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Administrative Strategies to Develop Innovators Among Secondary Science Teachers at Saint Gabriel's Foundation, Thailand

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Abstract

The purposes of the research Administrative Strategies to Develop Innovators Among Secondary Science Teachers at Saint Gabriel's Foundation, Thailand were to 1) create administrative strategies, 2) validate suitability and feasibility of administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand. In this research, a mixed method was applied. The data has been gathered from 11 secondary school directors, 110 staff at the management level and 149 secondary science teachers at Saint Gabriel's Foundation, Thailand in the academic year 2020; there were 270 personnel in total. The tools used to collect the data were questionnaires, interview forms, and focus group forms. The quantitative data was analyzed by using percentage, frequency, mean and standard deviation, whereas content analysis was used to analyze qualitative data.

The results of administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand consisted of vision, missions, goals, share values and 4 master strategies, 13 minor strategies, 28 measures, and 24 indicators. The master strategies were Strategies 1: Encourage and enhance science teachers to be innovation teachers containing 4 minor strategies, 10 measures, and 10 indicators, Strategies 2: Improve quality of science learning management to create innovation consisting of 3 minor strategies, 6 measures, and 4 indicators, Strategy 3: Create cooperative network for creative innovations containing 3 minor strategies, 7 measures, and 5 indicators, and Strategy 4: Effective management of innovative teachers comprising 3 minor strategies, 5 measures, and 5 indicators. Furthermore, the overview result of accuracy and feasibility validation of administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand was in high average.

Keywords: Administrative strategies, Innovators, Science teachers, Saint gabriel's foundation

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Introduction

Thai society is transforming to knowledge and innovation-based society. Urgently necessary development of competitiveness, chain enhancement, value of agricultural products, value of industries, and services are mentioned in the furtherance of Thailand 4.0 policy (NESDC, 2016) which goes along with the Twelfth National Economic and Social Development Plan (2017-2021) in order to apply science, technology and innovation knowledge which is still performed less in the present. Lack of the forementioned knowledge causes low agricultural, industrial, and service production bases along with the major quality problems which are quality of people, quality of education, and quality of public service and public health service. High inequality leading to cleavages still exists in Thai society. One of main development issues in the period of the Twelfth Plan is innovation development. Innovation is used to drive the progress in all dimensions to enhance country's potential focusing on creativity and innovation development leading to innovation which contains high economic value in both production processes and models of new products or services. The issue about innovation development is also pointed out in the National Scheme of Education (2017-2036). (Office of the Education Council, 2017) It is the scheme for all organizations involved in education to apply as a guideline to develop Thai education. The scheme covers the development of education and learners of all ages; moreover, its purpose is to provide opportunities and equity in education, educational quality and standard, education aiming for employment and creating new careers under the Wisdom-Base Society, Lifelong Learning Society, and Supportive Learning Environment along with the vision "All Thai are provided quality education and life-long learning so that they live happily in the line with the Philosophy of Sufficiency Economy and changes in the 21st century world." Teachers are professional personnel whose major duties are teaching and supporting students' learning in various methods in both private and public educational institutions according to the National Education Act of 1999. (Office of the Education Council, 2013) The progression of technology changes learning style and the pursuit of knowledge from teacher-centered approach which teachers transfer knowledge to students to student-centered approach which students are able to learn by themselves. Therefore, it is necessary for teachers to upskill in accordance with the changes. (Dechakhup & Khangkhan, 2008) The education results report of conditions of teacher production and teacher development in Thailand in accordance with the study of countries which PISA scores are high shown one important feature of teacher development which is the competency building for teaching and learning in the 21st century and cooperative learning of teachers. (Office of the Education Council, 2015) It is inevitable for teachers to attempt new teaching style and assessment to produce knowledgeable citizens with skills for the 21st century. (Chiengkul, 2016) However, education system and personnel development in science and technology are still weaknesses since research and development personnel are inadequate for the enhancement of science, technology, research, and innovation into the advanced level. The proportion of the research and development personnel is low comparing to the number of the personnel in developed countries causing disadvantages of Thailand to develop economy and society in diverse dimensions. (Office of the Education Council, 2017) To improve quality and standard of the production of teachers, professors, and educational personnel according to the National Scheme of Education (2017-2036) (Office of the Education Council, 2017), it is discussed to proceed as the following (1) establish a mechanism for setting up policies and plans for teacher production and development to coordinate, manage, follow up, evaluate the results, and develop teachers leading to suggestions of budget allocation and resource mobilization to support research and development of innovation production, teachers, professors,

