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Reflection of Critical Thinking on the Sustainable Educational Development

A Case Study of the Middle East and North Africa

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Abstract—The development of education through critical thinking is becoming the ultimate goal in developing countries. However, there are numerous factors and challenges in the implementation and adopting of a unique educational system particularly in the developing countries. Most countries in the Middle East and North Africa have made significant progress toward raising children's school enrollment and completion. However, the quality of education and coherence in content between countries' education systems are still considered as a major issue. To achieve the sustainability of the higher education system, educators must have the knowledge and skills to integrate the critical thinking approach in the development and delivery of the educational curriculum. The purpose of this paper is to simplify the understanding of the importance of critical thinking in the sustainable educational system. Also, this study aims to propose a critical thinking approach that might help to improve the performance and raise the production efficiency of the educational system in Saudi Arabia and Libya. This paper defines both regions in the Middle East and North Africa with cases of Saudi Arabia and Libya, respectively. We focus on determining the educational system needs, its development cycle, and documenting requirements in each country, and we proceed with design synthesis and system validation while considering the complete problem.

I. INTRODUCTION

Education is the key to develop the country, and the educational system is the way to achieve social development because it teaches our future generations [51]. Education is vital, especially for our young children, any civilization's most precious resource, but education always needs to improve and to maintain competitive with international rivals. Therefore, investment in the quality of education necessitates the development of educational research and measuring instruments in particular. These requirements include the characteristics of both pupils and teachers, and the specific features of the family and school environment. A priority in many initiatives to improve the quality and efficiency of education is the increased use of information in policy formulation and planning. Only when the dimensions and the problems that beset the education system are clearly understood, the system can be appropriately planned, implemented, and managed [2].

Education and learning are the basis of building nationalities and peoples. In addition, they have a direct

influence of the actions and experiences that deal with the mind and physical ability of the individual as well as the main factor in the formative nature and development of the countries. Unfortunately, not all people in the world have the same opportunity to receive education especially in the third world countries, and this was the biggest reason for the classification they reached. The Middle East and North Africa countries have achieved a significant improvement in the average school enrollment rate has quadrupled since the 1960s and almost complete gender equality in primary education. Furthermore, the ability to access the education system in the region has increased tremendously, from 86% to 94% between 2000 and 2010, over the past two decades [37]. However, there is still a big hole between these countries and the top educational system in the developed countries. Therefore, they should think critically about how they can develop the education system and adopt new methods and techniques.

A study investigated how technology usage in teaching, learning, and the training system [32]. Another study found that e-learning adoption in the teaching and learning system has a significant direct effect on students' perceived in higher education [36]. On the other hand, critical thinking is considered essential not only for achieving educational achievement outcomes based on the narrow criteria of standardized testing. However, the benefits of critical thinking transcend school life, enhancing the quality of life and professionalism greatly in the workplace. Critical thinking benefits not only the individual but society in general. The critical thinking skills are tools for a cohesive social mission.

This study provides a proposal to develop a suitable solution for the developing countries that might help to improve the performance and raise the production efficiency of the educational system, especially in the Middle East and North Africa. As researchers, we started on defining the educational system in Saudi Arabia and Libya as a case study, exploring the system needs, functionality the development cycle, and documenting requirements. Then, a synthesis design and system validation were carried out while considering the complete problem.

The paper is structured as follows. Section .2 presents the literature review including the concepts of hematic and interrogative, critical thinking, curriculum, learning environment, the system of systems, and system requirements.

Section .3 describes the best educational systems in the world and providing three examples from different countries: Finland, Japan, and Singapore. Section .4 covers an overview of two countries that taken as a case study: Saudi Arabia and Libya. Section .5 presents suitable solutions to improve the educational process crisis in Saudi Arabia and Libya. The methodology is explained in section .6 while section .7 demonstrates the proceedings with design synthesis and system validation and verification methods. The last sections cover the recommendation part, lessons learned, and the conclusion, respectively.

II. LITERATURE REVIEW

A. Thematic and Interrogative

Education is not a limited process, the process is ongoing. "It is not initiated at the morning bell and terminated at dismissal, and it most definitely does not start on the first day of Kindergarten and end on graduation day" [52]. Focusing on improving the performance of the educational process can gradually improve the outcomes of education in North-Africa and the Middle-East. The system was defined with the characteristics outlined below.

