning, as evidenced in the following example:

“The continued emphasis on numeracy and literacy and the pace of curriculum change is putting too much pressure on teachers, planning is going into complete overdrive!”

(Principal Comment, Q12. Survey 195)

Likewise, another participant discussed the time required to navigate new policy/government directives etc., specifying that they require more support:

“... as Teaching Principals we are Jack of all trades & need more support for Admin - the paperwork for new legislation - without warning is very difficult - we end up doing it in our own time” (Principal Comment, Q12. Survey 374).

5.5.2.2 Lack of Resources

Resources was the second most referenced theme with nine subthemes: Professional Development, Outreach/Specialist Teacher Instruction, School Leadership, General Funding, Prioritisation of STEM in the School Budget, Fundraising, Digital Technologies, WiFi and Pupil-Teacher Ratio.

For instance, principals raised concerns around the sourcing of funding to implement STEM education, guidance on purchasing of equipment, and the location and provision of professional development. For example, in discussing general funding and resources for STEM education, one participant stated:

“Funding in the area or resources for STEM Education is completely inadequate and this directly impacts on our school’s capacity to incorporate STEM Education into teaching and learning in our school” (Principal Comment, Q12. Survey 335).

Additionally, some principals suggested that the provision of specialist teacher instruction would support schools in their efforts to implement STEM education. For example, one participant stated: (Principal Comment, Q12. Survey 334).

“A visiting STEM teacher perhaps for 1 day each fortnight would be beneficial to keep and maintain a focus as other things often take over” (Principal Comment, Q12. Survey 81).

Furthermore, participants expressed a need for professional development support for

their school communities from STEM experts. For instance, one principal expressed that:

“... STEM development would benefit from the sector being more supported in schools; if there was some kind of a mentoring service that would support schools concretely. Skilled personnel who would liaise with schools... with Principals, teachers and students to enable and encourage them in developing a sound range of STEM skills and abilities. Personally, I think that having adequate numbers of skilled personnel is usually key to good development in any area and STEM is no different” (Principal Comment, Q12. Survey 78).

Also, concerns were raised regarding the fact that some teachers may not have experienced the subject area of STEM during their initial teacher education programme. For example, one principal expressed:

“Older teachers did not study Science/STEM at college. In-service training is sporadic & involves travel, cost & teacher's own time” (Principal Comment, Q12. Survey 50).

With regards to leadership in STEM, principals commented on the infancy of whole school approaches. For example, one participant stated:

“In primary school it depends on the knowledge and interest of individual teachers. Whole school approaches are only developing” (Principal Comment, Q12. Survey 93).

Furthermore, participants suggested a need for a designated leadership post for STEM, as exemplified by the following comment:

“Each school needs to be appointed funding for a post of responsibility for STEM” (Principal Comment, Q12. Survey 93).

Another concept that was raised by principals under the theme of resources was the challenge of providing hands-on STEM lessons to students in large class settings. For instance, one participant stated that:

“It is very difficult to deliver as comprehensive a programme as we would like as we

feel overloaded with 30+ in each classroom and 3 class groups within that. Science is very difficult to turn in to a truly hands-on experience for pupils if the class size does not reduce. We are enthusiastic, committed but are drowning in overcrowded rooms and disgraceful levels of funding for the wonderful children which we teach!” (Principal Comment, Q12. Survey 245).

Additionally, with regards to resourcing in the area of technology, many participants made comments about the necessity of having access to devices and reliable broadband. For instance, one principal expressed:

“The IT grant in the last few years has been welcome but often that has to be used to replace old laptops, IWB etc. I'm all the time firefighting outdated technology and sometimes I feel it is difficult to progress” (Principal Comment, Q12. Survey 146).

Challenges around school access to the internet were also highlighted by principals. For example, one participant stated:

“Urgently needed - A fast reliable internet speed” (Principal Comment, Q12. Survey 172).

5.5.2.3 Policy Prioritisation

Policy Prioritisation was the sixth most referenced theme. Within this theme, many participants gave rise to the increasing volume of policies/directives that they must navigate as principals. For example, one participant expressed:

“I love my job but hate the stress of deadlines and yet another policy/procedure to implement. I've always wanted to be a teacher, but the job has changed so much since I started. It is hard to be enthusiastic about ALL of the curriculum” (Principal Comment, Q12. Survey 108).

Additionally, some participants made references to the strong government emphasis on the value of STEM for the economy. For example, one principal stated:

“I do not value the overemphasis on STEM for employment as opposed to emphasizing the skills of collaboration, communication and problem-solving, which are skills that will be much more future-proof than content and can apply to all areas of learning” (Principal Comment, Q12. Survey 29).

Finally, with regards to STEM implementation, some participants suggested that a change from traditional practice will take time. For example, one principal expressed that: *“The STEM message is diluted. STEM should be more to the forefront in Primary Education but due to traditional educational values, it is going to take time to be embedded”* (Principal Comment, Q12. Survey 37).

5.5.2.4 Schools with Additional Needs

Schools with Additional Needs was the fourth most referenced theme with three sub-themes: Small and Rural Schools, Special Educational Needs (SEN) Schools, and DEIS schools. Many participants highlighted additional supports that are required to support STEM implementation in these settings.

For instance, within the context of SEN, one participant declared that there is a lack of government consultation: *“Special Schools are not consulted in STEM Strategy”* (Principal Comment, Q12. Survey 323).

Despite this lack of consultation, another participant suggested that STEM is suitable for SEN settings and that their school would welcome direction:

“STEM is very applicable to SEN and I would welcome an element of CPD in this area for staff and school leaders, on how to plan and implement STEM principles and strategies within a special class/school” (Principal Comment, Q12. Survey 54).

Also raised in the theme of schools with additional needs was the necessity for enhanced funding provision for disadvantaged school settings. For instance, one principal stated:

“DEIS schools should receive additional STEM funding allowance which would encourage further involvement in Science/tech clubs after school hours” (Principal Comment, Q12. Survey 378).

Additionally, smaller schools were also identified by participants as requiring additional supports. For instance, many participants discussed the challenges of accessing supports in rural settings and navigating initiatives as a teaching principal. For example, one participant highlighted the challenging role of the teaching principal: *“The role of the teaching principal is overloaded and mostly unrecognised”* (Principal Comment, Q12. Survey 40).

Table 5.13 represents a summary of the challenges that principals expressed.

Table 5.13 Summary of Qualitative Thematic Analysis Findings: Perceived Challenges

Perceived Challenges

Illustrative Quote	Subtheme	Theme
<i>“Work overload on teaching principals affects new initiatives”</i> (Principal Comment, Q12. Survey 144).	Principal Job Demands	Time Pressure
<i>“I feel STEM education is very important. The big issue is curriculum overload. Something has to give. There is not enough time to cover everything that is required”</i> (Principal Comment, Q12. Survey 224).	Overloaded Curriculum	
<i>“Initiative overload is a major problem for schools. There is no clear directive from the DES of what is expected of us... except to introduce new initiatives without taking anything out! The workload on Principal's increased to a level where it is not quantifiable”</i> (Principal Comment, Q12. Survey 100).	Initiative Overload	
<i>“Extra funding, supports, training and resources needs to be made available to all primary schools”</i> (Principal Comment, Q12. Survey 103).	Funding	Lack of Resources
<i>“The lack of confidence from teachers not into STEM (like me) means that it won't develop in a coordinated fashion. My nearest Education Centre is 60km+. With a family there is no way I can travel that far, after school for training or information. In-service must be in-school; during the time I am paid to be here”</i> (Principal Comment, Q12. Survey 93).	Professional Development	
<i>“More visiting experts to do workshops in schools funded by DES or outside agencies would be worthwhile”</i> (Principal Comment, Q12. Survey 242).	Outreach Specialists	
<i>“In primary school it depends on the knowledge and interest of individual teachers. Whole school approaches are only developing”</i> (Principal Comment, Q12. Survey 127).	School Leadership	
<i>“While there is an ICT grant it is very limited and a huge expense for primary schools is technical support and the cost of this. This needs to be factored in when assigning funding in STEM education for schools”</i> (Principal Comment, Q12. Survey 228).	Digital Technologies	

Perceived Challenges			
Illustrative Quote	Subtheme	Theme	
<i>"School's broadband is currently inadequate"</i> (Principal Comment, Q12. Survey 103).	Wi-Fi		
<i>"It is very difficult to deliver as comprehensive a programme as we would like as we feel overloaded with 30+ in each classroom and 3 class groups within that. Science is very difficult to turn into a truly hands-on experience for pupils if the class size does not reduce. We are enthusiastic, committed but are drowning in overcrowded rooms"</i> (Principal Comment, Q12. Survey 37).	Pupil: Teacher Ratio		
<i>"The role of the teaching principal is overloaded and mostly unrecognised"</i> (Principal Comment, Q12. Survey 350).	Small/rural Schools	Schools with Additional Needs	
<i>"Special Schools are not consulted in STEM Strategy. We are not funded for activities although we offer second level programmes"</i> (Principal Comment, Q12. Survey 323).	SEN Schools		
<i>"DEIS schools should receive additional STEM funding allowance which would encourage further involvement in Science/tech clubs after school hours"</i> (Principal Comment, Q12. Survey 378).	DEIS Schools		
<i>"I do not value the overemphasis on STEM for employment as opposed to emphasizing the skills of collaboration, communication and problem-solving which are skills that will be much more future-proof than content and can apply to all areas of learning"</i> (Principal Comment, Q12. Survey 29).	General	Policy Directives	

5.5.3 Perceived Opportunities

5.5.3.1 Positive Perceptions of the Concept of STEM

Positive Perceptions of STEM was the third most referenced theme with three subthemes: Student Interest, Subject Integration and 21st Century Skills. Within this theme, many participants made references to the value that STEM has for students. For example, one participant stated:

“STEM education is vital. Children love the hands on, activity-based learning created” (Principal Comment, Q12. Survey 195).

Another concept that arose within this theme was that of integrated learning. For instance, one principal stated:

“STEM with life experiences enhanced by the Arts. A healthy balance in subjects focused on what really matters for humanity to thrive together” (Principal Comment, Q12. Survey 352).

This importance of subject integration is echoed by another participant:

“I firmly believe that STEM education is so important in our schools and that the curriculum needs to change and accommodate this. STEM allows for so much integrated learning” (Principal Comment, Q12. Survey 322).

Additionally, participants discussed the value of STEM with regards to promoting skills acquisition and problem-solving strategies. For instance, one principal stated:

“It’s a slow process but is very rewarding to witness higher levels of fruitful engagement in learning: greater levels of pupil agency in their learning; real strides in breathing life into our school mission statement that promotes creativity, problem solving, collaboration and 21st Century Skills” (Principal Comment, Q12. Survey 165).

5.5.3.2 STEM Implementation

STEM Implementation was the fifth most referenced theme with two subthemes: School STEM Offerings, and STEM Leadership. Many participants discussed positive experiences of STEM implementation in their schools. One area of prominence was that of school participation in STEM-related weeks and events. For example, one principal stated:

“We hold Science Week, Maths week, Technology week and Engineering week every year at minimum cost and high interest to the pupils” (Principal Comment, Q12. Survey 327).

Additionally, some participants made references to specific outreach programmes that their schools participate in. For example:

“... we are embarking on a STEAM project in conjunction with a local medical company Harmae, Castlelea, Co. Roscommon with students entitled Science in a Box” (Principal Comment, Q12. Survey 259).

Leadership distribution and school self-evaluation were two more areas that principals highlighted with regards to STEM implementation. For example, one principal declared:

“I recognise that a lot of work is needed on my part to foster greater, positivity towards building a STEM culture. I'm going about this process in a deliberate and paced manner using the SSE process: Croke Park sessions; newly reformed/revised in-school leadership posts & building distributive leadership opportunities for non-post holders” (Principal Comment, Q12. Survey 165).

Similarly, on the concept of leadership supports that were accessible to the school, one principal stated:

“One of my staff is presently part of a Limerick City DEIS initiative in the maths/technology area. It is a fulltime post (one of 4 such posts) in the area of maths/technology. Having a person working fulltime in this area and feeding back to DEIS

schools in the city, is proving invaluable in furthering STEM in our school” (Principal Comment, Q12. Survey 201).

Below, table 5.14 provides a summary of findings on opportunities related to STEM education.

Table 5.14 Summary of Qualitative Thematic Analysis Findings: Opportunities Perceived Opportunities

Illustrative Quote	Subtheme	Theme
<i>“STEM education is vital. Children love the hands on, activity-based learning created” (Principal Comment, Q12. Survey 195).</i>	Student Interest	Positive Perceptions of STEM
<i>“I firmly believe that STEM education is so important in our schools and that the curriculum needs to change and accommodate this. STEM allows for so much integrated learning” (Principal Comment, Q12. Survey 322).</i>	Subject Integration	
<i>“It’s a slow process but is very rewarding to witness higher levels of fruitful engagement in leading: greater levels of pupil agency in their learning; real strides in breathing life into our school mission statement that promotes creativity, problem solving, collaboration and 21st Century Skills” (Principal Comment, Q12. Survey 165).</i>	21 st Century Skills	
<i>“We hold Science Week, Maths week, Tech week, Engineers week every year at minimum cost and high interest to the pupils” (Principal Comment, Q12. Survey 327).</i>	School STEM Offerings	STEM Implementation
<i>“I recognise that a lot of work is needed on my part to foster greater, positivity towards building a STEM culture. I’m going about this process in a deliberate and paced manner using the SSE process: Coke Park sessions; newly reformed/revised in-school leadership posts & building distributive leadership opportunities for non-post holders” (Principal Comment, Q12. Survey 165).</i>	STEM Leadership	

5.6 A Synthesis of Quantitative and Qualitative Findings on Promoting STEM Education

5.6.1 Principal Ability: Transformational Leadership

Transformational Leadership. The empirical findings which indicate that transformational leadership is positively linked to principal and school commitment to the implementation of STEM education are consistent with findings from thematic analysis of the open qualitative data. For example, one principal discusses their transformational leadership role:

“I recognise that a lot of work is needed on my part to foster greater, positivity towards building a STEM culture. I'm going about this process in a deliberate and paced manner using the SSE process: Coke Park sessions; newly reformed/revised in-school leadership posts & building distributive leadership opportunities for non-post holders” (Principal Comment, Q12. Survey 165).

