Introduction of Simulation in Education Management: A Literature Review

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Abstract

This paper is a literature review to present past studies related to simulation modeling used in educational management. The growing digital era of today has left many things to change digitally. Therefore, the field of education should not be left behind in this matter, where the management in educational institutions also needs to change in that direction to further increase efficiency in their administration. However, there are constraints that there is a management system that does not give a good effect on the administration. Therefore, this study is to see the findings of previous studies which can be an illustration to the reader about the methods and methodologies used that may help in developing a management system model. In addition, it is to enable readers to get an overview of modeling and simulation. The objective of this study is to expand knowledge about the understanding of simulation modeling and provide a discussion of what is known about simulation modeling in educational management. In addition, the addition of this study is to see the conceptual framework used in building a simulation of school management and education. The methodology used in this study is based on document analysis of past research articles. Next, literature on previous research related to modeling and simulation will also be highlighted based on different fields and categories. The results of analysis of past studies show that computer simulation is very important in helping management efficiency in educational institutions. In addition, it was found that computer processes and automated simulations are carried out commercially and rapidly at all levels of educational institutions and computers have been used as a form of integration in today's educational administration environment. The results of this study are expected to provide information to policymakers about the importance of developing an effective computer simulation to assist the administrative process in educational institutions.

Keywords: simulation, modeling, education management, system, efficiency

Introduction

Currently, rapid economic growth has made computer technology one of the most important utilities in all activities. Following the years, the utilisation of computer technology has grown

rapidly, which is in line with the development of the country. Computer technology is not only limited within the boundaries of Malaysia; it has also influenced societies around the world (Mariam, 2007).

According to Senn (1998), computer technology consists of three components which are computers, communication, and the knowhow to utilise them. The combination of these three components provides an opportunity to humans and organisations to master the skills to become more productive, effective, and successful. Based on the development of computer technology, we can see that through the implementation of the Multimedia Super Corridor (MSC) by the government to bring Malaysia to higher levels of success through the possession of sophisticated technologies such as computer technologies which can compete with developing countries in the field of information technology.

The era of computer simulation with the usage of computer technology is suitable in the handling of an organisation. Examples would be a management system which involves a big amount of data to speed management as well as information recording without having to be done manually. Due to the rapid development of computer technology, the researcher has suggested to conduct research that involves simulation in the educational management of schools. This is because the management plays a crucial role in the organisation of the school. Because of that, it can be said that computer simulation is very suitable to be used in the management of education by administrator of a school to assist them in obtaining a suitable pattern in their organisation. Mohd Yusri (1996) also supports the notion that by using computer technology, all information can be easily obtained while maintaining the secrecy of confidential information at the same time.

Purpose

This article is suggested because the researcher sees a problem the administration of the school's face in obtaining a suitable management pattern for their administration. This is because every school come from different backgrounds in terms of the number of students, the location of the school, the facilities in schools, the background of the students and the teachers as well as other related data. It is predicted that a simulator will be developed in this research where the users can almost a hundred percent be involved in real situations and problems that arise in schools.

Thus, the purpose of this article is to expand the knowledge of readers on the definition and understanding of simulation modelling. Aside from that, this study is to explain the importance of simulation in the educational management. The next part discusses major literature contributions that have been done in recent years.

What is Simulation?

Simulation is a discipline that utilises models including emulators, prototypes, and simulators. It can be used for management and technical decisions. These data and phenomena are usually illustrated virtually with added environment to ease the manipulation and the perception of

users. All these are important for effective and efficient analysis, training, operation, and data (Mathias Kolsch, 2010). This proves that simulation can facilitate the users in any management or activity that requires a decision making. Simulation is flexible where all situations related to data and numbers can be used in developing the simulation. Based on this study, simulation is an important basis for development where the situations of the schools related to the management of the administration are used. These data will be collected to obtain the most suitable management pattern for a school

According to Hayden (2010), the term "simulation" is generic for any technique that enables overlapping or copying of a part of a situation. This is suitable for the study because real data from schools were used to enable precise simulation. Besides that, there are also other terms where simulation is a science social research tool as defined by Dawson (1962) as the construction and manipulation of an operation model, which is a physical and symbolical representation of all or some aspects of social or psychological processes. For social scientists, simulation brings towards the model construction of individual or group processes while experimenting with the replication of the process by manipulating the variables and the relations in the model. By developing the model, components and relationships which are hypothesised as important are taken from the reality (Dawson, 1962).