- Education in critical thinking offers an alternative to drift toward postmodern relativism, by emphasizing that we can "distinguish between facts and opinions or personal feelings, judgments and inferences, inductive and deductive arguments, and the objective and subjective" [7].
- Change the teaching methodology in the schools from a style that is based on conservation and memorization to a different pattern that is based on the understanding, interpretation, comparison, and criticism [7].
- Provide an educational curriculum that meets the necessary life needs of students, and away from radicalism and extremism [2].

The study in question will be the creation of an educational system that offers the arts of critical thinking and critical reading, so that a critical spirit becomes a permanent possession of every student and pervades the teaching of every course in North-Africa and Middle-East, as an example. The belief that this will improve performance and raise production efficiency.

- Who: The North-Africa and Middle-East societies.
- What: The study will be the creation of the essence of education, the ability to think critically and protect oneself from falsehood and lies in order to increase the efficiency of the educational system.
- When: This new educational system will take five years to be completed.
- Where: The system is proposed for the Ministry of Education of countries in North-Africa and the Middle-East.

- Why: society needs this project for the reasons outlined below:
 - Critical thinking can be infused in lessons throughout all disciplines by utilizing in-depth questioning and evaluation of both data and sources.
 - Having students track patterns in information forces them to look at the information as a process instead of merely information to be memorized and helps them develop skills of recognition and prediction.
 - Maximize society ability to think rationally.

B. Critical Thinking Conception and Related Strategies

Thinking comes naturally, but people can make it happen in different ways. For example, people can think positively or negatively as well as think with rational judgment, and these are a few of multiple ways in which the mind can process thought. Additionally, there is no doubt that critical thinking is connected to one's mental abilities, but one who cannot be a critic of high style can criticize at the ordinary level and can stand the objective position of those who criticize. Back to 1962, Ennis defined critical thinking as "the correct assessing of statements" [42], and later in 1985, he defined it as reflective and reasonable thinking that is focused on deciding what to believe or do" [43]. Broadly defined critical thinking as "the process of purposeful and self-regulatory judgment" [46], "sense of teaching students the rules of logic or how to assess evidence" [47]. Also, the American Philosophical Association defined it as "the process of purposeful, self-regulatory judgment. This process gives reasoned consideration to evidence, contexts, conceptualizations, methods, and criteria [49]. In short, critical thinking may be defined as the ability to verify assumptions, ideas, or news whether it is real, whether it is part of the truth or not. The critical thinking helps to promote independent thinking between the students in personal autonomy and reasoned judgment in thought and action, which helps them in the future carrier. Therefore, it is crucial for governments to understand the role they play in developing critical thinking through the education system.

Developing critical thinking is a significant goal of the education system in developing countries, and it will enable students to have more skills including self-reflection, analyzing, explanation, problem-solving, utilization analysis, and decision-making. There are many strategies for teaching critical thinking skills that may prove immediately useful when encouraging. At the same time, strategic thinking is a process where vital issues and decisions can are considered in a particular way [54]. There have been many studies that introduced effective teaching strategies for developing and measuring critical thinking skills such as concept mapping [45] [49]. Another important point is maintaining the critical thinking assessment. Robert emphasized defining a clear idea of the purpose of critical thinking testing to ensure the goals of the critical thinking curriculum [44]. Deanna, also, underlined the importance of drawing on contemporary empirical research in developing the model of critical thinking in order to process

intellectual development in children and adolescents [48]. The development can be by involving critical thinking as an essential part of the curriculum, and there have been many trends on the most effective approach through the content of the curriculum.

C. Critical Thinking in the Curriculum

Specialists and curriculum developers have begun to pay attention to the skills of thinking and adding the concept of critical thinking in the curriculum. Although much progress has been made in critical thinking skills development within the curriculum in the developed countries, the developing countries still need efforts to develop the curriculum within the critical thinking conceptual. There are many ways to include the concept of critical thinking in the curriculum including direct education, education for thinking, and integration into the teaching of thinking. Ennis early addressed the in action including the critical thinking in curriculum, and how the teaching materials and tests can be developed within this concept [6]. However, the critical point is the right approach to integrate the concept to achieve the educational goals.