Additionally, principals have highly commended the significant positive contribution to STEM implementation that staff in leadership roles (e.g., assistant principal, or post of responsibility), have had in supporting the development of STEM implementation in their schools. However, whilst the guidance of key national organisations and policy documents is evident in the approach to leadership that principals are adopting, the qualitative data also highlights that whole school approaches are still only developing. For example, in relation to leadership in STEM education, one participant stated:

“In primary school it depends on the knowledge and interest of individual teachers. Whole school approaches are only developing” (Principal Comment, Q12. Survey 93).

Furthermore, some participants suggested that increased distributive leadership support should be a government priority. For instance, one principal expressed a need for:

“... leadership posts & building distributive leadership opportunities for non-post holders” (Principal Comment, Q12. Survey 165).

Similarly, the concept of the infancy of distributed leadership in Ireland is highlighted. For instance, one principal expressed that:

“In primary school it depends on the knowledge and interest of individual teachers. Whole school approaches are only developing” (Principal Comment, Q12. Survey 93).

Furthermore, teaching principals highlighted that in smaller schools, there were less posts of responsibility. A possible solution to address this conundrum regarding STEM leadership in smaller schools was explored by one principal who stated:

“A visiting STEM teacher perhaps for 1 day each fortnight would be beneficial to keep and maintain a focus as other things often take over” (Principal Comment, Q12. Survey 81).

As such, this could prevent exclusion of particular school cohorts from targeted leadership-development in the area of STEM.

5.6.2 Principal Motivation

Consultation with Government Agencies. The empirical findings that demonstrate the positive impact that effective consultation with government agencies has on principal commitment to STEM, principal intention to adopt STEM education and school implementation of STEM education are in line with findings from the thematic analysis. For instance, one participant discussed their use of a government Self-Evaluation strategy to effect change in their school setting:

“STEM education is a very important part of the Primary School Curriculum. Our school has adopted STEM education for our school self-evaluation for this year” (Principal Comment, Q12. Survey 196).

Overall, despite the found significance between consultation with government agencies and principal and school intention to adopt and implementation of STEM education, qualitative data highlighted contrasting views of educators and the government. For instance, one principal stated:

“I do not value the overemphasis on STEM for employment as opposed to emphasizing the skills of collaboration, communication and problem-solving which are skills that will be much more future-proof than content and can apply to all areas of learning” (Principal Comment, Q12. Survey 242).

This is not a surprising finding that participants were not in support of government vision, as they also expressed a lack of consultation in general surrounding education policy development and implementation. For example, one principal stated that there is a:

“... dichotomy between Govt. which sees only the possibilities for training new workers vs. primary schools which are trying to educate pupils for life as whole humans. New wellbeing initiatives (also brought in with no consultation with teachers, no time to embed and - of course - no extra resources) are in place because of possible future legal action” (Principal Comment, Q12. Survey 88).

Overall, these findings suggest that whilst principals will enact policy directives in a committed way because they are required to do so, they might not always be in agreement with the actions that are asked of them.

Opportunities. Despite the non-significant quantitative relationship between consultation with government agencies and school participation in STEM-related weeks, thematic analysis findings demonstrated that principals regarded such events highly. For instance, principals reported high levels of interest in STEM-related weeks, events, and structured award programmes suggesting that these often are effective in generating high pupil interest in the subject areas of STEM. For example, one participant stated:

“We hold Science Week, Maths week, Technology week, and Engineering week every year at minimum cost and high interest to the pupils” (Principal Comment, Q12. Survey 327).

However, whilst participation in such events is clearly seen as a positive with regards to STEM implementation, some principals expressed concern regarding access to outreach events/supports. For example, one participant expressed challenges relating to the distance at which they had to travel to participate in STEM showcases and the costs incurred on schools as a result:

“We find the cost of bus-hire alone, limits the number of classes allowed to visit STEM related events/workshops. These workshops should be free to primary school groups” (Principal Comment, Q12. Survey 378).

Overall, participants expressed strong values for STEM education, particularly around the potential that the subject area holds for subject integration and active learning.

5.6.3 Principal Opportunity

Access to Specialist Teacher Instruction. The empirical findings which indicate that access to specialist teacher instruction increases principal commitment to STEM, school implementation of STEM education and school participation in STEM weeks are consistent with qualitative findings. For instance, one participant stated:

“We need specialists with passion...to move forward and to enable our children to progress in these fields with confidence” (Principal Comment, Q12. Survey 71).

Additionally, qualitative findings support the failure to find the expected significant relationship between access to specialist teacher instruction and principal intention to adopt STEM education. For example, principals made references to their increasing job duties, and as such delegation of duties to staff members and outreach providers. For example, one principal exemplified their delegation of leadership to another staff member:

“Great work being done here by school team led by AP2 post holder” (Principal Comment, Q12. Survey 373).

Similarly, another principal explores the involvement of outreach STEM leaders in their school:

“We also link with a number of outside agencies, including UCC, CIT, Lifetime Lab, etc., as well as having expertise on staff” (Principal Comment, Q12. Survey 103).

Whilst the empirical results demonstrate that having access to specialist teacher instruction does not increase principal intention to adopt STEM, the qualitative data highlights the perceived value that specialist instruction can contribute to school implementation of STEM. For example, one principal stated:

“More visiting experts to do workshops in schools funded by DES or outside agencies would be worthwhile” (Principal Comment, Q12. Survey 143).

Additionally, there is also the concept of schools who have additional specialist on-staff expertise in the area of STEM. For example, one principal stated:

“One of my staff is presently part of a Limerick City DEIS initiative in the maths/technology area. It is a fulltime post (one of 4 such posts) in the area of maths/technology. Having a person working fulltime in this area and feeding back to DEIS schools in the city, is proving invaluable in furthering STEM in our school” (Principal Comment, Q12. Survey 201).

Despite some successful examples of on-staff specialists, many principals struggle for a multitude of reasons to source and employ teachers with STEM expertise. For example, one participant discussed constraints regarding the hiring panel:

“List of interview panel assessors is prescribed so very limited opportunity to have STEM specialist at interviews” (Principal Comment, Q12. Survey 276).

Additionally, the topic of initial teacher education and teacher confidence as hindering factors were prevalent. For instance, one principal suggested:

“Older teachers did not study Science/STEM at college” (Principal Comment, Q12. Survey 50).

Similarly, the implications of insufficient teacher confidence were elaborated on by another participant:

“The lack of confidence from teachers not into STEM (like me) means that it won't develop in a coordinated fashion” (Principal Comment, Q12. Survey 93).

Despite the opportunity that principals have to implement STEM education, they express time constraints as being a significant barrier in their ability to explore new initiatives in a meaningful way.

5.6.4 Challenges Related to STEM Implementation

Thematic analysis has identified time pressure as a major barrier in the implementation of STEM, with three specific areas of concern: overloaded curriculum, initiative overload, and increasing principal job demands.

Initiative and Curriculum overload. The data here indicates that principals would welcome guidance on subject prioritisation. Participants clearly expressed that they value STEM and the potential that this has for their students, however they feel that it cannot be afforded the time that is required to implement it. For example, one participant stated:

“I feel STEM education is very important. The big issue is curriculum overload. Something has to give. There is not enough time in the school day to cover everything that is required.” (Principal Comment, Q12. Survey 263).

This point is echoed by another participant: *“I would like to have a greater focus on STEM but teachers are overwhelmed at present - too many changes and not enough time. It is devastating teachers”* (Principal Comment, Q12. Survey 124).

Despite their dissatisfaction with the current overloaded curriculum, participants value the potential that STEM has for subject integration. For example, one principal suggested that *“STEM allows for so much integrated learning”* (Principal Comment, Q12. Survey 322). Elaborating on this concept, another participant suggested:

“STEM is a way to break down the artificial walls that we construct in the place of individual subject instruction” (Principal Comment, Q12. Survey 240).

Resources. One of the most prominent issues that was referenced to regarding the resourcing of STEM education, was that of professional development provision. For example, one participant stated:

“I feel that the introduction of STEM needs much more consideration especially in terms of upskilling school staff” (Principal Comment, Q12. Survey 95).

Furthermore, concerns arose frequently from teachers in small and/or rural schools, whereby they could not access substitute cover and funds to travel to a more urban area to access desired supports. However, some principals also provided examples of effective professional development that their schools have engaged in:

“Over the last 2 years we have availed of PDST in-school support in both SSE (Numeracy) and ICT. I found this form of CPD to be of significant benefit to the staff, the feedback on the practical nature of the advice given was extremely positive and this in turn has impacted successfully on teaching and learning in a very real way in our school. Teacher engagement in STEM has definitely improved and as the support was given within our own context, recommendations were specifically tailored to our needs” (Principal Comment, Q12. Survey 159).

The COVID-19 pandemic magnified the findings from Study 1, which gave rise for further reflection on the concept of school leadership styles and government communication regarding principal job responsibilities.

5.7 Chapter Summary

SEM was used to test the hypotheses presented in this study. The open comments were thematically analysed and were classified into five distinct themes. Finally, a synthesis of the qualitative and quantitative results was presented. The following chapter will explore the findings from Study 2: Leadership during a Crisis. Sample representativeness, profile of the respondents, and descriptive statistics are presented. Following this, hypotheses are tested via structural equation modelling. Next, an analysis of the open comments of the survey is presented. A synthesis of the quantitative and qualitative findings is produced and finally, a summary of the findings from the study.

CHAPTER SIX

RESULTS OF STUDY 2: LEADERSHIP DURING THE COVID-19 CRISIS

6.1 Introduction

The research findings from Study 2 - *Leadership during the COVID-19 Crisis*, are discussed in detail in this section. The layout of the chapter is as follows: First, sample representativeness is outlined along with the breakdown of the sample profile (e.g., gender, and tenure etc.). Next, correlation between variables is provided through the reporting of descriptive statistics. Following this, SEM is outlined to examine the hypothesized model. Next, thematic analysis of the quantitative data is presented. Finally, a synthesis of the quantitative and the qualitative findings are outlined.

6.2 Sample Representativeness

Sample representativeness was deemed to be acceptable, as per the stipulations outlined previously in Study 1. After several reminders, 708 responses were received (26%). After deleting incomplete responses, the final sample size was 634 (20%), which research on response rate to web-based surveys deem to be an acceptable sample size (Hill, 1998; Peers, 2006).

Non-response bias was checked by exploring differences in responses between early versus late respondents (received after the 1st reminder), as it has been suggested that late respondents are similar to non-respondents (Armstrong & Overton, 1977). No significant differences were found between these groups ($F = .11$ for gender, $F = .00$ for age, $F = 1.05$ for school size, $F = 1.06$ for tenure, none was significant). The results of the ANOVA comparison analysis are summarised in table 6.1 below.

Table 6.1 ANOVA Results from Comparison Analysis

Items	Early Response v Late Response	
	F	Sig
Gender	.01	.91
Respondent Age	.01	.96
Respondent Tenure	2.28	.13
School Size	1.61	.21

6.3 Profile Respondents

The principals who piloted the study advised the researcher that principals were under significant time pressure managing their schools during the COVID-19 lockdown and therefore, they suggested keeping the survey as short as possible to ensure that principals would have time to respond to it. As a result, a reduced volume of demographic questions were asked in the Leadership during COVID-19 survey in comparison to the survey in Study 1. The pilot group deemed the following categories as being necessary: principal gender, principal age, principal tenure, and school size.

The breakdown of respondents consisted of 78% females and 22% males. With regards to the age of the respondents, nearly half (45%) were aged between 50-59, (30%) were aged between 40-49, (18%) were aged less than 39, and (7%) of participants were aged over 60. The average tenure of participants was 11 years (SD =7.53). The average size of school – the number of students, was 190 (SD = 169).

6.4 Analysis of Quantitative Data

6.4.1 Individual Item Descriptive Analysis

This section includes a summary of the respondents' perceptions of a variety of items that were outlined in the survey including: dependent variables (school performance and

work alienation), the independent variable (transformational leadership) and mediating variables (employee trust and relational coordination). These variables were included to reflect principals' experiences of leadership during the COVID-19 pandemic.

6.4.1.1 Dependent Variables

School performance. Table 6.2 illustrates the breakdown of respondents' replies on attitudinal items relating to their school's performance during the COVID-19 lockdown. Respondents were asked to respond to 9 statements on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The average score for the school performance scale was 4.64, indicating that overall, the principals who responded to these items (n = 630) agreed that their schools performed well during the COVID-19 lockdown.

Overall, 96% of participants agreed that their school carried out parts of their core job well and completed core tasks well. Additionally, 91% agreed that they ensured that tasks were completed properly. Likewise, 95% agreed that they adapted well to changes during the crisis and coped with changes to the way that they had to complete core tasks. Additionally, 79% of participants agreed that their school learned new skills to help them to adapt to changes. 88% of principals declared that their school initiated better ways of doing core tasks. 93% of participants were in agreement that their school came up with ideas to improve the ways in which core tasks are completed. Finally, 59% of principals declared that their school made changes to the way our core tasks are completed.

