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A Study on the Establishment of a Business Continuity Plan (BCP) for the Ministry of Education to Respond to Complex Disasters

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Abstract

Purpose: The purpose of this study is to present a method for establishing a scenario-based standard Business Continuity Plan (BCP) model to protect the core functions of educational institutions in complex disaster environments caused by climate change and digital transformation. **Research Method:** We designed a 7-step BCP standard process that reflects the specific characteristics of educational institutions by analyzing the ISO 22301 international standard and domestic and international disaster management guidelines. In addition, based on past disaster cases such as the Pohang earthquake, we constructed four core scenarios for natural, social, cyber, and health disasters to establish a Business Impact Analysis (BIA) and Recovery Time Objective (RTO). **Results:** By introducing an RTO grading system that prioritizes student safety and the right to learn, we have secured the capability to restore core operations within four hours, and through scenario-based response strategies, we have optimized resource allocation and strengthened organizational resilience against complex disasters. **Conclusion:** The BCP standard model proposed in this study can be utilized as a practical guideline to minimize gaps in educational administration and provide uninterrupted educational services even in the event of a disaster

Keywords : Business Continuity Plan (BCP), Complex disaster. Recovery Time Objective (RTO). Educational Institution Safety. Resilience.

JEL Classification Code : I21, H12, H84

1. Introduction[1]

1.1. Background and Necessity of the Study.

Recently, the threat of natural disasters such as typhoons, underpass flooding, and earthquakes caused by climate change is accelerating. At the same time, new types of

complex disasters, such as battery fires, large-scale power outages, cyber terrorism, and the spread of infectious diseases, are intensifying crisis situations across society and expanding the scope of their impact. Such disasters go beyond mere physical damage to threaten the functional safety of government and public institutions, acting as a serious impediment to the core functions of educational administrative agencies, such as education and research activities and the guarantee of the right to learn. Past crisis management systems have primarily focused on disaster recovery (DR) in preparation for physical disasters such as earthquakes or fires. However, in the modern environment of complex disasters, such as large-scale infectious diseases or cyber-attacks that cause human and functional paralysis without the direct destruction of facilities, existing systems are revealing their limitations in response. Therefore, it is essential to establish a Business Continuity Plan (BCP) that goes beyond simple recovery and secures it preventively. In particular, educational institutions bear important public responsibilities as a social safety net, such as protecting student safety, guaranteeing the right to learn, and providing meals and childcare. Therefore, it is urgent to establish a Business Continuity Plan (BCP) system that reflects the unique characteristics of educational institutions and is practically operational.

1.2. Purpose of the Study

The purpose of this study is to present a scenario-based standard BCP model capable of minimizing damage to educational institutions and ensuring the stable continuity of educational services even in various disaster and crisis situations. To this end, the study aims to systematically analyze the unique functions of educational administrative agencies to derive priorities for core tasks and to develop response strategies for each disaster type based on Business Impact Analysis (BIA) and Recovery Time Objectives (RTO). In particular, by designing a practical BCP framework based on specific scenarios such as natural disasters (flooding), social disasters (power outages), cyber disasters (ransomware), and health disasters (infectious diseases), this study seeks to contribute to strengthening the disaster response capabilities and organizational resilience of educational institutions.

1.3. Scope and Methodology of the Study

This study employs a combination of literature review, case analysis, and a scenario-based design methodology to propose a practical BCP model that reflects the unique characteristics of educational institutions. The specific methods and scope of the research are as follows: First, document and institutional analysis are conducted. A theoretical framework for establishing BCPs in educational institutions is derived by reviewing the ISO 22301 international standard, FEMA's Continuity of Operations Planning (COOP) guidelines, relevant domestic laws such as the Framework Act on Disaster and Safety Management, and prior research. Second, risk factors for the disruption of the Ministry of Education's core functions are identified through the analysis of recent complex disaster cases, such as the 2023 digital administrative network paralysis incident and the 2024 extreme heavy rainfall and ransomware attacks on the Academic Information Center. Third, the design of a scenario-based standard BCP model is proposed. A complex crisis scenario is established in which an environmental disaster (flooding) transitions into a social and technological disaster, and a customized BCP framework for the Ministry of Education is constructed that includes phased response and recovery strategies. The scope of the research is defined with the Ministry of Education as the central focus, while also considering the organic connectivity with the Offices of Education and school sites where educational services are provided.