Furthermore, King used developed a practical approach to promoting critical thinking in the curriculum to enhance student learning, promote self-regulated learning, and motivation to prepare for classes [8]. This incorporating can be even by a simple way, by developing activities in students' books urging them to self-study and searching for information or presenting problems from their environment and motivating students to search for solutions to these problems. Thompson established a framework for understanding critical thinking across the curriculum, and he found that a comprehensive integrating will develop the characteristics of thinkers, which leads to contribute to the development of the society [50].

D. System of Systems

The Educational Services system is an extensive system of systems. Figure 1 shows the system of systems structure. The Political system is required to provide public funding, resource allocations, and procedures for determining funding levels. The need for technology is essential to facilitate services and keep up with the times. The Educational System needs to identify new and engaging ways to share cutting-edge and tech-savvy best practices with schools, district stakeholders and community members.

In the Social and Culture System, most people would say they understand what a teacher is and does. So far, many people would not be able to explain precisely what people need to do and become certified teachers; state policies and requirements may dictate or influence; what teachers teach in a course; and what they commonly use specific instructional methods. Also, some people have a lack of determining which seems to work best; and how educational research informs new instructional approaches; or how certain kinds of professional development can improve teaching effectiveness in a school. When investigating or reporting on education reforms, it may be useful to look for more concrete, understandable, and relatable ways to describe abstract concepts such as an education system [7].

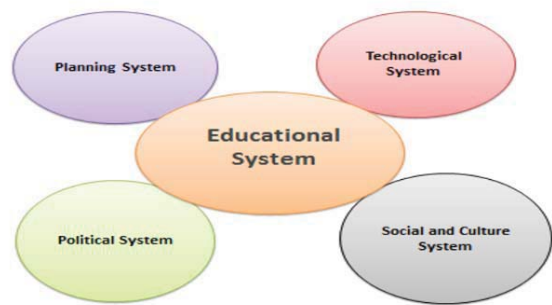


Fig. 1. System of Systems

E. System Requirements

Knowledge of the education system in the world's educational institutions is an important step in the right direction for planning and improving the system for countries that are looking for better [39]. The education system has a set of requirements including:

- The system shall provide a teaching approach that encourages students to question and challenge existing beliefs, structures, and practices.
- The system shall minimize the approach to learning through rote memorization in the educational system.
- The system shall integrate critical thinking skills into preparation for current teachers.
- The system shall train prospective teachers to emphasize effective thinking strategies.
- The system shall teach the student to seek evidence to support assumptions and beliefs.

III. EDUCATIONAL BEST PRACTICES IN THE WORLD

Some countries have a state-of-the-art educational system, and many countries competed in the top places and overall scores according to several criteria including the quality of the education system, institutions, infrastructure, macroeconomic environment, health and basic education, university education and training, market size, business development, innovation. Many organizations and institutions make ranking and evaluation based on different factors and some criteria. However, the most important standards are the percentage of adult learners, the enrollment rate in the primary and secondary levels and the ability of the country to participate its citizens in the educational system [38]. Let's take a look at the education systems in top-performing countries around the world. The objective from listing these countries is to learn from them and adapt those lessons for use as a reference for our case study. In this section, we include three examples of the best education system in the world which are:

A. Education System in Finland

Finland's school system has consistently come at the top for the international rankings for education systems. Education is one of the cornerstones of the Finnish welfare society, and there has been a massive development in education policy and reform principles [20]. In Finland, there are no nationwide examinations or grading tests. Adopting new methods for learning and teaching could knock Finland off the top of the international Pisa rankings for education systems, but this is of little interest to Finns. The most important goal is to teach youngsters the skills that they will need in the future. As a result, Finland is a shining example of best practices. Students are given a great deal of freedom, can pursue interests. Teacher training courses are widespread and difficult to qualify for. The teaching profession is seen as highly desirable among Finnish youngsters, and there is fierce competition for places in teacher training courses. Under the new curriculum teachers will become enablers who no longer spoon-feed facts to their students, but instead, help them to learn and understand [21].