Table 6.2 School Performance

School Performance (average, SD)				4.64	.55
Items	Disagree	Neutral	Agree	Mean	SD
Carried out the core parts of our job well.	2%	2%	96%	4.47	.51
Completed core tasks well.	1%	3%	96%	4.57	.62
Ensured tasks are completed properly.	2%	7%	91%	4.39	.71
Adapted well to changes during the crisis.	1%	4%	95%	4.56	.64
Coped with changes to the way that we have to complete core tasks.	2%	3%	95%	4.52	.66
Learned new skills to help us adapt to changes.	7%	14%	79%	4.73	.61
Initiated better ways of doing our core tasks.	3%	9%	88%	4.11	.96
Came up with ideas to improve the ways in which core tasks are completed.	2%	5%	93%	4.35	.80
Made changes to the way our core tasks are completed.	25%	16%	59%	4.48	.70

Note: N = 630

Work alienation. Table 6.3 illustrates the breakdown of respondents' replies on attitudinal items relating to their work alienation during the COVID-19 lockdown. Respondents were asked to respond to 3 statements on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The average score for the work alienation scale was 3.34, indicating that overall, the principals who responded to these items (n = 620) agreed somewhat that they felt alienated during the crisis.

Overall, 59% of participants claimed that they felt disconnected from themselves while working from home. Additionally, 56% of principals agreed that whilst working from

home they often wished they were doing something else. Finally, 50% of participants agreed that they did not feel connected to their staff members when working from home.

Table 6.3 Work Alienation

Work Alienation (average, SD)				3.34	1.01
Items	Disagree	Neutral	Agree	Mean	SD
Working from home I feel disconnected from myself.	25%	16%	59%	3.51	1.32
Working at home I often wish I were doing something else.	30%	14%	56%	3.37	1.33
I do not feel connected to my staff members when working from home.	38%	12%	50%	3.14	1.30

Note: N = 620

6.4.1.2 Independent Variable

Transformational leadership. Table 6.4 illustrates the breakdown of respondents' replies on attitudinal items relating to their transformational leadership during the COVID-19 lockdown. Respondents were asked to respond to 6 statements on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The average score for the transformational leadership scale was 4.40, indicating that overall, the principals who responded to these items (n = 708) demonstrated that they view themselves as transformational leaders.

Overall, 68% of participants believe that they inspired others with their plans for the future. Additionally, 96% of principals agreed that they led by example. Furthermore, 95% of participants agree that they fostered a team attitude and spirit among staff members. Regarding the concept of encouragement, 89% of principals agreed that they encouraged only the best performance, whilst 88% encouraged staff members to rethink the way that they do things where necessary. Finally, 98% of participants agreed that they showed respect for their staff's personal feelings.

Table 6.4 Transformational Leadership

Transformational Leadership (average, SD)				4.40	.47
Items	Disagree	Neutral	Agree	Mean	SD
Inspire others with our plans for the future.	3%	29%	68%	3.87	.82
Lead by example.	0%	4%	96%	4.61	.59
Foster a team attitude and spirit among staff members.	1%	4%	95%	4.54	.61
Encourage only the best performance.	2%	9%	89%	4.35	.74
Encourage staff members to rethink the way we do things, as necessary.	1%	11%	88%	4.29	.69
Show respect for my staff's personal feelings.	0%	2%	98%	4.74	.49

Note: N = 708

6.4.1.3 Mediating Variables

Employee Trust. Table 6.5 illustrates the breakdown of respondents' replies on attitudinal items relating to employee trust during the COVID-19 lockdown. Respondents were asked to respond to 4 statements on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The average score for the school performance scale was 4.58, indicating that overall, the principals who responded to these items (n = 707) agreed that their staff trusted each other and the principal as leader.

Concerning the topic of employee trust, 92% of principals agreed that their staff trusted each other a lot. Similarly, 93% felt that their staff know that they can count on one another. And 95% agreed that their staff know that they can count on management. Finally, 96% of principals believe that their staff trust them in a position of leadership.

Table 6.5 Employee Trust

Employee Trust (average, SD)				4.58	.61
Items	Disagree	Neutral	Agree	Mean	SD
My staff trust each other a lot.	2%	6%	92%	4.53	.75
Know that they can count on one another.	2%	5%	93%	4.59	.71
Know that they can count on management.	2%	3%	95%	4.60	.69
Trust me in a position of leadership.	1%	3%	96%	4.60	.67

Note: N = 707

Relational Coordination. Tables 6.7, 6.8 and 6.9 illustrate the breakdown of respondents' replies on attitudinal items relating to relational coordination with the BoM, staff members and the Parents' Association (PA) respectively during the COVID-19 lockdown. Respondents were asked to respond to 7 statements on a 4-point Likert scale, ranging from 1 = strongly disagree to 4 = strongly agree.

Relational coordination with the Board of Management. The average score for the BoM scale was 3.10, indicating that overall, the principals who responded to these items (n = 605) agreed that they communicated with the BoM effectively during the lockdown. With regards to communication, 37% of participants agreed that they communicated in a timely manner, 22% felt that communication was frequent and 80% felt that communication was accurate. Overall, 78% of principals reported that they share the same goals with the BoM in their efforts to best help students. However, only 32% agreed that they share responsibility with the BoM for when issues concerning students arise. Furthermore, 48% of principals agreed that they share knowledge about ongoing developments and 26% expressed that they collaborate on new initiatives with the BoM.

Table 6.6 Relational Coordination with the Board of Management

Relational Coordination (average, SD)				3.10	.65
Items	Disagree	Neutral	Agree	Mean	SD
Communicate timely.	29%	34%	37%	2.08	.81
Communicate frequently.	43%	35%	22%	1.79	.78
Communicate accurately.	7%	13%	80%	2.72	.60
Share the same goals in our efforts to best help students.	7%	15%	78%	2.70	.60
Share responsibility when issues concerning students arise.	45%	23%	32%	1.87	.87
Share knowledge about ongoing developments.	20%	32%	48%	2.28	.78
Collaborate/contribute on new initiatives.	43%	31%	26%	1.82	.81

Note: N = 605

Relational coordination with staff members. The average score for the staff members scale was 3.80, indicating that overall, the principals who responded to these items (n = 600) strongly agreed that they communicated with staff members effectively during the lockdown. Of the principals that responded, 84% of participants agreed that they communicated in a timely manner, 86% felt that communication was frequent and 90% declared that their communication was accurate. Additionally, 86% of respondents agreed that they share the same goals with staff members in their efforts to best help students. Furthermore, 65% of participants expressed that they share responsibility when issues concerning students arise. Finally, 80% of respondents agreed that they share knowledge about ongoing developments and collaborate/contribute on new initiatives.

Table 6.7 Relational Coordination with Staff Members

Relational Coordination (average, SD)				3.80	.36
Items	Disagree	Neutral	Agree	Mean	SD
Communicate timely.	1%	15%	84%	2.83	.40
Communicate Frequently.	2%	12%	86%	2.84	.41
Communicate accurately.	1%	9%	90%	2.90	.32
Share the same goals in our efforts to best help students.	1%	13%	86%	2.85	.39
Share responsibility when issues concerning students arise.	8%	27%	65%	2.57	.64
Share knowledge about ongoing developments.	2%	18%	80%	2.83	.42
Collaborate/contribute on new initiatives.	2%	18%	80%	2.78	.47

Note: N = 600

Relational coordination with the Parents' Association (PA). The average score for the PA scale was 2.65, indicating that overall, the principals who responded to these items (n = 524) agreed somewhat that they communicated with the PA effectively during the lockdown. The results regarding communication indicated that, 48% of principals felt that they communicated in a timely matter, 35% felt that communication was frequent, and 77% felt that communication was accurate. Furthermore, 79% expressed that they share the same goals with the PA in their efforts to best help students. In contrast, only 35% of participants agreed that they share responsibility when issues concerning students arise. Of the principals that responded, 58% of principals expressed that they share knowledge about ongoing developments and 50% declared that they collaborate on new initiatives with the PA.

Table 6.8 Relational Coordination with the Parents' Association

Relational Coordination (average, SD)				2.65	.88
Items	Disagree	Neutral	Agree	Mean	SD
Communicate timely.	1%	51%	48%	1.68	.82
Communicate Frequently.	2%	63%	35%	1.49	.75
Communicate accurately.	2%	21%	77%	2.51	2.05
Share the same goals in our efforts to best help students.	1%	20%	79%	2.36	.84
Share responsibility when issues concerning students arise.	1%	64%	35%	1.50	.78
Share knowledge about ongoing developments.	2%	40%	58%	1.85	.83
Collaborate/contribute on new initiatives.	1%	49%	50%	1.67	.0

Note: N = 524

6.4.2 Descriptive Analysis of Variables

Table 6.9 presents the means, standard deviations and intercorrelations for all variables.

Table 6.9 Descriptive Statistics and Bivariate Correlations

Variables	Mean	S.D.	1	2	3	4	5	6	7	8
1. School performance	4.48	.52								
2. Work alienation	3.33	1.07	-.11**							
3. Employee trust	4.60	.60	.23**	-.04						
4. Relational coordination	2.90	.67	.24**	-.16**	.17**					
5. Transformational leadership	4.41	.47	.31**	-.15**	.36**	.32**				
6. Gender	.78	.41	.05	-.03	.06	.03	.08			
7. Age	3.43	.86	-.02	-.13**	.07	.08*	.05	.06		
8. Tenure	11.30	7.59	.04	-.09*	.09*	.03	0	-.03	.49**	
9. School size	192.80	171.82	.10*	-.08	.02	.07	.05	-.13**	.13**	.08*

Note: N=585 (Listwise). ** $p < .01$, * $p < .05$, (two-tailed tests).

6.4.3 Measurement Models

This study had five main variables, i.e., transformational leadership, employee trust, relational coordination, school performance and work alienation. Among them, relational

coordination and school performance had sub-dimensions. Therefore, a full measurement model was tested with second-order confirmatory factor analysis for relational coordination and school performance along with first-order factor analysis with other three variables in the model. The five-factor model showed a good model fit ($\chi^2/df = 1580.27/575 = 2.75$, $p < .001$, CFI = .90, RMSEA = .05 and SRMR = .05).

Since all variables in the study were collected from a single source, it was essential to check whether common method bias was present in the data. As explored in Study 1, recommendations made by (Podsakoff et al., 2003, 2012) were followed.

For instance, a series of confirmatory factor analyses were carried out to test for common method bias and to establish the discriminant validity of the scales (Podsakoff et al., 2012). sequential χ^2 difference tests between the alternative factor model to the full measurement model were again calculated as shown in Table 6.10 The comparison shows that the fitness of the alternative models was significantly worse compared to the full measurement model (all at $p < .001$).

Table 6.10 Fit Statistics from Measurement Model Comparison

Models	χ^2 (df)	CFI	RMSEA	SRMR	$\Delta\chi^2$	Δdf
Full measurement model	1580.27(575)	.90	.05	.05		
Model A ^a	2375.41(581)	.83	.07	.08	795.14	6***
Model B ^b	1854.41(579)	.88	.06	.06	274.14	4***
Model C ^c	2756.37(581)	.79	.08	.08	1176.10	6***
Model D ^d	3081.15(584)	.76	.08	.09	1500.88	9***
Model E ^e	4287.78(584)	.64	.10	.12	2707.51	9***
Model F ^f	2753.33(582)	.79	.08	.07	1173.06	7***
Model G ^g	5795.28(590)	.49	.12	.13	4215.01	15***

Notes: ***p<.001; χ^2 = chi-square discrepancy, df=degrees of freedom; IFI = Incremental Fit Index; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardised Root Mean Square Residual; $\Delta\chi^2$ = difference in chi-square, Δdf = difference in degrees of freedom. All models were compared to the full measurement model.

^a= Employee trust and relational coordination combined into a single factor

^b= Transformational leadership and employee trust combined into a single factor

^c= Transformational leadership and relational coordination combined into a single factor

^d= Transformational leadership, employee trust and relational coordination combined into a single factor

^e= Relational coordination and school performance combined into a single factor

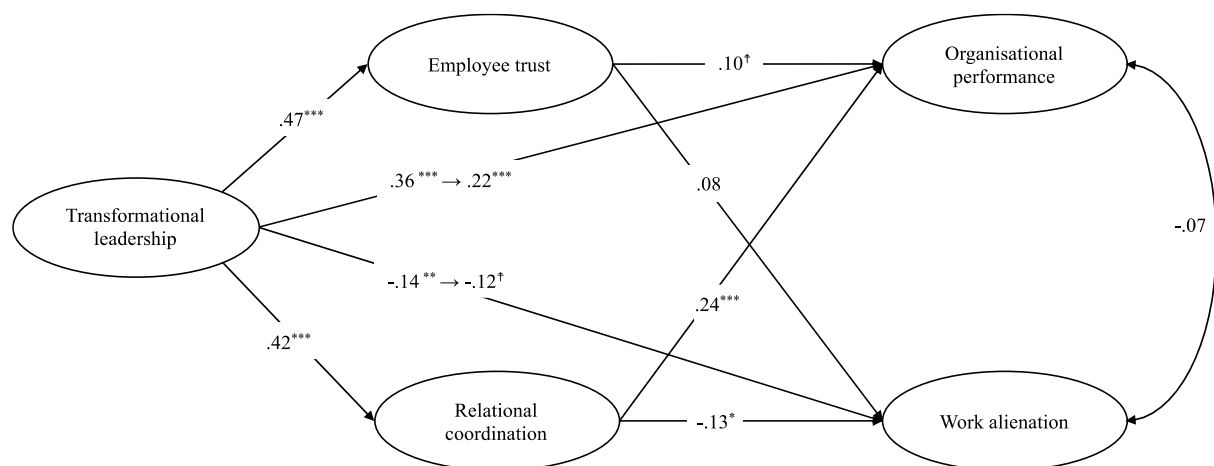
^f= Employee trust and school performance combined into a single factor

^g= All factors combined into a single factor

6.4.4 Structural Model and Hypotheses Testing

Figure 6.1 presents the Structural Equation Modelling results for Study 2: Leadership During the COVID-19 Crisis

Figure 6.1 Structural Equation Modelling Results for Study 2



Note: N= 134 (listwise) *** $p < .001$ ** $p < .01$ * $p < .05$ † $p < .10$

Hypothesis 1 proposed that transformational leadership would be positively linked to school performance (1a) and negatively linked to work alienation (1b) during crisis. The results from Figure 6.1 show that the link between transformational leadership and school performance was positive and significant ($\beta = .36$, $p < .001$), and the link between transformational leadership and work alienation was negative and significant ($\beta = -.14$, $p < .01$), supporting Hypothesis 1.