2. Theoretical Background

2.1. Concept and Importance of Business Continuity Planning (BCP)

Business Continuity Planning (BCP) is a strategic management framework designed to protect an organization's core functions from interruption in the event of disasters, accidents, or crises, and to ensure rapid recovery within a target timeframe if interruption occurs. The international standard ISO 22301 defines this as a "Business Continuity Management System (BCMS)" and emphasizes an enterprise-wide approach that includes a series of measures, procedures, resources, and responsibility structures to be implemented before, during, and after a disaster. In today's complex disaster environment, the importance of BCP is emerging as it goes beyond simple IT system disaster recovery (DR) to protect human resources and the entirety of service functions. Particularly in public institutions, BCP is becoming increasingly important as a key means to protect the lives and safety of citizens, minimize social disruption, and maintain the reliability of national administrative services.

2.2. Specificity of Educational Institution BCP

The business continuity of educational institutions possesses unique characteristics that differentiate it from the preservation of economic interests in general administrative

agencies or corporations.

First, there is the public nature of guaranteeing the right to education. As education is a fundamental right guaranteed by the Constitution, uninterrupted educational services must be provided even in disaster situations; this is directly linked to students' future competitiveness and the management of national human resources. Second, there is the role of a social safety net. Since schools perform functions such as providing meals, childcare, and emergency shelters in addition to education, they serve as key hubs supporting the community's resilience during disasters. Third, there is the high interdependence of infrastructure. Educational administration is characterized by the close integration of large-scale information systems like NEIS, physical school facilities, and human resources such as school staff, which creates a unique situation where there is a high possibility of cascading functional paralysis in the event of a complex disaster.

2.3. Prior Research

To establish an effective BCP model for the Ministry of Education, major domestic and international standards and existing prior research were analyzed as follows. First, international standards (ISO 22301) and the U.S. FEMA's Functional Continuity Planning guidelines provide structural methodologies regarding Business Impact Analysis (BIA) and the setting of Recovery Time Objectives (RTO). Furthermore, prior research, such as education-specific guidelines (REMS, UNESCO), emphasizes the importance of establishing systems for transitioning to disaster-induced remote learning, ensuring flexibility in academic operational guidelines, and building emergency communication systems with students and parents. In particular, recent academic trends address 'cyber resilience' and 'organic integration of business processes' as core tasks to prevent the paralysis of ICT infrastructure from leading to the shutdown of the entire organization, in light of the deepening digital administrative environment. However, as the majority of prior research focuses on responding to single disasters, studies on 'complex crisis scenarios' where natural disasters escalate into technological and social paralysis remain insufficient. Therefore, based on the limitations of such prior research, this study aims to design a practical BCP framework tailored for the Ministry of Education by applying a scenario combining recently frequent environmental disasters and digital threats.

2.4. Status of the Ministry of Education's Business Continuity Plan (BCP) and Disaster Response Cases

2.4.1. Core Analysis of the Ministry of Education's BCP. Status of the Ministry of Education's Business Continuity Plan (BCP) and Disaster Response Cases.

The Ministry of Education's Business Continuity Plan aims to protect students and faculty and minimize gaps in academic operations by maintaining core educational administrative functions during crisis situations such as disasters, calamities, and infectious diseases. The main components and key analysis contents are as shown in Table 1.

Table 1: Analysis of Key Components of Educational Institution BCP

Division	Key Contents and Key Analysis
Core Objective	Maintaining the continuity of educational functions within the school and setting the guarantee of the constitutionally protected right to learn and student protection as the top priority.
Activation criteria	*Clear numerical criteria, such as the number of confirmed cases and the damage ratio. *Activated a phased response system (Alert → Warning → Emergency).
Organizational structure.	Reorganization of the emergency organizational structure. Operation of a situation control center for rapid decision-making through a committee and real-time situation management.
Core business.	Maintain core functions as a social safety net without interruption, such as designating the scope of essential classes and providing meals and care.
Response strategy.	Respond flexibly by applying scenarios specialized for the education sector, such as switching to non-face-to-face classes, depending on the disaster situation.

The Ministry of Education's BCP is not limited to mere system recovery but features a structure in which organizational decision-making, trigger indicators, and strategies are organically combined. It focuses on minimizing administrative gaps that may occur during a disaster and securing the resilience of the educational community.