B. Education System in Japan

The Japanese education system has emerged as a well-developed and quality education provider. Japan is a technological country, so the teaching methodology is a techno-nihilist form of education [23]. The curriculum is designed in such a way that the children develop motor skills early on. While school is mandatory until the child reaches the secondary level, there are multiple systems with local variations to promote higher education [24]. Vocational education is systematically planned to keep the students at par with global standards. Japan is a laboratory for the idea of continuous improvement in teaching practice. The incarnation of that idea in Japanese schools is the lesson study. This practice undoubtedly contributes in meaningful ways to the high quality of instruction in Japanese schools [25]. A high percentage of Japanese students attend after-school workshops where they can learn more things than in their regular school classes, and some do these workshops at home or another venue.

C. Education System in Singapore

In recent years, the Singapore government has moved to put in place measures to manage the level of stress faced by students. They shift the focus away from the traditional school tasks of rote memorization and repetition and instead focus on active learning education. In more recent years, the educational emphasis has shifted toward creative learning and school autonomy. Conceptual learning and problem-based education play a significant part in their educational system. They want students to solve problems on their own with a teacher there to help, should they get lost in the process [22].

IV. CASE STUDIES IN THE MIDDLE EAST AND NORTH AFRICA EDUCATIONAL SYSTEMS

We choose these countries as a case in this paper for many reasons. First, the authors are originally from these countries, and they have reliable experience and knowledge about the

education system in these countries. Second, The Kingdom of Saudi Arabia is the largest Arab state in Western Asia by land area similarity with Libya in North Africa. Third, Both are the largest oil exporters in the world and depend heavily upon its oil revenues to achieve economic development and prosperous life for its citizens [3] [40]. Fourth, Both have an active program to send students to study abroad. Therefore, Hundreds of thousands of Saudis and Libyan have joined several studies and research programs in the United States and Europe. They learn to analyze using rigorous methods that help them to play a significant contribution in the knowledge-based societies. Fifth, Saudi Arabia has been taken great strides in education in the last few years [41], and Libya has a high ranking for keen to ensure access to appropriate education for all members of its society [27].

However, the education system in both countries has been criticized as a lack of the required skills to implement critical thinking effectively. Additionally, there is a lack of knowledge of critical thinking among students and in the teaching strategies of all school levels in both cases. Students are exposed to so many different viewpoints on - and offline and thus prone to accepting whatever they read., that they lead them to be under a risk of becoming brainwashed. Students are usually taught only one viewpoint about everything; they accept the theory they learn on their teacher's authority with perhaps little understanding of the reasons provided.

Therefore, they have a similarity in curriculum style since it is focusing on the theoretical side instead of the practical side. That causes the loss of educational messages amid the rubble of information. One of the fundamental drawbacks of the academic system is its imposition of a national curriculum that does not vary across any public or private high school. The system requires that every student study identical academic material in the sciences, literature, and math regardless of where a student's interest lies. Additionally, the material offered in many of these subjects is hugely lacking; history topics only cover the Islamic era, honors classes are nonexistent. The curriculum depends on memorization only, and teachers encourage a system of ineffective memorization and a superficial understanding of facts for the sole purpose of passing a test. This type of education extends far beyond high school to the college and university levels. Students are continuously taught of ways to pass an exam rather than the proper approaches to learning.

A. Middle East Case (Saudi Arabia)

The discovery of oil in the kingdom and an increase in fuel consumption worldwide spurred on rapid industrial development and urbanization beginning in the early 1970s [1]. The total budget for education (schools, curriculum, universities, colleges and the Ministry of Education) was US\$ 8 billion: this amount constitutes 3.6 percent of the total budget for Saudi Arabia in 1985 [1]. In 2014, the total budget for education was US\$ 57.86 billion². Today, more than 70 percent of the population is under 30 years old [1]. The culture in Saudi Arabia is predominantly one of uncritical submission to authority. For example, children are discouraged from questioning their elders and from challenging their educators.

The problem comes from the early stages, from the environment in which Saudi Arabia society grow up. They are living in an uncritical society. Saudi society needs to learn that others' views must be respected. The problem is a society that doesn't encourage discussion, even in the home between parents and their children. The need for education reforms based on critical thinking to elevate the quality of education in Saudi Arabia.