and educational personnel to enhance country development which is correspond with 20-Year National Strategy (2017-2036) and Thailand 4.0 strategy (2) design a system and model of the production of teachers, professors, and educational personnel which goes along with the policy. The system is developed with the cooperation of network of institutions producing teachers to recruit good and talented people who have faith in the profession to become teachers. (3) encourage, support, and advance institutions producing teachers, professors, and educational personnel, and develop institutions which are teaching operation units to achieve their highest quality and standards in fields of expertise. Panich (2012) stated that learning in the 21st century is changing, and teachers are necessary to enhance potential and upskill of the profession. Teachers are demanded to transform themselves to be "teachers for students in the 21st century". In the similar way as Sinlarat (2016) he presented the idea of education 4.0 consisting of the production and development of learners which learners have opportunities to create new products expressing new idea and system called "innovation". To create learners with ability to build innovation, teacher and student development is essential. The ability to analyze, synthesize, interpret, and the ability of doing are nor lonely mentioned, but the ability of building products is also focused. Education 4.0 is aiming for creativity and the transforming the creativity into products. The standards of national education in 2018 (Office of the Education Council, 2019) was stated that learners are required to be an innovative co-creator who have intellectual skills, 21st century skills, digital intelligence, creative skills, cross-cultural understanding, crossdisciplinarity, and entrepreneurship in order to create and develop innovations of technology and society aiming for creating opportunity and value for themselves and society. Therefore, to develop teachers to have the ability to build learners to be innovators, they are required skills, knowledge, understanding of innovation process, essential skills for building innovation, and being innovators. According to the assessment of strategic plan of Saint Gabriel's Foundation, Thailand (2010-2015), the problem which needed urgent improvement was unsystematic and unclear resource management. The results of national standardized tests of some schools were low comparing to preeminent private and public schools in Thailand. Furthermore, students who studied in schools under the auspices of Saint Gabriel's Foundation, Thailand had low critical thinking skills. The establishment of innovation of education was in low rate including lack of innovation, research, and knowledge exchange in school and among schools under the auspices of Saint Gabriel's Foundation. These problems were direct responsible of administrators and teachers, and the development of teachers was urgently necessary.

Strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand are aware of the management of human resource development policies and plans, the development of courses, teaching management, and teaching advisory. The study of document and involved research found that educational research about the development of innovators among secondary science teachers were rare and the strategies and development guidelines were unclear defined. Hence, the study and development of school management strategy to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand are crucial; research results are valuable for teacher development leading to quality of students which goes along with the national education reform policy. Moreover, it will be an administrative guideline for schools providing fundamental education to enhance quality and to achieve the maximum benefit in the future.

Research Objectives

1. To create administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand.

2. To validate suitability and feasibility of the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand.

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Methodology

In this research, the mixed method which consisting of quantitative and qualitative research methods was applied. The methodologies of the research Administrative Strategies to Develop Innovators Among Secondary Science Teachers at Saint Gabriel's Foundation, Thailand were divided into 3 phases:

Phase 1: Qualitative data collection which the information of current and desirable conditions of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand was collected from 11 secondary school directors, 110 staff at the management level and 149 secondary science teachers at Saint Gabriel's Foundation, Thailand in the academic year 2020; there were 270 personnel in total. Study variables are current and desirable conditions of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand. Instrument used for data collection is a questionnaire of current and desirable conditions of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand. The values of construct, the questionnaire was checked by 5 experts. It found that Index of Item-Objective Congruence (IOC) of all items was above 0.600. Therefore, the questionnaire was appropriate to use. The Cronbach's alpha statistic for reliability analysis was proved for the questionnaire with the result 0f 0.970 in current condition and 0.980 in desirable condition. This indicated that there was acceptable reliability. The analysis of current and desirable conditions of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand was applied to a package program to find average, Standard Deviation (SD.)

Phase 2: Quantitative data collection collected from the focus group discussion among the academic experts, stakeholders, and researchers to draft administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand. Informants are 7 academic experts and stakeholders comprising an educational department committee of Saint Gabriel's Foundation, Thailand or the representatives of directors or deputy directors of schools under the auspices of Saint Gabriel's Foundation, Thailand, co-executives of the academic affairs and office of the director (Human resource), university professors of educational and learning management with the academic position, higher than or equal to Assistant Professor. The focus group discussion was arranged to draft administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, and the informants participated and discussed in the group. A study variable was an administrative strategy draft to develop innovators among secondary science teachers at Saint Gabriel's Foundation.