Hypothesis 2 proposed that employee trust would mediate the relationship between transformational leadership and school performance (2a) and work alienation (2b) during the crisis. Following Hayes' (2013) guidelines, the first condition to be met to establish mediation is the significant relationship between the independent variable and the mediator. The second condition is the significant relationship between the mediator and the dependent variable. The last condition is the significant effect of the mediator on the dependent variable while controlling for the independent variable. As shown in Figure 6.1, the coefficient of

transformational leadership on employee trust was positive and significant ($\beta = .47, p < .001$), satisfying the first condition. Employee trust was positively but marginally associated with school performance ($\beta = .10, p < .10$), which met the second condition. The indirect effect of school performance on transformational leadership via employee trust was calculated as .04 ($p < .10$) with 90% confidence interval between .003 and .077, which does not cover 0. This satisfied the third condition. Therefore, Hypothesis 2a was supported that employee trust mediated the relationship between transformational leadership and school performance. In relation to work alienation, as employee trust was not related to work alienation ($\beta = .08, n.s.$), the second condition of mediation was not met. Therefore, Hypothesis 2b was not supported and employee trust did not mediate the relationship between transformational leadership and work alienation.

Hypothesis 3 proposed that relational coordination would mediate the relationship between transformational leadership and school performance (3a) and work alienation (3b) during crisis. Adopting the same mediation test approach (Hayes, 2013), the first condition was met by the significant coefficient between transformational leadership and relational coordination ($\beta = .42, p < .001$). The second condition was met by the results on the significant path coefficients of relational coordination to school performance ($\beta = .24, p < .001$), and to work alienation ($\beta = -.13, p < .05$). The last condition was tested by calculating the indirect effect which was .08 for transformational leadership linking to school performance via relational coordination (with 90% of CI between .043 and .124); and -.11 for transformational leadership linking to work alienation via relational coordination (with 90% of CI between -.207 and -.018). Therefore, Hypothesis 3 was supported that relational coordination mediated the relationship between transformational leadership and school performance (3a) and work alienation (3b) during crisis.

6.5 Analysis of Qualitative Data

6.5.1 Overview of Main Findings

The thematic analysis of the principals' responses yielded 1,230 references and 325 codes, and together were classified into four themes, in two topics. The first topic - Findings Relating to the Principal includes: (1) Guidance and Support, (2) Work-Life Balance. The second topic – Findings Relating to the School Community includes: (3) Digital Learning and (4) Schools with Additional Needs.

6.5.2 Findings Relating to the Principal

6.5.2.1 Guidance and Support

Guidance and support was the most significant theme that emerged. Four subcategories present and the references within the theme are broken down as follows: guidance and support outlets; timeliness of received communication; lack of guidance and communication within school. Participants also provided recommendations for improvement in this area.

With regards to perceived support by principals, there were a few centres and organisations that were referenced to. For example, one participant stated:

“Education Centres and the PDST were a shining light in providing support and information during the crisis” (Principal Comment, Q6. Survey 162).

Similarly, another participant expressed:

“We have discussed and taken on board advice, relating to procedures policy and practice, from webinars with IPPN, Mason Curran and Hayes and others” (Principal Comment, Q6. Survey 683).

6.5.2.2 Work-Life Balance

Work-life Balance is the third most referenced theme. It is broken down into three subcategories: increased job demands; balancing work and personal life and reduced personal wellbeing. Many principals made references about the increase in work demands, and the stress and isolation that they felt as a result. For example, one participant stated that: *“Working days have tripled in length. I still feel terribly isolated and burdened with trying to keep up with all the webinars, advice and demands as well as planning”* (Principal Comment, Q6. Survey 560).

Similarly, participants discussed the effect that navigating staff emotions and relationships had on their own wellbeing. For example, one participant declared:

“As a principal I have always supported and empathised with all staff members, however now more than ever the support required to work with stressed employees is definitely taking its toll on me personally” (Principal Comment, Q6. Survey 155).

Likewise, teaching principals expressed frustration with trying to balance administrative and teaching duties. Some participants made reference to the increasing work demands that they faced and the inability to look after their wellbeing as a result. For example, one principal stated:

“The workload for me, as a teaching principal, had been extreme under normal circumstances but this has been ridiculous. It is fine for many professionals to tell us that we need to mind ourselves and look after our own wellbeing which is all well and good. However, the other side of the coin (and the reality) is that we have things being thrown at us from all angles” (Principal Comment, Q6. Survey 589).

Additionally, participants made references to the fact that facing directive implementation was challenging for teaching principals who balance administrative and teaching duties. For instance, one teaching principal expressed:

“Teaching Principals cannot implement changes from a classroom” (Principal Comment, Q6. Survey 416).

In addition to commenting on their experiences, many principals also provided recommendations for improvement in this area. For example, one participant communicated:

“Supports needed for teaching principals- a minimum of one day a week to read and process documents and time to THINK and to carry out administrative duties, and a restoration of middle management posts lost in the recession” (Principal Comment, Q6. Survey 490).

With regards to the timeliness and usefulness of government communication and guidelines, many participants expressed frustration, as exemplified by the following quote: *“Directives are being issued too late and they aren't always helpful or understanding of our situation”* (Principal Comment, Q6. Survey 125).

Similarly, another participant stated, *“There was an absolute dearth of any guiding framework”* (Principal Comment, Q6. Survey 532). In discussing communication with the school community, many participants expressed that they found this stressful and time consuming. For instance, one participant stated that it was:

“... very stressful trying to manage the communication of all parties” (Principal Comment, Q6. Survey 417).

In addition to commenting on their experiences, many principals also provided recommendations for improvement in this area. For example, one participant shared:

“I would like to see increased support/guidance for school leaders when school returns, as well as the option to step down from principalship without loss of seniority after a certain number of years” (Principal Comment, Q6. Survey 481).

Also on the concept of increasing leadership support, another participant reported:

“I would like that the management posts that were lost due to retirements during the last economic downturn were reinstated. Our school lost 4 posts and only 1 was reinstated”
(Principal Comment, Q6. Survey 256).

Table 6.11 below details some of the perceived experiences of principals within the above established themes.

Table 6.11 Summary of Qualitative Thematic Analysis Findings: The Principal
The Principal

Illustrative Quote	Subtheme	Theme
<i>“Education Centres and the PDST were a shining light in providing support and information during the crisis”</i> (Principal Comment, Q6. Survey 162).	Guidance and Support Outlets	Guidance and Support
<i>“Directives are being issued too late and they aren't always helpful or understanding of our situation”</i> (Principal Comment, Q6. Survey 125).	Timeliness of Received Communication	
<i>“There was an absolute dearth of any guiding framework”</i> (Principal Comment, Q6. Survey 532).	Lack of Guidance	
<i>“Very stressful trying to manage the communication of all parties”</i> (Principal Comment, Q6. Survey 327).	Communication Within School	
<i>“Working days have tripled in length. I still feel terribly isolated and burdened with trying to keep up with all the webinars, advice and demands as well as planning”</i> (Principal Comment, Q6. Survey 560).	Increased Job Demands	Work-Life Balance
<i>“Supports needed for teaching principals- a minimum of one day a week to read and process documents and time to THINK and to carry out administrative duties, and a restoration of middle management posts lost in the recession”</i> (Principal Comment, Q6. Survey 564).	Teaching Principals	
<i>“Working from home, home-schooling children and balancing all of these needs in a time of immense emotional trauma, has been horrendous”</i> (Principal Comment, Q6. Survey 327).	Balancing Work & Personal Life	
<i>“As a principal I have always supported and empathised with all staff members, however now more than ever the support required to work with stressed employees is definitely taking its toll on me personally”</i> (Principal Comment, Q6. Survey 155).	Reduced Personal Wellbeing	

6.5.3 The School Community

6.5.3.1 Digital Learning

Digital learning was the second most-referenced theme. Four subcategories present and the references within the theme are broken down as follows: inadequate broadband and

lack of devices; online learning cannot replace face-to face learning; lack of digital knowledge, and positive responses to online learning.

Many of the participants made references to facing the challenge of working digitally with poor quality broadband and a lack of devices. For example, one participant stated that *“Broadband and access to ICT devices are big issues for online learning”* (Principal Comment, Q6. Survey 227).

With regards to the substitute of online learning for in-person tuition, participants highlighted apparent differences. For example:

“The outstanding issue is trying to keep pupils engaged with their learning from a distance. Nothing can replace the dynamism of the classroom. Pupils learn so much from each other and the interaction that a vibrant classroom brings” (Principal Comment, Q6. Survey 137).

Additionally, participants referenced the concept of their lack of knowledge and professional development regarding the selection of a suitable online learning platform. For instance:

“The delay in the provision of any workshops/CPD in online platforms meant that by the time these tutorials were made available, schools had already committed to one or other platform and had to make that decision in isolation and purely from the advice offered on the PDST technology website” (Principal Comment, Q6. Survey 594).

Despite the challenges associated with the swift move to working digitally, many principals felt that there were positive outcomes of this. For instance, one principal exclaimed:

“To put a positive slant on this the Crisis has possibly modernised at an enormous rate our approach to how we can do things in schools. All staff have upskilled in the area of

IT a rate that we would not have thought possible. New communication methods with parents have now been firmly established” (Principal Comment, Q6. Survey 638).

In addition to commenting on their experiences, many principals also provided recommendations for improvement on the concept of working digitally. For example, one participant recommends the provision of licences for widely used technological platforms:

“... nationwide schools’ licence for products such as Zoom, Aladdin, See Saw etc” (Principal Comment, Q6. Survey 666).

Furthermore, many participants provided recommendations regarding the provision of professional development. For example, one participant stated:

“Time and money spent by the DES on supplying courses run during our working day to upskill us in online learning platforms would be beneficial” (Principal Comment, Q6. Survey 525).

6.5.3.2 Students and Families with Additional Needs

Students and Families with Additional Needs is the fourth most significant theme that emerged. Two subcategories present: economic disadvantage and special educational needs.

Frequently referenced by participants in this theme is the issue of economic disadvantage. For example, one participant stated:

“Difficulties with access and the digital divide exacerbate the problems for vulnerable children, leading to increased educational disadvantage” (Principal Comment, Q6. Survey 347).

Additionally, participants also raised concerns about the academic ability of parents in DEIS situations, and provision of basic needs. For example, one participant communicated:

“There are vulnerable children who cannot be support by their parent(s) at home as the parent does not have the academic ability to support them, these children are of great

concern to us. Also, school is a safe place for some children, they know they will be fed and cared for when they walk through our gates” (Principal Comment, Q6. Survey 239).

Principals also provided recommendations for addressing concerns. For example, one participant expressed:

“We are a DEIS school, and we are very aware of how this crisis has affected our pupils more than others and will continue to do so in the future. An IT grant will not bridge these inequalities. A lower pupil teacher ratio would help” (Principal Comment, Q6. Survey 142).

Students with SEN were also frequently flagged by participants as requiring additional supports. For example, one participant stated:

“SEN need one to one tuition and teachers need time with students observing our students throughout the course of the day to know what’s going on with the individual children to know how to best guide their learning” (Principal Comment, Q6. Survey 545).

Other participants noted that some special needs assistants (SNAs) were supporting school administration before being redeployed to other areas of the public service during school closures. For instance, one principal shared:

“SNAs (while awaiting redeployment) & ancillary have taken on the tasks of supporting learning & maintaining administration, building security and maintenance with enthusiasm, while observing HSE/Government guidelines” (Principal Comment, Q6. Survey 165).