In Saudi Arabia, the focus has long been on the curriculum, right from 1954, when the education ministry was established. There is a continuing debate about the emphasis on religion and languages at the expense of science and mathematics. Many Saudis see their education system as affected by political currents, with senior scholars fiercely shielding the curriculum from those who want to bring about change. There is a particular watchfulness towards a colloquial term "awakening" in reference to political Islam because this is seen as the cause of extremist tendencies. Unfortunately, this never-ending cycle of debate delays improves on the necessary curriculum changes. Until this matter is resolved, there will be discontent within the education system.

The Kingdom needs to devote more resources and care into improving the defective educational system. Even though the average annual budget of 3.7 billion dollars for education in Saudi Arabia over 40 years was accompanied by roughly a 9 percent increase in education expenditures, the education sector remains incapable of satisfying the demand for skilled employees according to the government's Saudization objectives [3]. In 2010, 57 percent of Saudi male students had a bachelor's level education, compared to only 35 percent of Saudi females. On the other hand, 35 percent of Saudi's female students had a master's level education compared to only 20 percent of male students [5].

In Saudi Arabia, the education system is very archaic. The current school system was introduced during the industrial revolution when an unskilled workforce was needed: one with basic literacy and numeracy skills that would do as they were told. Primary education in Saudi Arabia lasts six years, Intermediate education in three years, and Secondary education in Saudi Arabia lasts three years, and this is the final stage of general education [4]. After twelve years of indoctrination, the universities in Saudi Arabia require high school students to take a skills exam as part of the application process. This exam includes critical thinking tests and measures an individual's ability to analyze, conceptualize and reason effectively. At this academic semester, the high school student has to pay and attend a preparation course for only one month to prepare for the skills exam.

B. North Africa Case (Libya)

Libya is one of the North African countries, and it occupies an area of almost 1.8 million kilometers square with 95% of dessert [28]. Therefore there is an agglomeration population in the north part. The oil was discovered in 1959, and since then Libya's economy almost entirely dependent on oil and gas exports [40]. Thus, there is a significant growth in the Libyan population, in 1983 around 3.6 M while in 2016 around 6.4 M

for instance. The official language is Arabic while some people speak Tamazight and English is also used in business.

In 1952 after independence came, around 90% of the Libyan was illiterate, and A little bit people had studied at the university level [26]. After that, the education system from the primary level to the university level was developed, and Libya continues in the top list of the best education level in the African countries [27]. Under the Gaddafi regime, all education was required to be conducted in Arabic and a few English in some education levels, Also, Teaching Tamazight was illegal until the revolution of 2011.

Children in Libya start school officially at the age of 6-year-olds, and they attend primary school until the age of 15-year-old. Then they participate in secondary school for three additional years at the age of 15 to 18-year-olds or join technical institutes or national programs. After secondary school, they can choose the colleges, and sometimes the high school results are also used to determine the direction of a student's education. Hanley also says that enrollment in high school is based on test results in combination with student interests [29]. This is the general structure of the Libyan primary school educational system, and public education is free.

The education system before the 2011 revolution was relatively stable, and it certainly has not been that way for all the Libyan primary school students proceeding this system. Unfortunately, the public school system in Libya has been heavily disrupted since the fall of the Gaddafi regime. According to Fetouri, the school year has not been regular since the 2011 revolution [30]. Additionally, many cities have been the most affected because of various political and economic factors that have disrupted children's school attendance. The disruptions to education can range from the more mundane (not enough funding) to dangerous (military conflict making school attendance unsafe for teachers and students alike), and damage the infrastructure (the school's necessities and long hours of blackout).

The political instability has continued even to this day, unfortunately, But the Libyan educational system has been changed in the last two years after the new Minister of Education and Research. According to Zaher, the new Minister "took office in April 2017, a time when conditions in Libya's schools and universities were at their worst following years of infighting." [31]. The Minister has, arguably as a result of this, made drastic changes to the Libya education system including overhauling standardized testing procedures; how scholarships for higher education are awarded; rehabilitation the teachers in public and private institutions and schools; revise the curriculum; create new strategies and procedures for improvements. As a result, according to the Legatum Institute for Prosperity Index [33] [34] [35], Libya's ranking in the education sector for 2018 has jumped significantly from previous years to progress from 108 positions in 2016/ 17 to 87 in 2018, 21 degrees forward. The rank was jumped sharing with Portugal and Qatar as the most significant leap in education within one year. The three countries achieved the same 21 degrees of progress, which presents the highest jump in worldwide. At the African level, Libya had been achieved 9

points, which jumped from 11th place in 2016/ 17 to the 2nd place after Mauritius. At the Arabic countries level, Libya has been moved to the 7th place presenting 6 points in advance compared with 2016/17.