Instruments used for data collection are a dissertation proposal, SWOT analysis results, and an administrative strategy draft to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand.

Phase 3: The qualitative data collection used to study the suitability and feasibility of the strategy implement. The validation form of suitability and feasibility of the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand was applied in this phrase, and the information was used to adjust strategies to a complete edition. Informants are 29 academic experts and stakeholders consisting of academic experts of educational department committee of Saint Gabriel's

Foundation, Thailand or the representatives of directors or deputy directors of schools under the auspices of Saint Gabriel's Foundation, Thailand, heads of science departments of schools under the auspices of Saint Gabriel's Foundation, Thailand, heads of planning and policy of schools under the auspices of Saint Gabriel's Foundation, Thailand, a university professor of science learning management with the academic position, higher than or equal to Assistant Professor, an academic expert of educational management who are proficient in strategic planning, and an innovative academic expert. Study variables are the suitability and feasibility of the administrative strategy draft to develop the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand.

Instrument used for data collection is the suitability and feasibility validation form of the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand. The analysis of the validation form of suitability and feasibility of the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand was statistical analysis, such as mean, Standard Deviation (SD.). In addition, the analysis of opinions and additional recommendations on the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand was the content analysis.

Results

The results of research Administrative Strategies to Develop Innovators Among Secondary Science Teachers at Saint Gabriel's Foundation, Thailand were analyzed, and presented the analysis in form of tables and description divided into 3 parts:

Part 1: Results of the study of current and desirable conditions of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand

Table 1 The results of the internal and external environment analysis of current and desirable conditions and overview needs of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand (Kaewyongphang et al., 2021)

	The environment of schools under the auspices of Saint Gabriel's Foundation, Thailand	Current conditions		Desirable conditions		Needs		Environment analysis
		$\bar{x}$	S.D.	$\bar{x}$	S.D.	PNI modified	Group	
Internal	1. Strategies	3.69	0.61	4.46	0.47	0.207	Low	Strength
	2. Structure	3.63	0.66	4.46	0.49	0.229	High	Weakness
	3. System	3.67	0.65	4.50	0.51	0.226	High	Weakness
	4. Styles	3.90	0.63	4.59	0.47	0.178	Low	Strength
	5. Staff	3.64	0.65	4.51	0.52	0.240	High	Weakness
	6. Skills	3.71	0.55	4.58	0.45	0.235	High	Weakness
	7. Share values	3.84	0.60	4.61	0.46	0.200	Low	Strength
	Average on all sides	**3.73**	**0.52**	**4.53**	**0.41**	**0.216**		
External	1. Social conditions	3.62	0.63	4.48	0.50	0.236	High	Threat
	2. Technology conditions	4.06	0.58	4.61	0.46	0.136	Low	Opportunity
	3. Economic conditions	3.55	0.61	4.32	0.54	0.219	High	Threat
	4. Politic conditions	3.61	0.65	4.44	0.58	0.227	High	Threat
	Average on all sides	**3.71**	**0.49**	**4.46**	**0.43**	**0.204**		