2.4.2. Ministry of Education Emergency Response Organization Chart and Roles.

The Ministry of Education activates an emergency response organizational system headed by the Vice Minister to ensure rapid decision-making and the continuity of core operations in the event of a disaster or crisis. This involves reorganizing the normal organizational structure into a form optimized for disaster response, and the specific roles of each section and team are as shown in Table 2

Table 2: Ministry of Education BCP Emergency Response Organization and Key Tasks

Division	Manager	Main tasks C
Countermeasure Headquarters	Vice Minister (Director of Planning and Coordination Office)	Command of the emergency response organization and overall management of the control tower role.
Situation Management Team	Policy Planning Officer (Emergency Safety Officer)	Overall management of emergency organization operations and establishment of a plan for relocating to an alternative workspace.
Monitoring Team	Education Autonomy and Safety Policy Off	*Real-time monitoring of crisis situations and public/institutional outreach * Personnel mobilization and management of the situation before relocation to alternative spaces. Reporting.
Human Resources Team	Chief of Personnel Policy	* Establishment of plans for mobilizing essential personnel and securing replacements in case of absence * Management of personnel assembly and movement methods
Workspace Team	Head of Operations Support Division	*Securing alternative workspace and overall management of operations *Support for occupancy of alternative space and facility management
Work Environment Team	Digital Education Planning Officer	*Establishment of a work environment, including office equipment and consumables, within the alternative space *Preparation of work infrastructure through ICT infrastructure and communication technology support
Partner organizations.	Building Management Headquarters	*Request for cooperation from relevant agencies for the use of alternative spaces and assembly points

The organizational chart above focuses on business continuity. This organizational foundation serves as the driving force that enables the scenario-based BCP model presented in this study to function in reality, rather than remaining merely a plan.

2.4.3. Ministry of Education Data Recovery Components and System Diagram

In order to prevent the interruption of educational administrative services in the event of a disaster, the Ministry of Education operates a data recovery system as shown in Table 3 to ensure the integrity and availability of digital data as well as the physical work environment.

Table 3: Ministry of Education BCP Data Recovery Components

Item	Details
Target data	Academic. Personal Information. Education Data
Recovery Strategy	Periodic backup, cloud and central server redundancy
Recovery priority	Data directly linked to academic continuity
Target	RTO within 24h
Backup	Remote data center, real-time replication
System	Mirror site, Hot/Warm/Cold
procedure	BIA → Strategy → Training
group	Data Center, Person in Charge, Recovery Team
education	Regular DR training

2.4.4. Status by disaster type.

The implications derived from past cases serve as the basis for the design of the BCP model in this study.

Table 4: Analysis of Major Disaster Response Cases

Disaster Types	Major Cases (Year)	Key Response.	Implications and Limitations
Natural disasters	Pohang Earthquake (2017)	CSAT postponed by one week and test center changes	Certification of the importance of securing alternative worksheets and a rapid decision-making system in the event of facility destruction
Social disaster.	Gangwon Forest Fire (2019)	Utilization of school facilities as relief bases for disaster victims and psychological support for students	Emphasizing the role of schools as a community safety net
Technical disaster.	Digital Administrative Disruption (2023)	Switch to offline manual administration in case of national administrative network paralysis	Confirmed that in modern administration, which is highly dependent on IT, asystem paralysis leads directly to a complete shutdown of functions.
Infectious disease disaster	covid-19	Introduction of Nationwide Remote Learning	Highlighting the need to ensure the security of online administrative networks

Past disaster cases like the ones mentioned above suggest that Business Continuity Planning (BCP) for educational institutions must go beyond simple facility restoration and

require a flexible decision-making system tailored to the situation, as well as the securing of digital resilience. In particular, modern disasters are not limited to a single type but cause a chain reaction of functional paralysis. To overcome these past limitations, we propose a response model that combines ICT infrastructure with administrative processes.

3. Risk Analysis and BCP Model Design

3.1. Research Design and Methodology

3.1.1. Core principles of designs

The purpose of this design is to diagnose the current limitations of the operational structure and disaster response of educational institutions and to design a Business. Continuity Plan (BCP) model suitable for the educational environment based on international standards. To this end, the core design principles are data-based structuring, reflection of the specific characteristics of educational institutions, and model-based analysis. First, data-based structuring was conducted through analysis centered on highly reliable systems such as ISO 22301 and FEMA COOP. Second, reflection of educational institution specificities incorporated characteristics unique to educational institutions—such as the protection of students' right to learn, responsibility for psychological protection, fixed academic calendars, and high dependence on IT—into the model, differentiating them from general public institutions. Third, model-based analysis aimed for modeling research that structures analysis results, such as the Korean RTO model and BIA structure, rather than a simple summary of data.