Table 6.12 Summary of Qualitative Thematic Analysis Findings: The School Community

The School Community

Illustrative Quote	Subtheme	Theme
<i>“Poor internet connections and lack of devices has also been very challenging” (Principal Comment, Q6. Survey 192).</i>	Broadband and Devices	Digital Learning
<i>“The outstanding issue is trying to keep pupils engaged with their learning from a distance. Nothing can replace the dynamism of the classroom. Pupils learn so much from each other and the interaction that a vibrant classroom brings” (Principal Comment, Q6. Survey 137).</i>	Online Learning Vs. Face to Face	
<i>“The delay in the provision of any workshops/CPD in online platforms meant that by the time these tutorials were made available, schools had already committed to one or other platform and had to make that decision in isolation and purely from the advice offered on the PDST technology website” (Principal Comment, Q6. Survey 594).</i>	Lack of Digital Knowledge	
<i>“To put a positive slant on this the Crisis has possibly modernised at an enormous rate our approach to how we can do things in schools. All staff have upskilled in the area of IT a rate that we would not have thought possible. New communication methods with parents have now been firmly established” (Principal Comment, Q6. Survey 638).</i>	Positive Responses to Online Learning	
<i>“There are vulnerable children who cannot be support by their parent(s) at home as the parent does not have the academic ability to support them, these children are of great concern to us. Also, school is a safe place for some children, they know they will be fed and cared for when they walk through our gates” (Principal Comment, Q6. Survey 239).</i>	Economic Disadvantage	Students and Families with Additional Needs
<i>“SEN need one to one tuition and teachers need time with students observing our students throughout the course of the day to know what’s going on with the individual children to know how to best guide their learning” (Principal Comment, Q6. Survey 545).</i>	Special Educational Needs	

6.6 A Synthesis of Quantitative and Qualitative Findings

By investigating the role of transformational leadership during crisis and the underlying mechanisms in the relationships between transformational leadership with school performance and leader's work alienation, this study makes three contributions to literature on leadership and crisis management.

6.6.1 Principal Leadership

The empirical findings which demonstrate the positive impact that transformational leadership mediated by relational coordination and employee trust has on school performance are supported by principal qualitative comments. For example, one participant discusses their transformative approach to navigating the crisis:

“To put a positive slant on this the Crisis has possibly modernised at an enormous rate our approach to how we can do things in schools. All staff have upskilled in the area of IT a rate that we would not have thought possible. New communication methods with parents have now been firmly established” (Principal Comment, Q6. Survey 638).

In revealing the underlying mechanisms in the study, employee trust was found to mediate the relationship between transformational leadership and organisational performance but not the relationship between transformational leadership and work alienation. This quantitative finding is supported by the qualitative data whereby principals make reference to working with stressed employees, thus signifying that the staff trust their principal and are comfortable communicating their stress in some shape or form. For example, a principal communicated:

“As a principal I have always supported and empathised with all staff members, however now more than ever the support required to work with stressed employees is definitely taking its toll on me personally” (Principal Comment, Q6. Survey 155).

Furthermore, another principal refers to their inability to be unavailable to others and expressed:

“I have found it hard to get across to various people that I was at home with my child therefore was not able to drop food/laptops to children, get signatures from my chairperson, go to the bank etc. There are demands from so many people on me professionally as well as navigating my own home situation” (Principal Comment, Q6. Survey 564).

Principals explained that their staff’s experiences with supportive and transformational leadership leads them to reciprocate by increasing their motivation at work. For example, references were made regarding principal reluctance to express frustrations with others in the school in order to maintain motivation levels:

“I cannot air my frustration to staff because I need to reassure them not heighten their stress levels - they cannot work at their best if they don't feel valued and part of a team and they are feeling pushed aside by the Government and being made to feel like scapegoats” (Principal Comment, Q6. Survey 653).

Efforts were made by some organisations to support principals and their staff members with increased levels of stress and isolation during the pandemic. For instance, one principal expressed:

“I am working on ways to improve my own wellbeing and since March 12th have offered various websites, links to wellbeing blogs e.g., PDST and reminded staff of their entitlement to access Inspire Wellbeing” (Principal Comment, Q6. Survey 155).

6.6.2 Staff Trust and Relationships

The findings in this study demonstrate that relational coordination with key stakeholders (e.g., parents and board of management in this study) was found to mediate the relationships between transformational leadership with school performance and work alienation. This is supported by qualitative findings whereby participants expressed their frustrations with the amount of time that communication took up during the school closures. For instance, one principal stated: *“It takes much longer to do things, to connect with staff”* (Principal Comment, Q6. Survey 641).

Additionally, the management of relational coordination contributed to increased stress levels for principals. Given the sudden shift to communicating digitally, it is not surprising that communication practices were stressful and time-consuming for principals. Working digitally efficiently is an area that several organisations provided support in. For example, one principal stated:

“We have up-skilled using available opportunities presented by Education Centres throughout the country and PDST” (Principal Comment, Q6. Survey 683).

Despite the stress involved in initiating effective relational coordination within their immediate school communities, as transformational leaders, many principals benefited from relational coordination practices with other educational leaders. For example, one principal stated:

“My mentor has been great and is just on the end of the phone.”. Similarly, another participant suggests that *“Schools have risen to the challenge over the past few weeks through collaboration with our colleagues in neighbouring schools and IPPN”* (Principal Comment, Q6. Survey 162).

6.7 Chapter Summary

This chapter presented the Structural Equation Modelling results of each hypothesis tested in the study. Next, the open comments were analysed and classified into four distinct themes, that are grouped in two topics. Following this, a synthesis of the qualitative and quantitative results was presented. The next chapter will explore a discussion of the main findings from the research. It opens with an introduction to the chapter, followed by an overview of the main findings from the research. Next, theoretical and practical implications are discussed. Finally, limitations of the study are addressed, and future research suggestions are outlined.

CHAPTER SEVEN

DISCUSSION

7.1 Introduction

The focus of this chapter is to present a broad overview of the research findings and the contributions made by the dissertation. First, the research aims are re-stated and an overview of the findings in Study 1 and Study 2 are outlined. Following this, theoretical implications, and implications for future practice are discussed. Lastly, limitations and future research are explored, and a summary is provided.

7.2 Summary of Key Findings

The main objective of this research was to explore the complex role of the primary school principal (Pont et al., 2008). To do so, this dissertation analysed primary school principals' perspectives on leadership in two areas, i.e., in STEM education and leading during the COVID-19 crisis.

Study 1- *Leadership in STEM Education*, provides insight on Irish primary school principals' leadership in STEM Education. The findings showed that overall, transformational leadership is significant in influencing principal commitment to STEM education, principal intention to adopt STEM education, school implementation of STEM education and school participation in STEM-related weeks. Additionally, consultation with government agencies was significant with the exception of school participation in STEM-related weeks. Similarly, access to specialist teacher instruction was significant, with the exception of school principal intention to adopt STEM education. Furthermore, important additional findings emerged relating to challenges and opportunities in STEM education.

Study 2 - *Leadership during the COVID-19 Crisis*, builds on and contributes to work in developing effective leadership in times of crisis. The overall findings provide evidence for the importance of transformational leadership during the COVID-19 crisis. In addition, the findings suggest that two relational resources are important (i.e., employee trust and relational coordination), and significantly help organisations to function during times of crisis. However, relational resources work differently towards individual leaders' experience with work, whereby only relational coordination could help reduce their perceived disconnection and isolation with work and people. Additional findings surrounding students and families with additional needs and digital learning also emerged.

Altogether, the findings of the two studies sheds insight into research and practice in education and leadership making several original contributions to knowledge.

7.3 Theoretical Implications

This research makes original contributions to knowledge in the areas of education and leadership in three ways: (1) integration of education and leadership, (2) development and promotion of STEM education and (3) managing education during crisis. Below each contribution is discussed in detail.

7.3.1 Integration of Education and Leadership

The findings from this research study contribute to existing research on educational policy implementation. To date, Irish educational research has largely overlooked the role of the primary school principal in promoting and leading new policy and initiative implementation. However, research in the area of general staff implementation of policy has started to emerge as the result of the DES school self-evaluation (SSE) process. As a result, recent findings have demonstrated that school staff are merely actors in policy implementation (Skerritt et al., 2021). This can be attributed to a lack of accompanying

policy implementation plans (Ball, 1997; Ball et al., 2011; Skerritt et al., 2021), and a lack of government consultation with key stakeholders during the policy-development process (Ball, 2012). The findings from this research align with this key literature, as many principals have expressed that they were not consulted by government agencies regarding the development and implementation of new policies.

Additionally, this research study contributes to theory as contrary to previous studies on general staff implementation, it focuses on the important role of the principal as leader of policy implementation. For instance, it is the responsibility of the principal as leader of a school to read, conceptualise and develop a plan of action on government policy documents and other directives (Drea & O'Brien, 2003). Therefore, the dissertation focuses on the role of the principal as the leader of policy implementation, which is crucial and currently neglected within the existing literature. For example, Study 1 explored the principal's role in STEM implementation, and the results indicate that principals as school leaders play an integral role in key aspects of STEM education policy implementation. For instance, principals influenced their schools to form links with STEM experts, participated in STEM events, and showcases and organised professional development for their staff. Additionally, the findings from Study 2, Leadership during the COVID-19 crisis illustrated principal implementation of government directives. For example, principals communicated digitally with the school community, and established and upskilled staff and students on the use of a digital platform amongst other directives. Collectively, the two studies integrate educational and leadership research.

Furthermore, in leadership research to date, most studies have focused on professional workers within a private context, however there is limited focus on school leadership or the role of the principal. As such, this dissertation sought to bridge the gap between leadership and educational research and practice.

7.3.2 Development and Promotion of STEM Education

This dissertation also makes contributions to literature on development and promotion of STEM education. Specifically, it does so by investigating the roles of transformational leadership, consultation with government agencies and access to specialist teacher instruction and their importance in promoting principal commitment to STEM education, principal intention to adopt STEM education, school implementation of STEM education, and school participation in STEM-related weeks.

First, this study adds new insights on the AMO framework given the context of school leaders and their role in STEM education implementation, which has not been explored previously. In line with the AMO framework (Appelbaum et al., 2000; Fu et al., 2017), this dissertation suggests that principals must have the ability (transformational leadership), motivation (consultation with government agencies) and opportunity (access to specialist teacher instruction) to ensure their discretionary effort with STEM Education (Appelbaum et al., 2000). Additionally, the work explores additional challenges that principals face in their implementation of STEM education with regards to time pressures and resources.

7.3.2.1 Ability: Transformational Leadership

The empirical and qualitative findings which indicate that transformational leadership increases principal and school commitment to change with regards to the implementation of STEM education are consistent with findings from other studies on the positive effects of transformational leadership and commitment to change (Abrell-Vogel & Rowold, 2014; Herold et al., 2008; Hill et al., 2012; Leithwood & Jantzi, 2005; Van der Voet et al., 2016; Yu et al., 2002). Of course, leaders will often demonstrate traits of more than one leadership style. and the findings from this research are supported by the work of MacNeill et al. (2018), who suggested that school leadership can commence with an individual but must be nurtured so that an exceptional leadership team can emerge. For instance, illustrative quotes from the

participants in this study suggest that principals, as transformational leaders, are carefully reflecting on, and implementing school development strategies set out by the DES and CSL, to carry out school self-evaluation and delegate leadership duties within their schools.

Furthermore, principals have also highly commended the significant positive contribution to STEM implementation that staff in leadership roles e.g., Assistant Principal, or post of responsibility, have had in supporting the development of STEM implementation in their schools. Whilst the guidance of key national organisations is evident in the approach to leadership that principals are adopting, the qualitative data also highlights that whole school approaches are still only developing. This is supported by key literature in the area of school leadership in Ireland, with the OECD noting that the CSL and associated bodies will need to further-develop their policies and programmes in order to achieve long term viability (OECD, 2019). A common issue presented in the thematic analysis was that of the lack of DES-appointed posts of responsibility. For instance, many principals reported that in small school settings, there is reduced capacity for delegation of leadership, as posts of responsibility are often allocated on a basis of school size.

Key literature in the area of leadership development suggests that contextual reflection and ongoing development is imperative and there is no quick-fix, or one size fits all approach when it comes to leadership development (Boud & Walker, 1998; Fullan, 2002). Fullan, (2007) in a discussion around implementing change in educational settings, emphasised that moral purpose alone does not suffice for creating change, and that identity, capacity, resources and support are also crucial factors in effecting meaningful change. In exploring the main barriers to STEM education at an international level, Hasanah and Tsutaoka (2019) suggested that the main external barriers for schools arise due to inadequate and unsuitable positioning of facilities and equipment. Meanwhile, Hasanah and Tsutaoka, (2019), outlined institutional barriers relating to curriculum, policy, technology, and

organisational sustainability. Therefore, whilst transformational leadership has significance in promoting STEM implementation, factors that are often external to the principal's control e.g., resources available to them, are also required. Additionally, it is imperative to consider the effect that consultation with government agencies has on leaders with regards to their motivation to effect STEM implementation within their schools, in addition to principals' perceived value of STEM.

Principals have suggested that posts of responsibility are accessible to smaller schools, even in a shared-teacher capacity, to prevent exclusion of particular school cohorts from targeted leadership-development in the area of STEM. Coolahan et al., (2017) supported this idea, suggesting that the delineation of responsibility posts in schools in order to reach aspired Irish leadership quality aspirations.

7.3.2.2 Motivation: Consultation with Government Agencies

Consultation with government agencies. The empirical findings that demonstrate the positive impact that effective consultation with government agencies has on principal commitment to STEM, school implementation of STEM education, and adoption of STEM education are in line with previous studies which outline the effectiveness of consultation within organisational change and policy implementation (Brown & Cregan, 2008; Erchul & Martens, 2010; Harney et al., 2018).

Despite positive empirical findings around the effect that consultation with government agencies can have for STEM education, the qualitative data did not demonstrate that effective consultation was taking place between principals and government agencies. In fact, principals made references relating to a lack of consultation around policy creation and implementation. Furthermore, they expressed their disagreements with policies stemming from economic goals as opposed to being child centred. These findings are in line with key literature on Irish education policy. For instance, Leithwood et al., (2002) discussed the

negative motivation to implement policies, and other research highlights the issue of policy development arising from governments relying on high-stakes assessment e.g. PISA, with recommendations arising which promote changes which would otherwise be disregarded (Ball, 2016; Gorur, 2008). Additionally, the STEM Education Policy Statement 2017-2026 outlines that the Irish Government strive to make Ireland the best country in Europe in the area of STEM by 2026. (DES, 2017e). High policy implementation expectations such as these are changing the relationship between school leaders and the government (Codd, 2005). Thus, the position of trust between principals and the government has moved from one of integrity (Bottery, 2006) towards a climate of distrust (Sachs, 2006). It is crucial that effective consultation takes place between principals and government agencies to ensure that increasing policy expectations, stemming from international economic goals are relevant for students and achievable for schools.