From Table 1: the internal environment analysis of current and desirable conditions and overview needs of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand shows that the overview of current conditions is in high average group. ($\bar{x}$= 3.73, S.D. = 0.52) The consideration of each aspect found that the internal environment of styles has the highest average categorized in a high average group ($\bar{x}$= 3.90, S.D.= 0.63). On the contrary, the internal environment of structure which has the lowest average among the 7 aspects still categorized in a high average group ($\bar{x}$= 3.63, S.D. = 0.66). Besides, the overview of desirable conditions has the highest average ($\bar{x}$= 4.53, S.D. = 0.41) and the consideration of each aspect found that the internal environment of share values has the highest average which is in a high average group ($\bar{x}$= 4.61, S.D. = 0.46). The internal environment of structure which its average is the lowest among 7 aspects also counted in a high average group ($\bar{x}$= 4.46, S.D. = 0.49). The analysis of needs found that the highest $PNI_{modified}$ is 0.240 and the lowest $PNI_{modified}$ is 0.178. Hence, the high group of $PNI_{modified}$ (Weakness) has the $PNI_{modified}$ between 0.210 to 0.240 and the group with low $PNI_{modified}$ (Strength) has the $PNI_{modified}$ between 0.178 to 0.209. The internal environment categorized into groups of low $PNI_{modified}$ or Strengths are the internal environment of Strategies, Styles, Share values. In contrast, the groups of high $PNI_{modified}$ or Weaknesses consist of the internal environment of Structure, System, Staff, and Skills. The results of external environment analysis of current conditions of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand has the average in a high average group ($\bar{x}$ = 3.71, S.D. = 0.49). The consideration of the external environment spotted that technology conditions have the highest average and their average are categorized in a high average group ($\bar{x}$ = 4.06, S.D. = 0.58) followed by social conditions ($\bar{x}$ = 3.62, S.D. = 0.63). In contrast, economic conditions have the lowest average, but are still categorized in a high average group ($\bar{x}$ = 3.55, S.D. = 0.61). Furthermore, the desirable conditions have their average in the high average group ($\bar{x}$ = 4.46, S.D. = 0.43). Additionally, the consideration of the external environment found that Technology conditions have the highest average categorized in the highest average group ($\bar{x}$ = 4.48, S.D. = 0.50). Economic conditions have the lowest average among 4 external environments, but their average is in a high average group ($\bar{x}$ = 4.32, S.D. = 0.54). The analysis of needs found that the highest $PNI_{modified}$ is 0.236 and the lowest $PNI_{modified}$ is 0.136. It is divided into 2 groups which are the high $PNI_{modified}$ group (Threats) - the $PNI_{modified}$ between 0.187 to 0.236 - and the low $PNI_{modified}$ group (Opportunities) - the $PNI_{modified}$ between 0.136 to 0.186. Thus, Technology conditions are categorized in the low $PNI_{modified}$ group considered as Opportunities, and the high $PNI_{modified}$ group considered as Threats consists of Social conditions, Political conditions, and Economy conditions.

Part 2: The results of administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand consisted of vision, missions, goals, share values and 4 master strategies, 13 minor strategies, 28 measures, and 24 indicators. The master strategies were Strategies 1: Encourage and enhance science teachers to be innovation teachers containing 4 minor strategies, 10 measures, and 10 indicators, Strategies 2: Improve quality of science learning management to create innovation consisting of 3 minor strategies, 6 measures, and 4 indicators, Strategy 3: Create cooperative network for creative innovations containing 3 minor strategies, 7 measures, and 5 indicators, and Strategy 4: Effective management of innovative teachers comprising 3 minor strategies, 5 measures, and 5 indicators which the details are presented below.

Vision:

Secondary science teachers are innovators and be able to create innovations to develop students' quality to be the cooperative innovation creators.

Missions:

1. Develop innovators among secondary science teachers.
2. Promote science teachers to develop innovations for students to cooperatively create innovations.
3. Encourage science teachers to develop the association of cooperative network to create innovations.
4. Support management factors to promote and develop teachers to be innovators.

Goals:

1. Build science teachers to be innovators.
2. Create innovations for students to be cooperative innovation creators.
3. Create the association of cooperative network for students to cooperatively create creative innovations.
4. Design the management system to promote and develop teachers to be innovators.

Share values of Science Teachers (ITR):

1. Innovator: Creativity and integration
2. Team: Cooperation and teamwork
3. Responsibility: Social responsibility

Master Strategy 1: Promote and develop science teachers to be innovative teachers.

Minor strategy 1.1: Promote science teacher to apply and create creative innovations.

Minor strategy 1.2: Develop potential of science teachers to enhance innovators.

Minor strategy 1.3: Enhance the quality of classroom research to global innovations.

Minor strategy 1.4: Increase motivation of science teachers to be innovative teachers.

Master Strategy 2: Enhance the quality of science learning management towards innovations.

Minor strategy 2.1: Enhance the quality of science learning management by the integration of innovation processes.

Minor strategy 2.2: Promote students centered learning by applying various.

Minor strategy 2.3: Promote students and teachers to create creative innovations.

Master Strategy 3: Build the association of network to cooperatively create creative innovations.

Minor strategy 3.1: Develop the cooperative innovation network by the cooperation among departments of school and schools under the auspices of Saint Gabriel's Foundation, Thailand.

Minor strategy 3.2: Develop the cooperative innovation network by the cooperation among educational institutions and entrepreneurs.

Minor strategy 3.3: Build cooperative innovative network among parents, alumni, and communities.