In the field of mathematics, simulation refers to the statement of systemic relationship in the form of mathematical formula (Fudenberg and Tirole, 1991). This can be done in two ways; analytical and numerical. In the case of analytical simulation, a model will be able to obtain a single optimum solution. The theory of games is an example of the types of analytical simulation (Fudenberg and Tirole, 1991). According to Macomber (2011), the usage of computer in generating simulations is not important in the theoretical perspective. However, many simulations are rather complex in the practical perspective and need the computer in executing their activities. Computer simulation plays an important role in running an activity that involves the usage of numerous data and numbers.

Based on the term of simulation shown above, simulation provides a variety of uses in our lives. Furthermore, it is not limited to one field. Instead, it encompasses whole fields like business, management, education, training and even the army. This is based on the development of computer technologies which are getting even more sophisticated at present. Because of that, many fields and activities require a paradigm shift that is suitable with the current way of living. In this study, simulation can be classified as a situation that is prepared by the computer by providing real illustration on an object, process, or event. Based on the terms given, school data are very suitable for the forming of this simulation. In this study, simulations refer to the real result that will be obtained through school data that are used in the development of this simulation. These data encompass the school background which consist of the school, location, facilities, the usage of school spaces/comfort, co-curricular facilities, and data related to the intended results. Obtained result or the output of the simulation is the patterns of management and administrative leadership for the schools, which can be learned by the users.

The Importance of Computer Simulation
in Educational Management in Malaysia

Computer and simulation relate to one another, where when one simulation is executed and developed, the computer is needed for the implementation. Because of that, the computer is inseparable from simulation. The computer is one of the important tools today where it is found that many activities and processes require computers as the media. Specialists estimated that by year 2010, all types of tasks shall involve the usage of computers (Shelly, et al., 2002). Besides that, the computer is important in completing tasks that involve management and administration. It can thus be seen that at present, many management tasks which were done manually in the past have been completed using the computer system.

Based on the statement above, computer and simulation are inter-related. This can be seen through Irwin's (2000) statement that computer simulation has already become an indispensable tool for any organisation to involve itself with global information exchange, international trading, economic growth, and education. In schools, most activities have used computer simulation as a part of teaching and learning. Hence, using computer simulation should not be an unfamiliar idea in the sense of education. In a related development, the school is the best platform to provide exposure on computer simulation and information technology. According to Barta (1995), schools which are behind in the implementation of information technology compared to other sectors are putting in effort to close the technological gap. The process of computer and automated simulation is commercially and rapidly done in all levels of educational institution and the computer have thus been used as a form of integration in today's educational administration environment.

This situation happens because the usage of computer simulation has proven to provide an edge in terms of improving the efficiency and effectiveness in the flow and the administration of the school (Visscher, 1996). Visscher's (1996) opinion supports the findings from the Computers in Education Studies (COMPED) research which was conducted by Pelgrum and Plomp (in Ahmad Fauzi, 1998). Subsequent findings which were by Wan Azlinda and Nor Hashimah (2001) shows that computer simulation in schools is also used in management and administrative activities. Research organised by The International Association for the Evaluation of Educational Achievement in 22 countries found that schools who use computer simulation in administrative matters show an increase in its effectiveness and efficiency of the management of the school. According to Tengku Azzman (in Wan Azlinda and Nor Hashimah, 2001), there are three main reasons as to why computer simulations are needed in education. Firstly, much information that can be obtained through computer simulation cannot be done by humans. Secondly, the ability to collect and keep information and knowledge can only be managed efficiently by the computer. Finally, information and knowledge are the keys to the solutions in human lives.

Research by Mohd. Al-Shaari (1995) found that besides teaching and learning, computer simulation is used in (a) type works, (b) school accounts, (c) data source management, (d) presentation material preparation, (e) communicating through e-mails, and (f) analysing students' academic performance. Syahrul Fahmy, Abdul Razak Hamdan and Aziz Deraman

(2002) have suggested a few reasons on the importance of using information technology in the educational management today. As a manager of information, information technology can run at least six main functions that are collecting, processing, generating, keeping, re-accessing, and sending. Besides that, computer simulation is very beneficial because tasks can be done more quickly, consistently, concisely, and with high potential (Ahmad Fauzi, 2011).