Opportunities in STEM. Non-significant empirical consultation findings regarding school participation in STEM-related weeks are in line with the ‘*STEM Education Policy 2017-2026*’ document (DES, 2017d). For example, in relation to STEM weeks and events, this policy suggested that “*there is a recognition that many of these activities are dependent on enthusiastic individuals and dedicated teachers to drive the initiatives*” (DES, 2017d, p. 8). This statement indicates that consultation could take place at school level as opposed to between the government and principals in relation to such activities. Qualitative findings support this concept and demonstrate the enthusiasm that schools have for participating in STEM-related activities.

For instance, principals reported high levels of interest in STEM-related weeks, events, and structured award programmes, suggesting that these often are effective in generating high pupil interest in the subject areas of STEM. Many of these programmes are underpinned by theory and provide resources that are co-created by STEM experts and

educators. Examples specifically referenced by participants include RDS STEM Learning/ESB Science Blast Fairs, SFI Discover Primary Science and Maths (DPSM) awards, Science in a Box Programmes, Engineering Week, Maths Week and Science Week. Furthermore, participation in outreach showcasing events and school engagement with STEM experts is highly encouraged by government STEM policy documents (DES, 2017e; The Stem Education Review Group, 2016).

Whilst participation in such events is clearly seen as a positive with regards to STEM implementation, some principals expressed concern at the distance at which they had to travel to participate in STEM showcases and the costs incurred on schools as a result. The global COVID-19 pandemic has led to many showcasing events moving to an online platform. Whilst a face-to-face event is preferable, the addition and sustainment of an online platform for outreach programmes moving forward could make the showcasing of work to experts and other schools more accessible.

In addition to school participation in STEM weeks and events, the findings also demonstrated principals' positive perceptions of the concept of STEM. In particular, principals praised the practical nature of the subject, which is consistent with the aims of the Irish primary curriculum to provide experiential, hands-on learning, centred around the enquiry process (Murphy et al., 2012). Also, mirroring recommendations within the primary curriculum, principals highlighted the potential that STEM has for subject integration (DES, 1999). Other participants highlighted the added value of the arts, forming 'STEAM' education, a growing trend in STEM (Dejarnette, 2018), denoting creative and innovative components to the integrated subject area (Herro et al., 2017; Hunter-Doniger, 2018; Land, 2013). Whilst this study refers to 'STEM', for the purposes of uniformity with relevant Department of Education policy documents, it is positive that principals are aware of

developments in the area of STEM and the potential benefits that Arts can have in these disciplines.

Whilst the data in this research has demonstrated that principals value STEM education, it is important to factor in the opportunity that presents for them to work with specialist teachers in this area.

7.3.2.3 Principal Opportunity: Access to Specialist Teacher Instruction and Resources

Access to specialist teacher instruction. The empirical and thematic findings which indicate that access to specialist teacher instruction increases principal commitment to STEM, school implementation of STEM education, and school participation in STEM weeks are in line with previous studies that outline the importance and benefits of incorporating specialist teacher instruction in STEM education (Ejiwale, 2013; Goldhaber & Brewer, 1998; Mervis, 2011; Posamentier & Maeroff, 2011; Rosicka, 2016).

However, there are several reasons to explain the failure to find the expected significant relationship between access to specialist teacher instruction and principal intention to adopt STEM education. Further exploring the issue of leadership, one possible reason for this can be attributed to the fact that often, too much responsibility falls on the primary school principal (Hargreaves et al., 2007; Hargreaves & Fink, 2006), and therefore, they may be in a position to increase their practice of distributed leadership, delegating responsibility of the area of STEM to the individual or group of individuals who have particular expertise in that area. This is something that is evidenced by principals particularly in the qualitative data.

Additionally, the findings are consistent with distributed leadership being highly promoted internationally currently at primary level as a result of international policy changes (Hallinger & Kovačević, 2019; Wang, 2018; Wenner & Campbell, 2017). Furthermore, Hallinger and Kovačević (2019) outlined recent international policy changes that have seen

an international adoption of a distributed leadership approach (Wang, 2018; Wenner & Campbell, 2017). Consequently, the onerous role of the principal is being reflected on, with principals being equipped with the skills to delegate leadership duties (Coolahan et al., 2017). For instance, Ireland is following the lead of other European countries e.g., Finland and the UK (Department for Education, 2019; Kumpulainen, 2017). In fact, there is a national drive towards leadership and management preparation through training carried out by the Centre for School Leadership in Ireland (Murphy, 2019). Furthermore, in the LAOS policy document, shared leadership is strongly encouraged (DES, 2016a), therefore putting principals in the position to delegate responsibility to teaching and non-teaching staff who hold particular expertise and instead prioritise areas for development whereby they view that external professional development etc. might be required.

Whilst the empirical results demonstrate that having access to specialist teacher instruction does not increase principal intention to adopt STEM, the qualitative data highlights the perceived value that specialist instruction can contribute to school implementation of STEM. These positive findings support key policy documents relating to STEM Education in Ireland (DES, 2017e; The Stem Education Review Group, 2016), which advise schools to form partnerships with STEM expert stakeholders. There is also the concept of schools actively recruiting teachers who have additional specialist expertise in the area of STEM. Principals discussed the benefits of working with such people in addition to the challenges that they faced in recruiting suitably qualified individuals.

For example, the topics of initial teacher education and teacher confidence as hindering factors are prevalent in the findings. Research suggests that a minimal amount of preparation in STEM fields during initial teacher education can often lead to reduced confidence in teaching in this practical area (Goldhaber & Brewer, 1998; Posamentier & Maeroff, 2011). This is an area that is being addressed currently in initial teacher education

settings. For example, the Irish '*STInt: STEM Teacher Internship Programme*' (DCU & Growth Through Diversity, 2019), or other international varieties, which coordinate paid industry internships for Initial Teacher Education students, where they acquire specialist STEM skills, could offer a viable solution to the shortage of STEM expertise. For example, these programmes could create the provision of a pool of talented and enthusiastic STEM specialists with the appropriate educator skills for principals to hire from (CASTeL, 2021; DCU & Growth Through Diversity, 2019; DES, 2017b; National Research Council, 2011; Prinsley & Johnston, 2015; Wilhelm & Fisher, 2019).

Despite the opportunity that principals have to implement STEM education, they express time constraints as being a significant barrier in their ability to explore new initiatives in a meaningful way.

7.3.2.4 Challenges in STEM Implementation

Thematic analysis has identified time pressure as a major barrier in the implementation of STEM, with three specific areas of concern: overloaded curriculum, initiative overload, and increasing principal job demands.

Curriculum overload. The data here indicates that principals would welcome guidance on subject prioritisation. Despite their dissatisfaction with the current overloaded curriculum, participants value the potential that STEM has for subject integration, something that is strongly recommended across the current primary curriculum (DES, 1999a). These findings are in line with government aims to promote enhanced subject integration at primary level. For instance the NCCA new draft primary school curriculum reflects a change towards the integration of STEM disciplines Science, Technology and Maths (NCCA, 2020). As it stands this new primary school curriculum will focus on broad curricular areas, one of these being Mathematics, Science and Technology Education. In elaborating further on this subject area, the NCCA explained that exploration of this subject area will improve a child's ability

to comprehend and engage to the fullest of their potential with the world in which they are living. Whilst revising the curriculum is a step in the right direction, this will not solely address the issue of increasing job demands on the primary school principal.

Initiative overload and increasing principal job demands. The issue of ‘new initiatives’ or ‘initiative overload’ is still of significant concern to principals, with many commenting on the increasing focus on numeracy and literacy attainment, as putting too much pressure on the staff body. Moreover, the paperwork for new legislation landing on principals often without prior notice can be difficult to navigate, and is often completed after school hours, in principals’ own time. Key literature in the area of school leadership supports these findings, suggesting that the role of the principal is unattractive due to the high levels of accountability associated with it, and that the role is in need of restructuring (Coolahan et al., 2017, p. 184).

Resources. In line with international research on barriers to STEM education implementation (Hasanah & Tsutaoka, 2019), resources is a theme that was widely referenced by participants within the data of the STEM Education survey. Principals expressed their concerns around the tight school general budget that they have each year, suggesting that it would be advisable for the government to allocate specific STEM funds, with the purpose of permitting schools to access equipment, professional development and engagement with outreach STEM projects, amongst other endeavours. Several schools reported that their current prime means of acquiring STEM funds is through fundraising activities. Digital technologies, including devices and WiFi, pre-COVID-19 were deemed to be inadequate in servicing the school community, for reasons including their high costs and local provision infrastructure. Quinn et al., (2019), highlighted Ireland’s lack of progression in this area on an international scale, suggesting that Irish ICT policy was not sufficient, thus leaving students with varying school-dependent experiences of technology usage.

The issue of high pupil-teacher ratio is something that participants also felt was a factor impeding STEM education implementation. This finding is supported by other research studies in this area (Huffman et al., 2006; Yıldırım & Sevi, 2016), whereby space and volume of resources to serve a full class group is often a barrier to successful integration of STEM education. These are all issues that could be explored in revisions to current government STEM policy (DES, 2017e). Furthermore, principals expressed concern with regards to the accessibility of professional development provision, particularly from teachers in small and/or rural schools. Several initiatives have been established by government organisations to combat this issue. For example, the PDST have an established STEM team, who travel to individual schools to provide workshops tailored to the needs of the school community. Practices such as this one provide schools with a space in which educators can reflect on and discuss practice and pedagogy, and yield support to scaffold reflection-on-practice (Ralls et al., 2020; Schon, 2010).

Overall, the findings around the autonomous role of the principal, increasing job demands and lack of resources are synonymous with key literature in the area of Irish school leadership (Coolahan et al., 2017) and barriers to STEM education implementation (Ejiwale, 2013; Hasanah & Tsutaoka, 2019). The Irish government has acknowledged that there are challenges associated with STEM education implementation in the '*STEM Education Policy Statement 2017-2026*' (DES, 2017e). This research therefore provides important insights therefore for future STEM policy revisions. The COVID-19 pandemic magnified the findings from Study 1, which gave rise for further reflection on the concept of school leadership styles and government communication regarding principal job responsibilities.

In summary, school principals and their relationship with STEM education implementation has not been addressed in previous literature. The overall finding generated from this sample indicate that principals as transformational leaders benefit from effective

consultation with government agencies and access to specialist teacher instruction with regards to implementing and promoting STEM education.

7.3.3 Managing Education During Crisis

By investigating the role of transformational leadership during crisis and the underlying mechanisms in the relationships between transformational leadership with school performance and leader's work alienation, this study makes three contributions to literature on leadership and crisis management.

First, this study adds new insights for how leaders influence school performance and their own work alienation during the COVID-19 crisis. Existing research on leaders during crisis has been focusing on the competencies and skills required by leaders. For example, 15 crisis leadership competencies have been identified by Van Wart and Kapucu (2011) including self-confidence, willingness to assume responsibility, motivating and articulating vision and mission, communication skills, delegating, teambuilding, networking, partnering, and social skills among others. Other key leadership skills include leader efficacy (Hadley et al., 2011), meaning making to contextualise the crisis to other stakeholders (Backman & Rhinard, 2018; Boin et al., 2010; Boin & Hart, 2005; Broekema et al., 2017; Christianson et al., 2009), decision making (Blackman et al., 2017; Curnin et al., 2020; dos Santos et al., 2016; Haus et al., 2016; Kaschner, 2017; McNulty et al., 2018; Oroszi, 2018) and mobilizing resources (Kreps & Bosworth, 1993; Neal & Phillips, 1995; Shepherd & Williams, 2014). Though some research addresses leadership styles during crisis, the focus has been on which leadership style is more effective than others (Ballesteros et al., 2017; Boin et al., 2013). This research builds on these studies and moves beyond by investigating the indirect impact of how one leadership style - transformational leadership which captures the key competences and skills required by leaders during crisis, influences organisations and themselves during the crisis.

Drawing on a relational perspective, this study identifies two types of relational resources, i.e., employee trust and relational coordination, as the mediators between transformational leadership with school performance and leaders' work alienation. Relationship building based on high-quality communication and coordination has been found critical for crisis management (Barton, 1993; Liu *et al.*, 2020; Simpson *et al.*, 2013; Williams *et al.*, 2017). This study reveals that transformational leaders improve school performance by building good relationships with employees and other stakeholders via gaining employee trust and relational coordination. By finding the indirect impact of leadership on school performance and work alienation via relational resources, this study therefore, contributes to the leadership and crisis by adding new insights on how leaders could influence organisations.