V. ALTERNATIVE SOLUTIONS FOR IMPROVEMENT

A. *Solution One: Develop a comprehensive plan / Find a new educational way of thinking*

a) *Improve Curriculum and Teaching Methods*

- Develop a new formulation of religious curriculum.
- Prepare mathematics and natural sciences educational materials and their supporting platforms (textbooks, teacher guides and parameters, pamphlets and scientific experimentation, transparencies, educational CDs), including the latest cutting-edge materials of advanced countries in these fields.
- Take advantage of the prominent specialized international expertise in the production of educational materials and use technology in the application of mathematics and science curriculum in public schools.
- Encourage students to make connections to a real-life situation and identify patterns is as a great way to practice their critical thinking skills.

b) *Rehabilitate and train teachers*

- Implement professional development programs for teachers.
- Train the teachers on international standards and philosophy of the mathematics, science and teaching methods.
- Improve the level of teachers learning in accordance with the principles of active learning, self-learning, and access to knowledge.

B. *Solution Two: Creating a thinking school*

- This school is not a regular public school. It will require tuition fees to study in it, and it will be optional and not mandatory. The teachers will be hired from abroad, developed countries.
- A thinking school will identify and select specific thinking tools that can be used across the curriculum. These tools will develop specific types of thinking and thinking processes.
- The students will develop an understanding of how they think and be able to articulate how they believe. Teachers will talk about thinking with their students.
- This solution can apply to both primary and secondary schools.

C. *Solution Three: Use the current system with more support*

- Increase education funding and provide more opportunities for the outstanding.
- Enhance the old-fashioned curriculum and involves the technology to facilitate and ensure the delivery of information.
- Develop personal skills and enhance the diversity in gifted education.

VI. METHODOLOGY

A. *Measures of Effectiveness (MOEs)*

A Measure of Effectiveness (MOE) is a system engineering concept that identifies the types of measures that will be collected in order to evaluate system performance (e.g., operational availability, mission performance, safety, and so on) Measures of Effectiveness can help in comparing operational requirements, define its values and be used as the standard of acceptance for the solutions [9]. Table I explains the differences between the three proposed solutions.

The Authors measured and evaluated the system performance of the three proposed solutions by looking at what constitutes a top performer. They leverage the literature reviews that they already read to collect information about the values of each one of the proposed solutions. The authors use their experience and knowledge to evaluate proposed solutions characteristics as well as cultural fit.

Table I gives us a big picture of the proposed solutions. When we compare the three solutions, we notice that the overall score of the first alternative is high, alternative 2 is Medium, and the overall score of the third alternative is low. Therefore, based on the MOEs comparison table, the preferred solution is finding a new educational way of thinking.

a) *The MOEs are defined as the following:*

- **Cost of Implementation:** The costs that are incurred during the design and construction process.
- **Efficiency:** The ability to avoid wasting materials; energy; efforts; money; and time doing something or in producing the desired result.
- **Performance:** The ability to rapidly provide the data of students, schools, and prospective teachers in real time as needed.
- **Ease of Implementation:** The ease to diagnose and track down an error.
- **Social Benefit:** The increase in the welfare of a society that is derived from this project such as greater social justice.

TABLE 1: MEASURES OF EFFECTIVENESS

Low: SYSTEM PERFORMANCE IS POOR. **MEDIUM:** SYSTEM PERFORMANCE IS AVERAGE. **High:** SYSTEM PERFORMANCE IS EXCELLENT.

MOEs	Solution 1 (Find a new educational way of thinking)	Solution 2 (Creating a thinking school)	Solution 3 (Do nothing)
Cost of Implementation	High (3)	High (3)	Low (1)
Efficiency	High (3)	Medium (2)	Low (1)
Performance	High (3)	Medium (2)	Low (1)
Ease of Implementation	Low (1)	Medium (2)	High (3)
Social Benefit	High (3)	Medium (2)	Low (1)
Total MOEs Score	13	11	7

B. Risk Management

Risk management involves understanding, analyzing, and solving issues that pose a significant risk to make the systems achieve their objectives. Once the risks are identified, a good plan should be created in order to minimize or eliminate the impact of negative events. There are several different types of risks [53] that risk management plans can mitigate (e.g., failures in projects, and the security and storage of data and records). The idea behind using risk management is to protect the project from being vulnerable [9].