Based on the studies that have been conducted above, it can be concluded that computer simulation plays an important role in life. For this study, the process of computer simulation is to assist users (the ministry, professional associations, education, future leaders of schools, educating societies, parents associations, and others) in school management. The Output of this research is to encourage the usage of simulation in the planning of the nation, districts and institutions through transferring and preparing services to third parties, including the transfer of computer applications to potential parties of interest such as the Ministry of Education while encouraging training for teachers and professional groups in the field of school administration. Besides that, this study can encourage awareness amongst target groups to use technology especially for decision making to support the usage of support tools in the governmental and non-governmental sectors. Besides that, it will open other research opportunities to other levels of educational institutions and thus will also further develop computer simulation for educational policies and management for any height of education in Malaysia.

Simulation in this study includes school data to obtain output which is the best management pattern for the school administration based on the background of a given school. The importance of this simulation is that every school has its own suitable pattern of administrative management according to their background. Besides that, it will help administrators in studying the most suitable management patterns that can be practiced in their schools. Based on the output, the management of the school can also be developed in a more systematic and arranged manner.

Besides that, computer simulation for school management can assist in educational management training in making decisions to achieve a more efficient and fair educational system. This computer simulation is also seen progress the educational management more rapidly, which is in line with other fields that have also used computer simulation as one of the most important tools such as in the fields of business, army, hotel services and most popularly in games.

Computer Simulation Models

Simulation is used to illustrate numerous potentials. All simulations involve recreating or extending the behaviour of the modelled system. The simulation model is the synthetic model from a certain process or system. The simulation model should have a characteristic like the real process (system). This is because simulation models possess characteristics like the real system, enabling us to learn the real system through a synthetic model (the simulation). However, in this article, a comprehensive and detailed explanation on the models of computer simulation is not given. Only the explanations on the functions are given. This is because the focus of this article is on the importance of computer simulation in educational management

and to look at previous studies regarding computer simulation. There are a few models of computer simulation which are often used in numerous fields as shown below.

The Taxonomy of Simulation

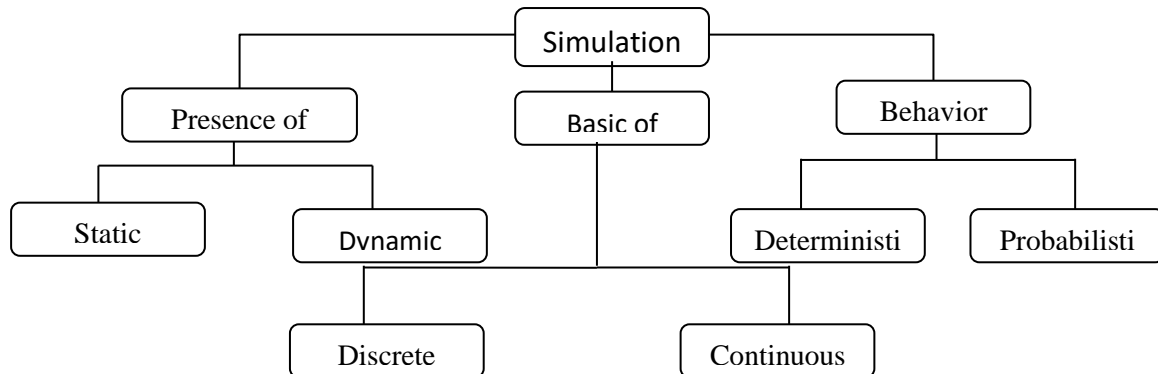Generally, simulation consists of three divisions as shown in Figure 1 below.