Secondly, this study moves the existing research on leadership during crisis forward by not only focusing on the functional effectiveness of leadership but also focusing on the leaders' individual outcome - work alienation, which is related to leaders' feelings and experiences during the crisis. Existing studies on leadership in crisis management have been focusing on organisational and employees' outcomes. The organisational outcomes include school performance (Adamu *et al.*, 2016; Barton *et al.*, 2015; Maley, 2019; Malinen *et al.*, 2019; Montani *et al.*, 2019), imaging and reputation (Coombs & Holladay, 2012; Pang, 2012). Employee outcomes include employee performance (Adamu *et al.*, 2016; Maley, 2019; Malinen *et al.*, 2019; Montani *et al.*, 2019; Tokakis *et al.*, 2018), employee resilience (Abdelzaher *et al.*, 2018; Harms & Wood, 2016; Hartwig *et al.*, 2019; Kennedy *et al.*, 2016; Lahad *et al.*, 2018; Lester *et al.*, 2018; Tokakis *et al.*, 2018), and employee experience and voice (Birkeland *et al.*, 2017; Cheng *et al.*, 2019; Kapucu & Ustun, 2018; Kovoov-Misra & Gopalakrishnan, 2016; Selart *et al.*, 2013).

A missing piece from research which focuses on leadership during the crisis is the leaders' outcome. During the global lockdown, leaders are struggling with work-life imbalance like most people. They also need to take on extra responsibility for organisational management. How leaders are coping with the COVID-19 crisis and the job resources which could reduce their negative experience has not been well-studied. This study identified the important role that leaders' own transformational leadership in addition to the social resources that they have during the crisis have on work alienation – perceived psychological disconnection with people and work. Particularly, relational coordination with key stakeholders was found to decrease work alienation but employee trust did not for leaders during crisis. Though contradictory to the hypothesis, this finding is not surprising. Even with trust from employees, leaders may still feel isolated, powerless, and disconnected with people and work. This could be due to the leaders' personal characteristics (e.g., introverted personality). Another reason could be because of the impact of locking down, where leaders have no psychical interactions with people. In this situation, even perceiving the trust from employees, leaders could still feel powerless and isolated facing the global health crisis.

The finding of the negative impact of relational coordination with other stakeholders on leaders' work alienation is important. It reinforces the importance of communication and coordination during the COVID-19 crisis (Adamu et al., 2016; Bundy et al., 2017; Devitt, 2020; Foote, 2013; Fortunato et al., 2018; Payne et al., 2018; Stam et al., 2018). More importantly, it adds great value to our current understanding that only when leaders are well connected with other stakeholders via timely, frequent, accurate and problem-solving based communication, sharing the same goals and knowledge as well as showing mutual respect, leaders will be less alienated during the crisis. This study, thus, puts humanity back into leadership during the COVID-19 crisis taking their experience and individual outcome into consideration.

Lastly, the research sample of principals in primary schools as organisational leaders provides valuable insights for current crisis research context in two ways. First, this study enriches the research context in crisis management, which has been primarily focusing on business and for-profit organisations. Second, principals in primary schools are leaders similar to the chief officers in private organisations. They are also managers dealing with teams consisting of teaching and support staff. Existing research on leaders' crisis management has been focusing on the top leaders (see Mitroff, 1988; Mitroff and Pearson, 1993; Pearson and Sommer, 2011; Sapriel, 2003). The rationale for focusing on top management leaders is that the top leaders' effectively managing and leading crisis depends on the development of a shared, collective understanding and belief (Rentsch & Klimoski, 2001; Smith - Jentsch et al., 2001), and culture (Bhaduri, 2019; Bowers et al., 2017). How managers with direct responsibilities of managing people and teams deal with crisis management has not been addressed. The overall finding generated from this sample - when people are well connected, clearly communicated to and motivated, organisations will function well, survive and maybe thrive during the crisis, adds value to other contexts.

7.4 Implications for Practice

7.4.1 Research Informed Recommendations for Education Policy

Given the research sample of principals in schools managed by the government, this research has an impact on policy making and implementation support. First, in response to the positive findings from Study 1, Leadership in STEM education regarding leadership interaction with STEM specialists, the researcher organised a STEM education conference that was due to take place in April 2020. The aim of this conference was to provide principals with the opportunity to form collaborations with over 50 cost-free STEM experts from industry and university settings. The conference was also cost-free for principals and was

fully subscribed with over 200 principals registered. Government organisations including representatives from the PDST and INTO, representatives from IAPSE and HR. Educational researchers were also due to attend the conference to facilitate relationship building and focus-group discussions with participants and outreach providers. Due to the COVID-19 pandemic this conference had to be postponed. However, significant interest from principals and outreach providers to be supported to form partnerships with STEM stakeholders was clearly demonstrated. Given this interest, combined with recommendations from STEM policy suggesting school-outreach partnerships (DES, 2017e), and positive findings regarding school interaction with outreach STEM specialists from this research, the researcher recommends that the government host similar events in various locations across the country. The practice of bridging the gap and assisting relationship development between principals and STEM specialists could contribute to the successful achievement of key STEM policy recommendations from the '*STEM Education Policy Statement 2017-2026*' (DES, 2017e). Additionally, a report which includes the main findings from Study 1, Leadership in STEM Education will be compiled and disseminated to key STEM stakeholders including the DES, PDST, CSL, TC and IAPSE. Findings from this report may inform future STEM Education policy revisions and implementation support for principals.

Secondly, the dissertation finds that principals require financial and psychological resources. Specifically, the dissertation highlights how principals are feeling psychologically and the kind of support that is needed. For example, a detailed report from the Leadership during a Crisis study was provided to the Department of Education with a list of recommendations which includes an important focus on principals' psychological wellbeing (Fahy et al., 2020). Additionally, this report was then shared by the Irish Teaching Council on their website. Finally, a digital report webinar launch was held in conjunction with the director of the PDST and the president of the INTO. During this webinar, the findings of the

study were discussed and over 300 stakeholders including government representatives, HR professionals and principals were in attendance. Therefore, this research calls out to all organisations to extend their attention from employee wellbeing to their leaders' and managers' wellbeing, particularly in times of crisis and new initiative or policy implementation.

Finally, the timing for each of the two studies mirrored national and international events that were taking place in each of the subject areas. For example, Study 1, Leadership in STEM Education was designed and carried out following the release of the national '*STEM Education Policy Statement 2017-2026*' (DES, 2017e), and during the design stages of the new primary STEM curriculum (NCCA, 2020). Thus, it has the potential to influence how research on the implementation of this policy and new curriculum is approached. Similarly, the Leadership during a Crisis study was carried out during the first COVID-19 school closure, and its associated national report provided insights for researchers on the impact that the pandemic was having on school leaders. Additionally, the large sample size that was achieved in Study 2, Leadership during the COVID-19 Crisis, provided national insights in COVID-19 educational research, putting the study in a position to be comparable with practices in other European and international countries.

7.4.2 Implications for Principals

This research offers a number of implications for principals. First, it raises the importance of transformational leadership for leaders during crisis management and implementing new initiatives. Transformational leaders encourage and inspire employees to change and innovate during organisational transformations (Bass, 1985; Bass & Avolio, 1993; Bass & Riggio, 2006). As such organisations need to have them to cope with organisational changes including the current COVID-19 crisis and the ongoing issuing of directives on new initiatives. Therefore, training focusing on leadership development will

help organisations to improve leadership effectiveness. Particularly in the context of crisis, whilst many people view a crisis as a completely new conundrum, there are often patterns between major crises that have taken place in history. Likewise, organisations need to use this crisis as an opportunity to prepare leaders for potential future crises via building leaders' competencies and skills in transformational leadership.

Second, given the significant findings surrounding the important managerial role of the principal, it would be beneficial to provide teachers with leadership training and the opportunity to assume leadership in projects as a component of initial teacher education courses. Early experiences of the concept of leadership will help to prepare teachers to assume management positions and lead initiatives in their schools.

Third, this study reveals that effective relational coordination and employee trust can improve organisational outcomes. Therefore, it is recommended that principals host regular meetings with various groups of the school community to build strong relationships. Particularly, leaders and organisations need to initiate and build relational coordination with key stakeholders via timely, frequent, accurate and problem-solving based communication, shared goals, and mutual respect. Doing so helps organisations to function better and helps leaders to feel more connected with people and work.

7.4.3 Implications for School and Education Management Relationships

Both the Leadership in STEM Education, and the Leadership during COVID-19 studies raised serious concerns surrounding the increasing job demands that are being placed on Irish primary school principals, something which warrants significant attention, as it could impede on a principal's ability to carry out their role effectively (Bakker, 2020). This is an issue that could be addressed by increasing the capacity for distributed leadership within schools (i.e., establishing more posts of responsibility and providing teaching principals with additional substitute cover for administrative days). For example, this research demonstrates

that, despite the demands that principals face, they do have positive perceptions of STEM education and want to implement it in their schools. Therefore, with increased capacity for delegation of the responsibility of STEM implementation, a principal could lead others to inform the development of this subject area.

Additionally digital learning is an area that was perceived as being weak by international standards pre-COVID (Marcus-Quinn et al., 2019). Principals were then catapulted into a solely virtual working world with COVID-19 school closures in March, 2020 (Burke & Dempsey, 2020), and forced to adapt to this new way of working in a very short space of time. Despite the challenges associated with this, principals have reported an increase in their level of digital competency. Globalization has led to increased flexibility in work arrangements, often coined ‘New Ways of Working’(Baarne et al., 2010; ten Brummelhuis et al., 2012; Van Steenbergen et al., 2018), including: employees choosing when they work; where they work and being facilitated by information technology e.g. smartphones, email, video conferences etc. (Kelliher & Anderson, 2008; ten Brummelhuis et al., 2012). Junctions of this avenue might be worth exploring including providing training for principals in an environment that suits them e.g., via videoconference in the comfort of their office, rather than losing a large proportion of the school day travelling, or providing adequate staffing support, enabling principals to take days away from the school environment for re-cooperation, self-development or continuing professional development during this challenging time. Research in this area has shown that employees who are exposed to new ways of working are not unwell as often (Schaufeli et al., 2009), and excel more in their roles (Salanova et al., 2005).

It is recommended that adequate IT infrastructure and support needs to be put in place for principals to enable them to meet directives. This includes ensuring that adequate WiFi is available; equipping principals with devices, providing professional development and

resources in the areas of STEM, working digitally and communication and promoting specialist teacher engagement (industry and initial teacher education). It is also recommended that supplemental individualised support (e.g., SNA and/or learning support teacher) is provided for students with additional needs (economic and special educational needs), to further allow the principal to focus their efforts on managerial duties. Also recommended is an online learning platform and concrete STEM resources designed specifically for students with special educational needs (SEN).

Furthermore, principals have expressed a need for clear instructions on how to implement new initiatives and policies. Possible interventions here include: revitalising the DES communication and consultation system, and making more use of expertise from principals to enhance the effectiveness of this process. Involvement with networks is strongly encouraged to provide a platform for principals to share and exchange knowledge and information, as well as for staff members in schools. More explicit use of knowledge sharing and knowledge dissemination such as online conferences, seminars and workshops as a central activity need to be in place. The communities of practice are a necessity in order to enhance collective ability to adapt to changes; for example, through regular principal and staff surveys and focus groups.

Lastly, key stakeholders, i.e., principals and educational organisations (e.g., PDST, INTO, education centres etc.), were involved in both the designing of this research and the interpretation and discussion of the findings. This process has ensured that the research is relevant and applicable for practitioners. Therefore, it is suggested that in order to address the many challenges surrounding school leadership and policy implementation that government bodies foster strong collaboration between research and practitioners. It would be of significant benefit for government agencies to engage in research with principals as leaders of

their schools with regards to not just the designing, but also the prospective implementation of any new policies and initiatives.

7.5 Limitations and Future Research

Despite its theoretical contributions and strong implications for practitioners, this research is limited in several ways.

Given that the research is cross-sectional in nature, causality is a limitation. For example, this research focused on current school management practices to produce evidence which could inform change for future practices. In contrast, a longitudinal study would identify changes over time and provide insight into cause-and-effect relationships on leadership in STEM Education and Crisis Management. Generalizability is another limitation of this research. For example, due to time and funding restrictions this study is based on the Irish primary education context in Ireland only. The researcher suggests that to obtain international insights on leadership practices, that comparative studies could be run in other European countries.

The sample for this research was large enough but the response rate was relatively low. Steps to mitigate a low response rate in future could be to perhaps collaborate with other agencies to carry out the survey (e.g., INTO, Teaching Council, IPPN etc.). Additionally, the research relies on principals' perspectives. Therefore, it would be beneficial for future research to acquire ratings from multiple sources (i.e., teachers, students, parents, government agencies etc.), to add depth and make the findings more robust.

Regarding leadership, both Study 1 and Study 2 focused on transformational leadership which has been regarded as an effective leadership style to manage work, people, and organisations during change, school improvement and crisis (Anderson, 2017; Marks & Printy, 2003a; Nissinen, 2001). It is acknowledged that there are other effective leadership

styles for school leadership including: distributive (Thien, 2019) instructional (Hallinger, 2007), and hybrid leadership styles (Vann et al., 2014), and particularly for during crisis such as: directive leadership (Stoker et al., 2019) and charismatic leadership (Davis & Gardner, 2012). Given the focus of this dissertation was not to examine which leadership is more effective, only the impact of transformational leadership was investigated.

Additionally, Study 1, *Leadership in STEM Education* examined a model that contained a range of factors (e.g., access to specialist teacher instruction, consultation, participation in STEM weeks etc.) as part of the AMO framework. Whilst this study provides a general overview of a range of factors which have implications on principals' leadership in STEM education, further mixed-methods research is recommended on stand-alone studies for each of the factors (e.g., STEM leadership and specialist teacher instruction). This would provide deeper insight into each of the areas covered in this work.