3.1.2. Design Target and Analysis Scope

The scope of analysis in this study extends beyond simple physical facility management to prioritize securing 'educational continuity.' In particular, considering the differences in risk factors between elementary and secondary education and higher education (universities), the analysis framework was subdivided around two axes: the safety protection of younger age groups and the protection of university academic information assets. This serves as a foundational step to minimize administrative gaps during disasters and maximize the resilience of the educational field. Table 5 presents a systematic model defined in detail across five categories.

Table 5: Design Target and Scope

Detailed range	Main contents
Functional range	Education and Learning, Academic Affairs and Evaluation, Student Protection, IT Infrastructure Functions
Organizational scope	Elementary and secondary schools (student safety), universities (ICT dependency), Offices of Education, Ministry of Education
Disaster range.	Natural disasters, infectious diseases, cyberattacks, power and communications disruptions.
Data range	International standards, domestic policy manuals, actual disaster cases, 25 agency-specific BCP documents
Level of analysis	Institutional (national system), functional (impact mapping), and system (ICT resilience) levels.

3.2. Identification of risk factors and importance analysis

The identified risk factors have been reorganized to shift away from a focus on typical natural disasters of the past and place greater emphasis on technical and external service risks arising from the recent digital transformation of the educational environment. In particular, with the rapid increase in cloud-based learning management systems, there has been a growing need to manage the impact of external service interruptions on the educational field using quantified indicators. Accordingly, this model analyzes the correlation between each risk factor and core business functions to serve as a basis for determining response priorities.

Table 6: : Four major classifications of risk factors

Risk factors	Main contents
Human risk	Departure of key personnel, large-scale absenteeism due to infectious disease, operator negligence
Physical danger	Natural disasters such as fires, floods, and earthquakes, and power and HVAC system failures
Technical risks	Cyberattacks (ransomware, DDoS) database corruption. Network paralysis
External service risk	Cloud Service Outages and Supply Chain Disruptions

3.3. Educational Institution BCP Design Model

The concept of international standards was redefined, and recovery priorities were graded according to the importance of the Ministry of Education's tasks. Based on established data, risk factors were classified, and their importance was quantified.

3.3.1. RTO(Recovery Time Objective)

Model for Ensuring Business Continuity in the Ministry of Education.

To ensure cross-application between the core functions

and risk factors of domestic school systems, a four-level grading system was established. A scoring system ranging from 1 point (very low) to 5 points (very high) was defined to facilitate this cross-application, and this serves as the input value for BIA priorities and RTO grade assignments. The key factor in determining RTO grades is adherence to the "golden time." Grade 1 (within 4 hours) tasks include emergency contact and situation dissemination functions directly linked to the safety of students immediately after a disaster occurs; these are zero-downtime oriented operations that must not be interrupted under any circumstances. Conversely, Grade 3 and 4 tasks are classified as administrative services that can be managed for a certain period using alternative means (such as manual tasks), designed to enable the efficient allocation of limited recovery resources.

Table 7: RTO (Recovery Time Objective) model

Grade	Recovery Time Objective (RTO)	Target Core Business (Example)	Remarks
Grade 1	Immediate~4hours	Securing student safety, activating emergency contact networks, maintaining LMS access, situational broadcasting	Top priority recovery
Grade 2	Within 24 hours	Real-time remote classes, academic administration (attendance, etc.), and essential service management	Same-day recovery
Grade 3	Within 72 hours	School meal support, facility maintenance and repair, general civil complaint response	Short-term recovery
Grade 4	Within 5 days (1week)	General administrative office work, supplies procurement, non-essential educational event	Medium-term recovery

4. BCP Standard Model and Scenario Analysis

4.1. 7 Steps of the Educational Institution BCP Standard Model.