Master Strategy 4: Efficiently manage innovative teachers.

Minor strategy 4.1: Efficiently develop departments for innovative management of the school.

Minor strategy 4.2: (1) Efficiently develop the management of innovative teachers.

Minor strategy 4.3: Improve the efficiency of innovative learning resource management.

Part 3: The results of the validation of suitability and feasibility of administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand were from 29 participants consisting of 7 academic experts of educational management and innovations, 11 directors or deputy directors and 11 heads of the science department of schools under the auspices of Saint Gabriel's Foundation, Thailand.

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Table 2 The overview analysis results of the suitability and feasibility validation of the overview administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand

Items	Suitability			Feasibility		
	$\bar{x}$	S.D.	Interpretation	$\bar{x}$	S.D.	Interpretation
Vision	4.48	0.51	High	4.14	0.64	High
Missions	4.29	0.38	High	4.35	0.65	High
Goals	4.24	0.40	High	4.44	0.73	High
Share Values	4.33	0.37	High	4.33	0.59	High
Strategy 1: Promote and develop science teachers to be innovative teachers.	4.36	0.39	High	4.30	0.65	High
Strategy 2: Enhance the quality of science learning management towards innovations.	4.26	0.46	High	4.15	0.74	High
Strategy 3: Build the association of network to cooperatively create creative innovations.	4.28	0.42	High	4.30	0.71	High
Strategy 4: Efficiently manage innovative teachers.	4.31	0.44	High	4.25	0.70	High
Average on all sides	**4.30**	**0.41**	**High**	**4.25**	**0.69**	**High**

According to Table 2 The analysis results of the suitability and feasibility validation of the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand, the suitability of the administrative strategies is in a high average level ($\bar{x}$ = 4.30, S.D. = 0.41) and likewise the feasibility ($\bar{x}$ = 4.25, S.D. = 0.69). The master strategy which is the most suitable strategy is strategy 1: Promote and develop science teachers to be innovative teachers followed by strategy 4: Efficiently manage innovative teachers. Furthermore, the most feasible strategies are strategy 1: Promote and develop science teachers to be innovative teachers followed by Strategy 3: Build the association of network to cooperatively create creative innovations, respectively.

Discussions

Interesting issues were discussed as followed,

According to the internal and external environment analysis of the current conditions of the management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand, the current conditions of schools under the auspices of Saint Gabriel's Foundation reflected that the administrators focused on and promoted the teacher development to create innovations. Moreover, teachers had potential, skills, creativity and were willing to develop themselves. However, the organizational structure of schools needed a department, which is directly responsible for planning, monitoring, and evaluating the development of both innovative teachers and teachers who lack motivation to improve the innovation development of themselves. The consideration of technology conditions found that there was the technology development which contributing to the innovator development of teachers. Besides, social and politics conditions affected the promotion of innovator development, but the consideration of

economic conditions showed the decrease of economic and income of students' families leading to the less activity support from parents. The analysis results of desirable conditions shown that the administrators and teachers were aware of the potential development of the institution and teacher development to create innovations and promote students to cooperatively create creative innovations in the next 3-5 years. The results also found that, schools well prepared to develop teachers to be innovators; additionally, the administrators and teachers expected for the school management which develop teachers to be innovators. Furthermore, the analysis of desirable conditions found the average of every aspect of desirable conditions was consistent with one another according to the administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand.

Master strategy 1: Promote and develop science teachers to be innovative teachers consists of 4 minor strategies, 10 measures, and 10 indicators. The strategy focuses on the promotion and development of basic information, skills, and attitude of science teachers by supporting the budget, technology for innovation development, encouraging teachers - participants of the projects- to continue studying the innovation development, and providing learning management for teachers such as seminars and training to raise their awareness of the importance of entrepreneurship and necessary skills for innovation. The enhancement of the quality of classroom research to global innovations can be operated by the budget support and providing research fund for classroom research and permanent jobs to enhance towards the innovative research and to publish the research in academic journals. The increase of teacher motivation to develop teachers to be innovators is significant for the promotion and development according to the principle of human resource development. The survey of science teachers in schools under the auspices of Saint Gabriel's Foundation, Thailand found that teachers request for the motivation reinforcement such as compliment, rewards, promotion leading to the innovation development - innovative thinking - of teachers which are agreeable with the study of Prajan & Chaemchoy (2018) found that the methods to develop innovative thinking of teachers consist of self-improvement – workshop, work study, continued study, and the potential development of technology, learning management, creating environment, learning, and knowledge integration.