Figure 1.0: Simulation Taxonomy (Source: A taxonomy of computer-based simulations and its mapping to parallel and distributed systems simulation tools (Sulistio, Yeo & Buyya, 2004)

Based on the figure above, it is divided into a few models which are:

- **The Descriptive Model (Discrete)** where it is determined by a group of input situations and operational strategies. This model will produce the situation that will happen (input-output model)
- **The Prescriptive Model (Continuous)** where it is determined by a group of situations. This model will provide the best solution for a given situation.
- **The Static and Dynamic Model (Static vs. Dynamic)** where the static model represents the behaviour of the system at a given time while the dynamic model represents the behaviour of the system along a given period.
- **The Deterministic vs. Stochastic Model (Deterministic vs. Probabilistic).** The deterministic model does not consist of a programme which randomly appears. Thus, by repeating the same simulation, the same results will appear. The stochastic model has a programme which already exists where the repetition of the simulation process will produce different results. Some examples of uniformities that were given examples were the period of an operation, the period of waiting, the frequency of failure, and the time for customer service.
- **The Presence of Time Model** shows whether there is a time factor in the system of simulation.
- **The Basic of Value Model** focuses on the value of simulation entity.
- **The Behaviour Model** refers to the way a simulation happens in the next step.

For the articles, it is found that a discrete type of simulation is suitable for this research. This is because there are influential entities / data between values in the space of infinity. In this study, school data are used in determining the obtained pattern and performance based on several criteria. This results in the suitable leadership pattern used in a school where it is related to the background of the school. Examples of data that influence the result produced are the type of school, location, facility and service, the usage of school space and the comfort, and co-curricular space facility. Enrolment and teachers' overall profiles are also used. For school performance, data obtained from school standards are used. Furthermore, schools' leader preferences in administrations are the main operational strategies used to support the model. All these data play roles in determining the pattern of management that will be obtained through model development. Besides that, there is Input and Output in this discrete model. The Inputs of the simulation on the other hand consist of manipulation of variables and the Outputs are the patterns of management that will be obtained based on the developed model which are the final intended result. In this study, the suitable administrative management pattern in an organisation based on the data used in this simulation is the main resources for learning.

The Conceptual Structure and Framework

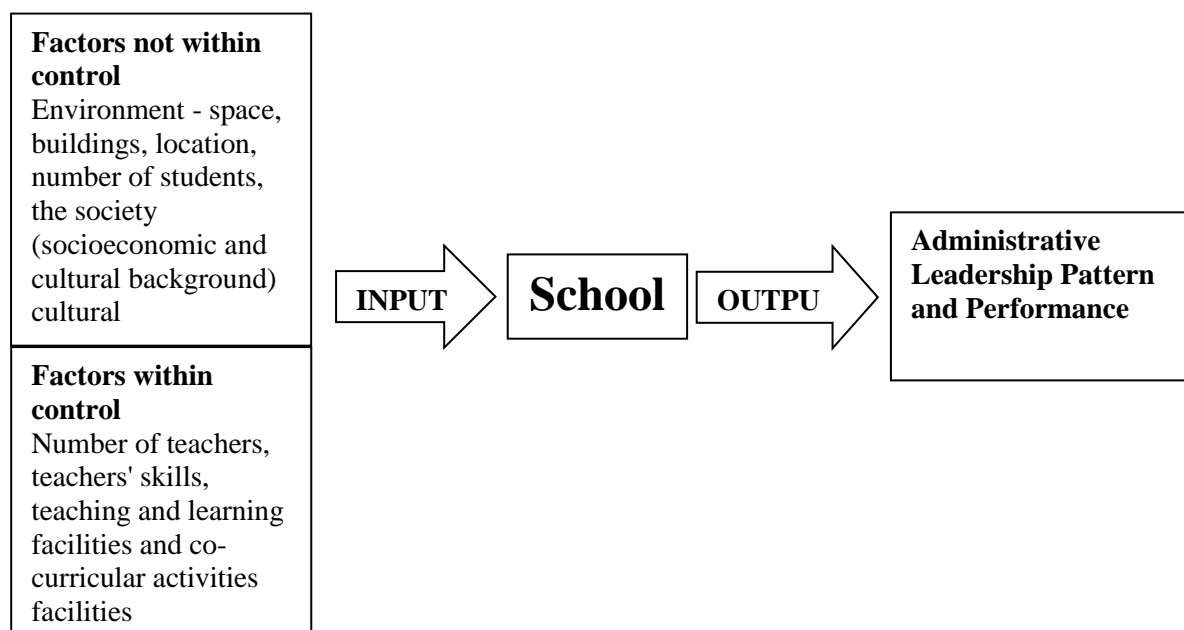| **Factors not within control**
Environment - space, buildings, location, number of students, the society (socioeconomic and cultural background) cultural | | INPUT ⟶ | **School** | OUTPU ⟶ | **Administrative Leadership Pattern and Performance** |
| **Factors within control**
Number of teachers, teachers' skills, teaching and learning facilities and co-curricular activities facilities | | | | | |