We designed and proposed a 7-step standard process optimized for educational institutions by analyzing risk factors, establishing design criteria, comparing RTO grades with case studies from the Ministry of Education and related organizations. This 7-step standard process aims for a virtuous cycle structure where Steps 1-3 are analysis and design, Steps 4-6 are implementation and communication, and Step 7 is maintenance. In particular, through the organic linkage between Step 2 (BIA) and Step 3 (Damage Minimization Strategy), we focused on verifying the operational feasibility of alternative infrastructure —such as actual remote education environments—going beyond the simple creation of recovery scenarios. Improvements identified through the final Step 7 maintenance process are then reflected back into the task identification process in Step 1, thereby completing a sustainable BCP model that flexibly responds to changing educational policies and technological environments.

Table 8: 7-Step Establishment Procedure

Grade	Process Name	Key Activities & Design Details
Step 1	Identifying work priorities	Identification of critical functions and designation of substitutes
Step 2	Business Impact Analysis (BIA)	Calculation of RTOs for each disaster scenario
Step 3	Damage Minimization Strategy	Establishment of flexible work and remote access environments
Step 4	Response and Recovery Measures	Activation of emergency organizations and execution of phased recovery
Step 5	Establishment and Implementation of BCP	Refinement of emergency contact networks and external coordination systems
Step 6	Information Sharing and Communication	Transparent decision-making among internal and external stakeholders
Step 7	Maintenance and Inspection	Verification of effectiveness and revision through simulation exercises

4.1.1. Model linkage system

Based on an established 7-step process, the BCP standard model prioritizes maintaining the core functions of educational institutions and protecting human and material assets in the event of a disaster. Going beyond a mere list of procedures, this model implements practical business continuity through a three-step linked process of 'Risk Assessment, Response Strategy, and Implementation Scenarios.' The system was structured as shown in Table 9 to ensure that data-driven quantitative assessments, rather than a simple list of procedures, lead to actual action guidelines.

Table 9: Linkage system

Category	Purpose	Key Points
Risk Assessment	Quantitative Risk Assessment. Standard Analysis.	Establish RTO/RPO standards, vulnerability-based assessment
Response Strategy	Ensuring Continuity and Risk Tolerance.	Secure emergency resources (power, backup, alternative locations) in advance
Implementation Scenario	Presentation of Specific Actions and Timelines.	Definition of roles, sequences, and responsibilities,

		implementation of recovery standards

This model designed and proposed a 7-step standard process optimized for educational institutions by comparing and analyzing cases of the Ministry of Education and related organizations with a3-step linkage of 'quantification-response strategy-execution scenario.' This 7-step standard process aims for a virtuous cycle structure in which steps 1-3 are analysis/design, steps 4-6 are execution / communication, and step 7 is maintenance.

4.2. Scenario-based BCP by Disaster Type

To enhance practical applicability in educational settings, four representative disaster scenarios were designed: natural disasters, social disasters, cyber disasters, and infectious disease disasters. Each scenario reflects vulnerabilities and success factors derived from actual cases (such as the Pohang earthquake and the fire at the National Information Resources Management Agency

4.2.1. Natural disaster - earthquake and damage to facilities (Pohang earthquake)

·Case: Strong vibrations occurred during class after arriving at school, resulting in classroom wall cracks and ceiling material detachment.

·Hazard Level: Very High (Aging building, high student density, possibility of aftershocks)

·Key Impacts: Student/staff injuries, isolation due to facility damage, psychological trauma

·Goal: Evacuate all students to the playground within 10 minutes of occurrence, initiate facility safety assessment within 24 hours.

·Strategy: Immediate evacuation (from under desks to the playground), preparation for aftershocks, situation dissemination, coordination with shelters for displaced persons, psychological support.

Table 10: Natural Disaster Execution Scenario

Time	Subject	Key Activities	Goal
T+0	All	Immediately upon receiving the disaster alert, evacuate to a desk, and protect your head.	Self-protection
T+2m	Teachers	Open doors (secure escape routes) and secure passageways. Confirm that shaking has stopped.	Securing passage
T+5m	Task Force	Use broadcasts or megaphones to guide students to the playground (or open space).	Safe evacuation
T+20m	Teachers	Check student headcount, identify injured students, and provide first aid	Verifying lives
T+30m	Command Team	Report the situation to the fire department and the Office of Education and conduct an initial exterior inspection of the facility.	Cooperation with relevant agencies
T+1h	School Principal	Decide whether to send students home or move to a temporary shelter in preparation for aftershocks.	Prevention of additional damage