With regards to specific limitations in Study 2, *Leadership during the COVID-19 Crisis*, only two relational resources were assessed, i.e., employee trust and relational coordination, in the link between transformational leadership with school performance and leaders' work alienation. Other resources such as human capital or employee adaptivity, and relational resources such as inter-organisational alliances and leaders' external network, may mediate the impact of leadership on school performance. In order to better understand how leaders influence organisations during the COVID-19 crisis, future research which investigates multiple leadership styles, and the mediating role of other relational resources is encouraged. Furthermore, Study 2 extends the current research focusing on organisational and employee outcomes towards leaders' work experience during the crisis, i.e., work alienation. Although work alienation overlaps with depersonalisation in the wellbeing literature (Garden, 1987; Maslach & Jackson, 1984; Schaufeli & Taris, 2005), work alienation cannot be regarded as an indicator of wellbeing but an enabler for wellbeing

(Chiaburu et al., 2014; Conway et al., 2018; Shantz et al., 2014, 2015). In order to better understand leaders' wellbeing during crisis management, future research should investigate leaders' wellbeing and illbeing and their antecedents.

Finally, Study 2, focuses on the COVID-19 pandemic as the overarching context. It is different from previous crises such as the economic crisis (e.g., financial recession), political interruptions (e.g., Brexit), and natural disasters. This is due to the scale and impact of COVID-19, which has turned the whole world upside down (Grint, 2020). Future research should empirically investigate whether the findings generated in this study can be applied to future crises, times of turbulence and uncertainty.

7.6 Chapter Summary

This chapter opened with a summary of the research aims and findings. Next, theoretical implications were discussed. Following this, implications for future practice were explored. Lastly, limitations and future research were discussed. The final chapter will provide a short, general conclusion to the research.

CHAPTER EIGHT

CONCLUSION

The concept of school leadership is increasing in importance internationally and as a result, principals are facing surmounting demands (i.e., leadership, admin, etc.). Consequently, the role of the principal is becoming increasingly more autonomous, particularly regarding the implementation of reforms and policies. Therefore, to fully understand the challenging and complex role of the principal, and how best to support them, this dissertation focused on primary school principals and explored the relationship that various factors have on leader wellbeing, school performance and implementation of new initiatives.

The research context is STEM education and crisis management, two areas that have been given significant consideration by government agencies in recent years. To date, research relating to school leaders has focused on school performance, however little research has been carried out on school leaders' implementation of specific policies and initiatives in relation to their communication with government agencies and their school communities. Therefore, this research investigated principals as transformational leaders, and their navigation of new initiatives and organisational change.

Drawing on AMO framework and relational coordination theory, this dissertation makes an original contribution to knowledge by answering the following research questions: (1) How do principals influence or promote STEM education? (2) How does principal leadership influence their own wellbeing, and their school's performance during the Covid-19 crisis? Results from two studies collectively revealed the importance of leadership, particularly, transformational leadership in promoting STEM education, managing principal wellbeing and school performance during the COVID-19 crisis.

Overall, despite its limitations, the research makes significant contributions to leadership education. Firstly, in Study 1, the research illustrates principals' ability as transformational leaders, motivation regarding their consultation with government agencies and opportunity to work with STEM specialists, in addition to other challenges associated with STEM implementation and promotion in their schools. Additionally, barriers to STEM implementation are identified including time pressure and lack of resources. As a result, it is suggested that future research should focus on developing a strong collaboration between academic researchers, government agencies and principals in order to investigate how best to mitigate such challenges and to work together on policy development and implementation.

Secondly, Study 2 illustrates how COVID-19 has completely transformed schools in terms of people, tasks, processes and management. For schools to survive during the pandemic and thrive post-COVID-19, leaders will continue to play a critical role. This study contributes to school communities by revealing the importance of relational resources during crisis management. This involves building employee trust and high-quality relationships with main stakeholders via relational coordination. These relational resources enable the functionality of leadership to lead organisations to navigate through the crisis by working and innovating their practices. Furthermore, they help leaders cope with the crisis by reducing their negative experiences such as isolation and powerlessness. Even when the COVID-19 pandemic is resolved and the world stabilizes, there will be future disruptions, turbulence and crises. Therefore, it is imperative that principals and schools be prepared. As such, this research argues that the insights gained through COVID-19 may also apply to forthcoming problems enabling leaders and organizations to better prepare for a future crisis.

Although progress is being made in the area of leadership preparation and development in Ireland it is evident that the field has much to overcome, particularly regarding research into continuing professional development, provision of wellbeing

initiatives, and policy creation and navigation for serving principals. Overall, this research offers a step toward understanding the complex role of the school principal, the important role they play in initiative implementation, and how best to support their endeavours whilst considering their wellbeing. To conclude, the following amalgamation of quotations from the research highlights the collective issue from the two studies of increasing principal job demands:

On-going stress levels for people in management positions continue to be the most common problem when you talk to other principals, this message seems to be overlooked/ignored.... There is no clear directive from the DES of what is expected of us in primary education except to introduce new initiatives without taking anything out! The workload on principals has increased to a level where it is not quantifiable. It is fine for many professionals to tell us that we need to mind ourselves and look after our own wellbeing which is all well and good. However, the other side of the coin (and the reality) is that we have things being thrown at us from all angles. Principals need directions, equipment and affirmation from the DES to support their endeavours (Principal Comments, Q6. Surveys 211; 224; 589; 682; 333)

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APPENDICES

APPENDIX A: ETHICAL APPROVAL

Approval Amy Fahy 13th August 2018

Inbox



Phdrsrch <PHDRSRCH@tcd.ie>

Mon, 13 Aug
2018, 10:13

to Amy, Colette

Approval Amy Fahy 13th August 2018

Dear Amy,

The School of Education's Ethics Committee received and reviewed the amendments to your application for approval of your research project entitled "Primary School Principals' Perceptions of STEM Education".

It is the decision of the Committee that you may now proceed with your research on the condition at it is carried out as indicated on your application. Should there be a change in the design of your research project, you will need to re-apply again for approval from the School of Education's Ethics Committee.

If you have any queries regarding this decision, please contact the Chair of the School of Education's Ethics Committee and Director of Research, Dr Ann Devitt (devittan@tcd.ie).

We wish you all the very best with your research project.

Kind regards,

Fiona McKibben
Research Officer at the School of Education
on behalf of Professor Ann Devitt
Director of Research

3088 School of Education Arts Building
Trinity College Dublin, the University of Dublin
Dublin 2, Ireland.
Tel | + 353 1 8963583

APPENDIX B: PRELIMINARY RESEARCH EXPLANATION

One of the exploratory interviews was carried out with a member of the National Principals' Representative Committee of the Irish National Teachers' Organisation (INTO). This participant was chosen as they are a practicing principal; very aware of relevant educational bodies' policies and they liaise with many principals on a regular basis. The interview helped to further develop the researcher's knowledge regarding the role the principal and the factors that facilitate and hinder the implementation STEM in schools. The interview centred around two areas: (i) The role of the principal and (ii) STEM education. It was recorded, transcribed, analysed and the findings were used in conjunction with the literature review to derive subject areas and structure for the survey.

This interview yielded valuable information regarding general everyday issues that principals have to face which potentially impact STEM implementation e.g., principal work-life balance/principal wellbeing, a lack of middle management posts, administrative duties, communication with educational bodies and a lack of professional development opportunities. Subsequent exploratory interviews with two additional members of the target community were carried out. These exploratory interviews specifically geared towards survey design were more pragmatic, with the purpose of defining core subject areas/sections in the survey structure.

The researcher attended the Irish National Teaching Council National Conference - Féilte as a presenter. This allowed for interaction with many principals and these discussions fed into the content/subject areas within the survey. Additionally, the researcher discussed the study at a principals' meeting in the Blackrock Education Centre with approximately 50 principals in attendance. A general discussion followed regarding existing STEM resources and outreach programmes that the principals made use of and resources/programmes that

they would like to see developed/made available. This information also contributed to the content of several survey questions.

Finally, the researcher participated in a STEM Stakeholders in Education round-table discussion including STEM lecturers, industry specialists, key funding parties, outreach project coordinators etc. The content of discussion fed into the RDS' (Royal Dublin Society's future STEM Learning Strategy). The researcher received input regarding two major additions to the survey: the concept of STEM integration and specialist teachers at primary level.

At all stages of the preliminary research process academics from the fields of STEM education, Leadership and Human Resources were consulted. The above exploratory study is critically important, not only for a better understanding of the Irish Primary education context, but also for creating a valid and suitable questionnaire for principals.

APPENDIX C: EXPLORATORY INTERVIEW QUESTIONS

Role of Principal

1. What would your definition of a principal be in the context of an Irish primary school?
2. What are the main reasons that you think motivate a teacher to take on the role of principal?
3. Could you please give me a short description of a variety of duties that the job entails?
4. Is there any managerial training that you are aware of that is specifically geared towards school principals?
5. What are the main benefits of a principal working alongside other figures of authority in the school (e.g., Board of Management, deputy principal, and teachers who hold roles of responsibility)?
6. Is there any team strengthening or communication training that is available for schools to strengthen these relationships?
7. What are the ways in which you feel principals are most supported by the Department of Education and Skills?
8. Are there any further supports that you feel would strengthen the national Department – Principal relationship?
9. What are the benefits of a principal being involved in a union?
10. To what extent to your knowledge are principals consulted in the establishment of key Department of Education policies?
11. In what way are new policies and circulars communicated to principals?
12. Is there any way that this process could be improved?
13. What CPD is available for principals (to your knowledge), and of that, which is compulsory and voluntary?

14. What are the factors influencing and impeding principals engaging in voluntary CPD?
15. Could you give examples of the kinds of CPD that you think would be beneficial for principals?
16. What do you think are the biggest influencing factors in principals' prioritizing of areas for whole school improvement?
17. How would you describe the perfect school in an ideal world?

STEM-Related Questions

1. What is your understanding of STEM?
2. Could you comment on your own experience of studying STEM-related subjects?
3. What significance does STEM have in your school and why?
4. In an ideal world, what would the ideal practice of STEM education in a school consist of?
5. What has been your incentive/motivation for implementing STEM education in the school?
6. Describe some of the jobs/tasks that the teachers carry out from week to week, term to term in relation to STEM education.
7. If hiring a teacher and you had to post a job opening, what key features would the job description entail? What would the interview process entail?
8. Describe the ideal STEM teacher candidate?
9. How do you imagine the future of STEM education in Ireland?
10. Are there any challenges that your school faces regarding STEM implementation?

APPENDIX D: COVER PAGE OF STEM EDUCATION SURVEY



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



Dear Principal,

Welcome to this major national study of STEM (Science, Technology, Engineering and Maths/Numeracy) Education in Irish Primary Schools, which is being conducted by a team of researchers based at Trinity College Dublin. It is supported by the RDS Science and Technology Programme and was recently presented to the Education and Principals' Committees of the [Irish National Teachers' Organisation \(INTO\)](#).

What is the purpose of the project?

The purpose of this study is to explore the relevance and current provision of STEM from the perspective of principals as leaders and managers of primary schools.

Why should I participate?

You will receive a full report with the overall findings such as the best practices in STEM education. You will be invited to attend workshops to share experiences with education and management professionals. The study will also benefit STEM education in Ireland, your profession and several doctoral students.

What are the questions about?

The questions relate to STEM activities in your school, your own views on and experience of STEM education and your role as principal of a primary school. We think that you will find this questionnaire both stimulating and interesting.

How long will it take?

The survey will take about 10 to 15 minutes to complete.

Who will read the results?

We assure you that this is a strictly confidential survey. Ethical approval has been granted for this project from Trinity College's Ethics Committee. Under no circumstances will your individual responses be made available to anyone in your school or other schools. Under no circumstances will your individual responses be made available to anyone. Data will be stored electronically and will be protected by secure passwords known only to the research team.

Who should I contact?

If you have any queries regarding the study, please do not hesitate to email me at fahyam@tcd.ie or contact me at the address below.

We would like to thank you in advance for your time and effort.

Yours faithfully,

Amy Fahy

On behalf of research team, Professors Colette Murphy & Na Fu
School of Education, Trinity College Dublin
Mobile Number: (+353) 83 307 6500
Email: fahyam@tcd.ie

APPENDIX E: COVER PAGE OF LEADERSHIP DURING THE COVID-19 CRISIS SURVEY



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Dear School Management Team,

We hope that you and your school community are safe and well at this time. Welcome to this major national study exploring 'School Leadership in Response to the COVID-19 Crisis'. The study is being conducted by a team of researchers based in the School of Education at Trinity College Dublin and was formed in response to concerns from teaching management professionals.

What is the purpose of the study?

The purpose of this study is to explore the leadership experiences in response to the COVID-19 pandemic. It seeks to provide information which will inform supports that school management teams may benefit from.

Why should I participate?

You will receive a full report with the overall findings such as the best practices in leadership and online learning. You will be invited to attend free online workshops with education and management professionals. Results of the study will be used to inform relevant agencies (e.g., DES, Teaching Council, Unions, Education Centres) etc., on how best to support school management teams moving forward.

We have worked in close collaboration with many principals in order to design and pilot the survey instrument. We understand that this is an extremely busy period for you, but we would like to stress that we have the best interests of school management teams in mind.

How long will it take?

The survey will take about **5 minutes** to complete.

Who will read the results?

We assure you that this is a strictly confidential survey. Under no circumstances will your individual responses be made available to anyone. Data will be stored electronically and will be protected by secure passwords known only to the research team.

Who should I contact?

If you have any queries regarding the study, please do not hesitate to email me at fahyam@tcd.ie. We would like to thank you in advance for your time and effort.

Yours faithfully,

Amy Fahy
On behalf of research team, Professors Colette Murphy & Na Fu
School of Education
Trinity College Dublin
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