Master Strategy 2: Enhance the quality of science learning management towards innovations comprises 3 minor strategies, 6 measures, and 4 indicators which enhance the teachers' full time job performance – design learning management for students. The strategy provides workshops to increase efficiency of learning management by the integration of innovation processes and promote students' careers through various innovations which corresponds with Emo (2015) who studied the motivation of teachers initiating innovation for the Midwestern community, USA. The results found that the motivation of innovation was from the necessity of learning management development which changed it into the professional development, and the personal boredom avoidance. Therefore, teachers initiate innovations according to the teaching failure, and their experience or other teachers'. The change effects which are from the professional development includes to encourage teachers to independently initiate innovations which appropriate with learning management of their classrooms and provide time for curriculum development and the variety of learning management. To reduce study time and provide more opportunities for students to cooperatively create creative innovation, teachers are openly provided an opportunity to determinate criteria for the evaluation of students' innovation development; additionally, teachers improve the processes of innovator which are consistent with the study of Kittiworapan (2016) which is discovered that the teacher development for the students' quality- thinking skills- can be enhanced by applying techniques which applied project in learning management can develop students'

thinking skills. After the cooperative workshop, teachers gained knowledge and understood the learning activity arrangement by applying the project techniques. Moreover, teachers had knowledge, ability, and lesson plans by applying the project technique. Both teachers and students effectively performed and arranged activities to enhance students' quality – thinking skills, by applying projects in learning management.

Master Strategy 3: Build the association of network to cooperatively create creative innovations comprises 3 minor strategies, 7 measures, and 5 indicators. The strategy promotes the development and the building of innovative network, the innovation exchanges and entrepreneurship information among teachers in the school, the creation of PLC network among schools under the auspices of Saint Gabriel's Foundation, the creation of a Memorandum of Understanding (MOU), and an arrangement of activities contributing to the innovations and entrepreneurship among state and private agencies, alumni, parents, and entrepreneurs which support the study of Prajan, O. and Chaemchoy S. (2018) . The study found that the methods to develop innovative thinking of teachers need the development by creating communities, professional learning, building network, and team exchange. The monitoring and reflection of the communication, cooperative innovative development, entrepreneurship in the country and overseas countries, and communities lead teachers to the innovator development; additionally, process skills and entrepreneurship, team management and creating network, and social responsibility and consciousness lead to the development of innovative thinking of teachers.

Master Strategy 4: Efficiently manage innovative teachers consists of 3 minor strategies, 5 measures, and 5 indicators. The strategy focuses on the management development aiming to efficiently manage innovative teachers. The development was initiated by raising awareness of the administrators about world's changes and innovations. The establishment of internal departments was caused by the cooperation among various departments which were special agencies comprising board directors with clear duties and responsibilities. The analysis of innovator development needs, the school strategy review and preparation of innovative curriculum, the system improvement of innovative development process of innovative teachers are parts of the strategy including the evaluation criteria affected the rewards and compliment of teachers with outstanding achievement in innovation development and the establishment of innovative center contributing to the innovation of both teachers and students.

The results of the suitability and feasibility validation of administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand shown that the suitability and feasibility of strategies were in high level, since the researchers studied the environment and guidelines of management to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand by collecting information from the administrators, secondary science teachers at Saint Gabriel's Foundation, Thailand, and the experts of educational management, the experts of learning management and the innovation experts who provided factual information. When the internal and external environment were discovered, the researchers analyzed the environment to identify strengths, weaknesses, opportunities, and threats, then, the TOWS Matrix table was created to formulate strategies. The drafted strategies were from the focus discussion group among academic experts, stakeholders, and the researchers. In addition, the suitability validation form applied to validate the strategy draft to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand was validated by the academic experts, director, and head of science department (Secondary) of schools under the auspices of Saint Gabriel's Foundation, Thailand. The strategies can be applied to develop the teachers' innovator which are agreeable with the study Creating Innovators through setting up organizational Vision, Mission and Core