Table 11: Natural Disaster Recovery Scenario

Time	Subject	Key Activities	Goal
D+1	Specialized Agency	Detailed safety assessment by structural safety experts (availability)	Building safety verification
D+2	Administration/Facilities	Repair of damaged facilities, installation of barriers in hazardous areas	Prevention of secondary accidents
D+3	Office of Education/School	Transition to remote learning or securing temporary teachers, resumption of in-person classes	Guarantee of the right to learn
D+3	Counseling Team	Psychological care and counseling for PTSD among students and staff	Emotional recovery

4.2.2. Social Disaster - Power Supply Failure at Ministry of Education Building

· Case: Power supply interruption due to cable defect at Ministry of Education building substation

·Risk Level: High (Flooding in low-lying areas surrounding the building; flooding of school routes and delayed evacuation)

·Key Impacts: Student safety, disruption of school commutes, delayed evacuation

·Goal: Safety of all students within 1 hour; securing alternative routes

·Strategy: Transition to remote learning, dual communication system (mobile), and deployment of flood barriers

Table 12: Social Disaster Execution Scenario

Time	Subject	Key Activities	Goal
T+0~10	Safety Manager	Broadcast announcement, assembly at shelters, school route blockage	Advancement
T+0	BCP Team	Verification of manual operation of emergency generators. Real-time sharing of student safety	Situation Dissemination

		information.	
T+10~30	Operations Team	Switching to NEIS Cloud backup. Sending remote guidelines to the Office of Education. Notification of alternative school routes. Informational text messages.	Situation Dissemination
T+10~30	Facilities Team	Emergency. generator fuel inspection. Partial supply test. Deployment of Office of Education vehicles to standby on flooded school routes.	Containment of Spread
T+30~60	Command Team	KEPCO. Recovery procedures. Inspection and replacement.	External Interconnection
T+30~60	BCP Team	NEIS Cloud full backup test. Update of alternative school routes. Contact with parents.	Call for Casualties

Table 13: Social Disaster Recovery Scenario

Time	Subject	Key Activities	Goal
T+45~60	Recovery Team	Power supply restored · Server full operation check completed	Cancellation Resumption
T+45~60	Safety Team	Evacuated occupants' safety confirmed. Removal of flood debris. Notification of restoration to schools.	Securing Safety
T+60	School/ Education Office	System restored to normal. Safety report submitted. Cloud full backup	Reinforced Return Casualties

4.2.3. Cyber Disaster - Ransomware Attack

·Case: Ransomware Attack on Ministry of Education System

·Risk Level: High (Malware distribution. Attack on major systems. Attempted to paralyze critical national systems).

·Key Impact: Student safety, academic support. Data loss

·Goal: Immediate transition to DR Center (within 4 hours)

·Strategy: Block attack IP, forensic analysis. Immediate suspension of exams. Immediate emergency system notification

Table 14: Cyber Disaster Execution Scenario

Time	Subject	Key Activities	Goal
T+1	Information Security Team	NEIS Subnet Blocking. Backup Verification.	Isolation complete
T+15~60	Situation Room	BIA Execution. Cloud Backup Verification.	1 hour
T+1~4h	IT Operations Team + HR Team	Cloud Failover, Remote Full time	4 hours
T+4h~24h	External Security Experts + Information Security Team	Ransomware Analysis. Backup Restoration	24 hours
T+24h	Executive Team + Training Team	Vulnerability Patching. Training	n/v

Table 15: Cyber Disaster Recovery Scenario

Time	Subject	Key Activities	Goal
T+4h~12h	Information Security Team + IT Operations Team	Backup data integrity verification / Clean server isolation restore / NEIS cloud normalization test	100% Data Integrity
T+12h~24h	External Security Experts	Attempt to decrypt encrypted files / Test restore after patching / Progressive recovery of academic management functions	Achieve TEO within 24 Hours
T+24h~48h	IT Operations Team + NEIS Team	On-premise full restoration / Full NEIS function recovery / User reconnection test	90% Business Continuity

4.2.4. Infectious disease disaster - Avian influenza cluster infection Disaster - Ransomware Attack

·Case: 30% of Ministry of Education staff infected

·Risk Level: High (Spread of airborne virus, building closure and attempted academic suspension)

·Key Impact: Student safety, classes, livelihood support, personnel loss

·Goal: Transition to a remote workforce pool (within 4 hours)