Figure 2.0: Conceptual Structure and Framework

Data in this study consist of data which represent factors within control or factors not within control. Data within control includes the number of teachers, the skills of teachers, the teaching and learning facilities, and the curricular and co-curricular facilities. Meanwhile, data which are not within control consist of the surrounding factors such as the condition of the school building, location, number of students, and the socioeconomic and societal background. All the data input collected determine the characteristics of the school. From the characteristics (type of school, location, facilities and services, space usage/ comfort, and co-curricular space facilities), the output will be obtained i.e. the suitable leadership pattern of the administration

for the school and the school performance. The conceptual framework of this simulation is to find out the suitable leadership pattern of the administration for the school based on the school data discussed above. The produced output can be used to assist the administration in implementing the best practice of leadership based on the latest school data.

Summary of Literature Review of Previous Studies on Computer Simulation

Date	Author(s)	Contributions to Theory Development	Methodological Issues	Statistical Technique / Assessment Instrument / Simulation Model Used	Results / Interpretation, Comments
2000	George H. Tompson University of Waikato, New Zealand Parshotam Dass University of Manitoba	Investigates the relative contribution of simulations and case studies for improving students' self-efficacy in strategic management.	To assess self-efficacy for both fixed and generative skills.	Experiential Learning Model	The results suggest that total enterprise simulations are an effective way to enhance students' self-efficacy. The results of this study offer one suggestion for how the strategic management course can be improved while still maintaining its focus on integrative approach and cross-functional thinking.
1994	Zbigniew H. Przasnyski	In this paper an inventory management spreadsheet simulation model is developed which is more general than the models developed in the literature in that two independent parameters are simulated. The model is used to compare three approaches to implementing the	(a) model assumptions, (b) probability distributions, (c) model for one trial, (d) trial summary table, and (e) global summary table.	Three alternative implementations of the model are presented: a two-dimensional model, a three-dimensional model and a two-dimensional model using the simulation add-in package @Risk.	It was found that the memory requirements and the run times for the 3-D (3.1), 2-D (3.1) and 2-D (2.2) models varied exactly linearly with both the number of periods and MAXTRIALS.

		simulation: a two-dimensional model, a three dimensional model and a two-dimensional model with a simulation package add-in.			
2011	Chris Kenaszchuk, Kathleen MacMillan, Mary van Soeren and Scott Reeves	This study investigates short term associations between simulation training and two results: the health of professionals in IPC and the cooperation by other groups, and self-reports of attitudes towards working in healthcare team. Studied the relationship between simulations, capacity, leadership, and teamwork attitudes because the leadership role is an important concept for an effective IPC.	An intervention study tests the relationship between team practice and inter-professional cooperation simulation steps, the nurse-medical professional relationship, and the attitudes toward healthcare team.	Multi-Model. (Professional Health Care taking part in a workshop and asked to equip themselves and instrument proxy – research reports for three times. Time 1: the completed steps on the same day as a simulation session and immediately before the strong beginning. Time 2: The steps completed in about 15 days after simulation of Time 1 exercise. Time 3: Steps completed six weeks after the simulation exercises.	Results from this study show that simulation focuses inter-professional education, and the sharing of leadership can be leverage to the improvement inter-professional care.
1998	Yuri Merkuryev, Juri Tolujew, Eberhard Blumel, Leonid Novitsky Egils Ginters, Elena Viktorova, Galina Merkuryeva and Jurijs Pronin	The paper discusses the key issues of the application of modelling and simulation for management of the Riga Harbour Container Terminal (RHCT), which have been explored within the concerted action project, "Application	It gives a methodology for simulation investigations, which was used at RHCT and could also be applied to similar logistics systems. The simulation study started by reviewing publications	A structure of the developed RHCT model	Simulation results demonstrated efficiency of the considered actions; in particular, the decision to install a new data processing system was taken. On the other hand, they demonstrated efficiency of the presented simulation methodology.