Values: a Strategic Model in Higher Education of Aithal (2016) which found that higher-educational institutions succeeded to achieve their goal – the creation of innovator– through vision, missions, goals, and share values need teamwork, respect, responsibility, ethics, manners, social services, communication, characteristics and capacity, scientific thinking ability, excellence pursuit, the courage to innovate and learn to continuously improve throughout life. Moreover, the strategies are consistent with the study the Development of mechanisms to drive the production system and develop high-performance teachers for Thailand 4.0 of the Office of the Education Council (2018). The development system of high-performance teachers for Thailand 4.0 consists of 1) Personnel who or organizations which are responsible for the teacher development should be teacher preparation institutions, institutions, and teachers, 2) Teacher development styles are the mixed development among on-the-job training, off-the-job training, self-learning through online courses and additional learning media, 3) Numbers of hours spent on teacher development should be mixed development among on-the-job training, off-the-job training, self-learning through online courses and additional learning media, 4) Teacher development management system should be managed by the affiliated agency in the educational service area with the national and spatial networks, 5) People who should be responsible for teacher development management system with spatial network is the affiliated agency of province, the main responsible agency, 6) The allocation of teacher development should provide the opportunities for institutions and teachers to spend the budget for personal teacher development - on-the-job training and self-learning.

Conclusion and suggestions

The Administrative Strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand consist of vision, missions, goals, share values and 4 master strategies; (1) Promote and develop science teachers to be innovative teachers, (2) Enhance the quality of science learning management towards innovations, (3) Build the association of network to cooperatively create creative innovations, (4) Efficiently manage innovative teachers; 13 minor strategies, 28 measures, and 24 indicators.

The suggestions were presented according to the research The Administrative Strategies to Develop Innovators among Secondary Science Teachers at Saint Gabriel's Foundation, Thailand as below.

1. The department of education of Saint Gabriel's Foundation should create policies to promote and support the teacher development and learning management which are consistent with each other such as the creation of strategies, the determination of success indicators, the set of development style, reward criteria, the overview of the participation of teachers in schools under the auspices of Saint Gabriel's Foundation in innovator development. Moreover, the administrators should be promoted to attend seminars and trainings to raise awareness and comprehend the process of innovation development including to the cooperation among educational agencies and innovation businesses, and entrepreneurship both in the country and abroad. The budget allocation and the creation of storage system for innovation storage of schools under the auspices of Saint Gabriel's Foundation are able to be implemented and developed the learning management.

2. The institutional administrators should study and be aware of the importance of the world changes and focus on the innovator development of teachers and students. The vision of institutions is determined involving in the potential development of secondary science teachers to be innovators by developing the basic knowledge, skills, teachers' good attitude to be

adequate for the integration of leaning management which caused by training, seminar, workshop, field study, the motivation promotion and support of teachers to focus on the innovator development of teachers.

3. The institutional administrators should promote teachers to create innovation and apply technology through various methods for leaning management, encourage teachers and students to cooperatively create creative innovations, build network of innovative teachers, establish professional learning community (PLC) of innovation in school and schools under the auspices of Saint Gabriel's Foundation, Thailand. Furthermore, the establishment of innovative development agencies and the entrepreneurship of state and private agencies, alumni, the communication of creative innovations to the community, and the teacher and student encouragement to present innovations in the national and international race are part of the development.

4. The institutional administrators should efficiently develop the teacher development system, establish an agency with a committee responsible for determining project plans, serious and continual monitoring, designing curriculum of innovative teacher development, budget allocation, the efficient innovative development, planning the budget allocation and resource funding for the management of innovative teacher development. Additionally, the criteria determination to participate in the innovative teacher development, the rewards of innovation development for teachers, and the establishment of innovative center to collect and learn innovation and entrepreneurship of teachers and students should be developed.

New knowledge and the effects on society and communities

The results of creation and validation of administrative strategies to develop innovators among secondary science teachers at Saint Gabriel's Foundation, Thailand are comprising vision, missions, goals, share values, 4 master strategies, 13 minor strategies, and 28 measures as presented in the following figure 1.

Vision: Secondary science teachers are innovators and be able to create innovations to develop students' quality to be the cooperative innovation creators.

Missions: (1) Develop innovators among secondary science teachers, (2) Promote science teachers to develop innovations for students to cooperatively create innovations, (3) Encourage science teachers to develop the association of cooperative network to create innovations, (4) Support management factors to promote and develop teachers to be innovators.

Goals: (1) Build science teachers to be innovators, (2) Create innovations for students to be cooperative innovation creators, (3) Create the association of cooperative network for students to cooperatively create creative innovations, (4) Design the management system to promote and develop teachers to be innovators.