·Strategy: Isolation of confirmed cases. Building closure. Transition to non-face-to-face NEIS. Immediate notification via emergency notice system:

Table 16: Infectious Disease Execution Scenario

Time	Subject	Key Activities	Goal
T+0~1h	Situation Room	Report of confirmed cases / Building closure order / Directive for remote work	Confirm Block

		transition	
T+4h~12h	HR Team	30% staff depletion / Transition to full-time remote work / Request for personnel from other education offices	RTO 4 hours
T+12h~24h	IT Student Safety Team	Activation of NEIS non-face-to-face classes and grade processing / Student safety emergency contact	Maintain 80% of operations
T+24h~48h	Emergency Response Committee	Deployment of substitute personnel completed / Establishment of building disinfection plan	Ensure Continuity

Table 17: Infectious Disaster Recovery Scenario

Time	Subject	Key Activities	Goal
D+4~7	IT Operations Team	Screening of negative cases / Return to work / Disinfection. Firefighting completed / NEIS pool restoration	50% Return to Office
D+7~14	HR. Academic Affairs Team	Return to normal operations after confirmed cases recover / BIA re-evaluation	100% Restoration of Operations
D+14	Management	Post-training results POCA / Bi-annual scenario training plan / BCP update	Prevention of Recurrence

4.3. Scenario BCP Effect Analysis

When applying the BCP model based on the four major disaster scenarios designed in this study, the expected effects were analyzed by comparing them with the existing system, and the following specific results were derived.

4.3.1. Improvement of recovery speed and execution capability based on quantitative indicators

Unlike the existing comprehensive response method, the recovery time was quantified by applying the RTO grading system (Table 7). First, the natural loss of initial response time was eliminated by specifying Grade 1 core tasks, such as student safety and emergency contact, to be completed within 4 hours of the disaster. Second, through an indicator-based response, Functional Impact Analysis (BIA) data using a scoring system from 1 to 5 points was executed immediately, excluding subjective judgment in disaster situations.

4.3.2. Optimization of resource allocation strategies and minimization of administrative gaps

Resources are always limited during a disaster. This model prevents bottlenecks where the entire system becomes paralyzed by attempting to restore all functions simultaneously. First, it protects the core of educational services by prioritizing the allocation of resources, such as emergency generators, alternative workspaces, and essential personnel, to Grade 1 and 2 tasks (student safety, real-time remote learning). Administrative tasks of Grade 3 and 4, which have relatively lower urgency (facility maintenance, general civil complaints), are classified as medium-term recovery (within 72 hours to 5 days) to efficiently maintain business continuity

4.3.3. Strengthening complex disaster response capabilities and resilience through an integrated system

Modern disasters cause a chain reaction of functional paralysis rather than a single event. We provide comprehensive response capabilities to prepare for this domino effect. First, we have established a scenario-based linkage system, such as immediately coordinating with a transition to remote learning in the event of facility damage caused by natural disasters (earthquakes). Second, through a three-stage linkage process of 'risk assessment, response strategy, and implementation scenario,' we have strengthened organizational resilience by enabling the integrated recovery of human resources and ICT infrastructure, going beyond simple facility restoration.

5. Conclusion

This study designed a scenario-based standard Business Continuity Plan (BCP) model to strengthen the complex disaster response capabilities of educational institutions in response to climate change and the acceleration of digital transformation. The key research findings and conclusions are as follows:

(1) Establishment of an Education-Specific BCP Framework: By analyzing the ISO 22301 international standard and domestic and international disaster management guidelines, a customized 7-step process for educational institutions was proposed, prioritizing "guaranteeing the right to learn" and "student safety" as the highest values.

(2) Setting of Quantitative Recovery Objectives (RTOs): By analyzing educational administrative tasks, a systematized RTO model was established, ranging from Level 1 tasks (restoration within 4 hours), which are directly linked to student safety and emergency notification, to Level 4 tasks, which involve general administration.

(3) Presentation of Practical Complex Crisis Scenarios: Through four major disaster scenarios—earthquakes, power outages, ransomware, and infectious diseases—response

strategies were concretized that go beyond simple facility restoration to ensure the organic operation of human resources and ICT infrastructure. This study confirmed that the model presented can serve as a practical guideline for minimizing gaps in educational administration during disasters and securing the resilience of the educational community.

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