		of Modern Concepts in the Automated Information Management in Harbours by Using Advanced IT-Solutions."	around harbour terminal simulation. It demonstrated high efficiency of using simulation to solve different problems in this area.		
2003	K. W. Kendall Washington State University Robert J. Harrington Nicholls State University	This research has focused on basic learning effectiveness and learning process issues in teaching business (also comparing the effectiveness of simulation cases to other pedagogy), as well as on the internal and external validity of simulation cases for research.	Four main factors to measure effectiveness: strategic business planning (SBP) skills, team process skills, overall perceived learning, and any differences in the level of difficulty or workload (efficiency) of the different forms of pedagogy using the same learning exercises or tasks.	The data used for this study were collected using senior-level students of a hospitality strategic management course (a required capstone course of the college of business) in a large western university. The set pedagogy over the 5-year study period represented three basic treatments. All treatments held the instructor, task requirements, reading assignments, and program participants constant.	Results of the empirical study suggest that the use of management computer simulation cases facilitates greater educational development than does the use of written cases (or a combination) as perceived by hospitality students in a capstone strategic management course.
2010	Precha Thavikulwat and Sharma Pillutla	They applied these considerations and a constructivist approach to develop a computer-assisted simulation, using it to investigate the concurrent and predictive relationships of market share and	The authors considered two principles of simulation design (simple rules and smart algorithms) and three essential attributes (choice of industries,	We view the refinement interval as divisible into three stages: functional, rational, and smart.	The authors found that the relationships are (a) as expected and stronger than those reported in an earlier study using a simulation of a more conventional design and (b) more consistent with a

		production experience on profitability.	employer-employee relationships, and real markets for products and participant services) for strategic management business simulations.		well-known series of field studies. They suggest that computer-assisted simulations developed through a constructivist approach may be used to advance the discipline of strategic management.
2010	Mathias Kolsch	We took a snapshot of the M&S community in the US Army and their education via a survey of senior personnel, querying the importance of M&S-related skills and the perceived proficiency of entry- and senior-level professionals. The goal was to obtain validation for education and training programs, and to determine areas for improvement.	We propose a three-pronged approach for shaping the future of training and education in M&S that addresses the observed shortfalls: (1) proper focus of the technical education, combined with (2) stronger emphasis on communication ((3) conduct concerted, interdisciplinary research and education efforts in human, social, cultural, and behavioral M&S. The most important skills were found to be communications, fundamental concepts of M&S, distributed simulations, training systems, computer networks,	The survey in the form a questionnaire was designed to determine the importance and the observed proficiency of a variety of skills pertaining to M&S (Modelling And Simulation (M&S) Tools)	The results of this survey provide insight into the M&S community in the US Army and their education and train-ing. This information is crucial to shaping programs to educate the best-prepared and most effective M&S experts.

			program management, and VV&A (Verification, Validation and Accreditation).		
2006	Dalia Rachman-Moore *College of Management* Ron S. Kenett *KPA Ltd., and University of Torino*	This article focuses on simulation-based training in performance management systems It is designed to promote understanding of the process of performance management.	The relationships among these four perspectives play an important role in the organization's strategic map. Feedback derived from such measures enables an organization to refine its standards, objectives, and targets; to track gaps and deviations; and to compare performance between employees and units.	The performance management simulation that we developed incorporates the Balanced Scorecard and the multirater assessment methods.	The feedback results indicate that these purposes were achieved. Performance management is also valuable in terms of the relationship between performance appraisal and meeting targets derived from strategic goals.
1978	Stanley Pogrow	Purpose of this article is to explore and demonstrate the advantages of using computer simulation techniques over more conventional techniques in studying problems of administrative planning.	Methodological debate in education focuses on the efficacy of naturalistic observational techniques versus quantitative techniques.	Pseudo-modelling	The capability of simulation to rapidly explore a wide range of alternatives is particularly important for fostering creative decision making in the present environment of contraction in which educational administrators must function.

Conclusion

Based on the studies conducted, it can be concluded that computer simulation plays an important role in many fields or activities. This is because according to previous studies, computer simulation is found to reduce the burden of tasks and pressure to the users. In this study, it is also observed that the importance of computer simulation provides many benefits to

the administrators in schools in determining the pattern of school management. It is hoped that with the simulation that will be conducted, it can help professionals who need to make decisions. Thus, the researcher hopes that the study that will be conducted can turn the field of educational administration into a steppingstone to further improve the level of educational education towards a better and more effective direction.

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