Share values of Science Teachers (ITR): (1) Innovator: Creativity and integration, (2) Team: Cooperation and teamwork, (3) Responsibility: Social responsibility

Strategy 1: Promote and develop science teachers to be innovative teachers.	**Strategy 2: Enhance the quality of science learning management towards innovations.**	**Strategy 3: Build the association of network to cooperatively create creative innovations.**	**Strategy 4: Efficiently manage innovative teachers.**
Minor strategy 1.1: Promote science teacher to apply and create creative innovations. (1) Support budget and technology contributing to the innovation development for teachers participating in the innovative teacher development projects, (2) Support technology, innovation for learning management, and the evaluation enhancing the technology and innovation skills of teachers. **Minor strategy 1.2: Develop potential of science teachers to enhance innovators.** (1) Organize seminars raising awareness of the significance of innovation development, (2) Provide workshops of innovative thinking skills, innovation processes, and entrepreneur skills for teachers, (3) Encourage teachers to study in the innovation development programs. **Minor strategy 1.3: Enhance the quality of classroom research to global innovations.** (1) Support research and publishment funds of the innovation development to the global innovations, (2) Develop quality of research development from classroom research to innovation research, (3) Enhance quality of classroom research with international standards. **Minor strategy 1.4: Increase motivation of science teachers to be innovative teachers.** (1) Compliment teachers for outstanding innovation and promote them to the higher position, (2) Award the innovation teacher models.	**Minor strategy 2.1: Enhance the quality of science learning management by the integration of innovation processes.** (1) Create new curriculums and activities promoting innovation creation and students' careers by providing teachers to independently set the criteria of students' innovation learning evaluation, (2) Determine the learning management focusing on cooperative learning of innovation development between teacher and students and promote teachers to use media and innovations in learning management. **Minor strategy 2.2: Promote students centered learning by applying various.** (1) Determine the learning management focusing on cooperative learning by applying various innovations, (2) Provide workshops increasing teachers' potential to have knowledge and ability to create cooperative learning management by applying various innovations. **Minor strategy 2.3 Promote students and teachers to create creative innovations.** (1) Decrease teaching time and increase learning time by decreasing some lessons and focusing on the integration for teachers and students to create creative innovations, (2) Set criteria of learning evaluation of students focusing on the cooperation of the creation of creative innovations.	**Minor strategy 3.1: Develop the cooperative innovation network by the cooperation among departments of school and with schools under the auspices of Saint Gabriel's Foundation, Thailand.** (1) Organize projects of innovative learning exchange and entrepreneurship of teachers in a school and among schools under the auspices of Saint Gabriel's Foundation, Thailand, (2) Build the Professional Learning Community (PLC) of innovation and entrepreneurship in a school and among schools under the auspices of Saint Gabriel's Foundation, Thailand. **Minor strategy 3.2: Develop the cooperative innovation network by the cooperation among educational institutions and entrepreneurs.** (1) Create the Memorandum of Understanding (MoU) of innovation with educational agencies, entrepreneurs, state and private agencies in the country and overseas countries, (2) Arrange field studies and seminars to exchange information with educational agencies and entrepreneurs. **Minor strategy 3.3: Build cooperative innovative network among parents, alumni, and communities.** (1) Support parents, alumni, and communities are supported to participate in the learning exchange and innovative support, (2) Set the establishments of parents, alumni, and communities as learning resources of innovation model, (3) Arrange projects which cooperatively developed innovation and technology transfer among parents, alumni, and communities.	**Minor strategy 4.1: Efficiently develop departments for innovative management of the school.** (1) Arrange projects providing knowledge and understanding of innovation development to the administrators of schools under the auspices of Saint Gabriel's Foundation, Thailand, (2) Establish agency responsible for innovation development and innovation development committee appointed clear duties and responsibilities - the operation of the analysis of needs, strategy validation, project evaluation leading to curriculums and projects contributing to the innovators development of teachers. **Minor strategy 4.2: Efficiently develop the management of innovative teachers.** (1) Develop the system of innovative teacher development process and the information system supporting the management of innovative teachers. **Minor strategy 4.3: Improve the efficiency of innovative learning resource management.** (1) Develop the system storing innovative work of teachers in schools the auspices of Saint Gabriel's Foundation, Thailand, (2) Establish an innovation center and provide the innovation consultation in a school.

Figure 1 The Administrative Strategies to Develop Innovators Among Secondary Science Teachers at Saint Gabriel's Foundation, Thailand including Minor Strategies and measures (Source: Researcher, 2023)

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