In Table II, the risks are divided into three different areas: high risks, medium risks, and low risks. These risks should be monitored for any change in their risk ranking. The high risks (A, B and C) will be avoided by working with engaging in special control efforts through the planning stage of the project. Then, the medium risks (D) should be managed and monitored carefully to avoid become high risks. Table III and IV show the risk after risk mitigation is taken.

TABLE II. ANALYSIS OF RISK MANAGEMENT

	Risk	Likelihood	Impact	Action (Response)
A	Religious people	Very High	High	Remove any holiness around any religious/high-rank officials, so students/community would focus on their ideas/messages instead of their sanctity.
B	Trained teachers	Very High	Medium	Implement professional development programs for teachers.
C	Funding	Medium	Very High	The government will get funds from the national budget. This is Important to boost long-term non-oil development through focused investment programs.
D	Culture	Medium	High	Encourage and build centers in every community for people in order to practice critical thinking by discussing various topics, as any typical community usually encounter.

TABLE III. RISKS MATRIX FOR THE SYSTEM

		Impact				
		Very Low	Low	Medium	High	Very High
Likelihood	Very High			[B]	[A]	
	High					
	Medium				[D]	[C]
	Low					
	Very Low					

TABLE IV. RISKS MATRIX AFTER RISK MITIGATION

		Impact				
		Very Low	Low	Medium	High	Very High
Likelihood	Very High	[A]				
	High					
	Medium	[C]				
	Low	[B]		[D]		
	Very Low					

TABLE V. VERIFICATION OF THE REQUIREMENTS

#	System Requirements	Verification Techniques
1	The system shall provide a teaching approach that encourages students to question and challenge existing beliefs, structures, and practices.	Demonstration (Adding logical and critical thinking class in elementary school. Children in this age are the most impressionable.)
2	The system shall minimize the approach to learning through rote memorization in the Saudi educational system.	Testing (Incorporate a final project for science classes rather than total reliance on exams.)
3	The system shall integrate critical thinking skills into teacher preparation for current teachers.	Testing (Teacher preparation workshop will end up with a comprehensive exam)
4	The system shall train prospective teachers to emphasize effective thinking strategies.	Demonstration (Develop training classes for teachers that emphasize different strategies of critical thinking and implement them.)
5	The system shall teach the student to seek evidence to support assumptions and beliefs.	Demonstration (Develop training materials embedded in the curriculum to support and fuel students' interest and fascinations.)

VII. VALIDATION AND VERIFICATION METHODS

The validation process will check that system specifications are meeting stakeholder needs. Verification involves verifying that the program conforms to its specifications, while validation involves verifying that the program as implemented meets the expectations of the stakeholders [9].

Table V lists all the requirements and indicates how they are verified by using four verification methods include inspection, demonstration, analyzing and testing [10].

A. Systems Architecting Approach/ Process

Systems Architecture is a part of the systems engineering process that can be seen as a deliberate approach to deal with the uncertainty characterizing complex, unprecedented systems. An architecture framework establishes a common practice for creating, interpreting, analyzing and using architecture descriptions within a particular domain of application or stakeholder community [16].

B. Operational Activity Model diagram (OV-5)

The OV-5 describes capabilities, operational activities.

C. Heuristic Approach

System Architecture has both a descriptive part and a prescriptive part. Heuristic methods are used to accelerate the process of finding a solution to a problem. Here are beneficial heuristics that were chosen specifically to be used for architecting this system:

- **Risks are impossible to detail completely and correctly but can be controlled by frequent and early numeric feedback and change.** Analysis and mitigation of risk management were conducted on the system to identify potential problems associated with its implementation. The system will use metrics such as the rate of students failing to check if the system is completing the intended goal.
- **Systems need to be built to tolerate change and expansion beyond current stakeholder needs.** The proposed system is designed to meet the changing needs of the students and their families. Furthermore, it is important to plan and stay ahead of current stakeholder needs as they change with the times. The proposed system is upgradeable.

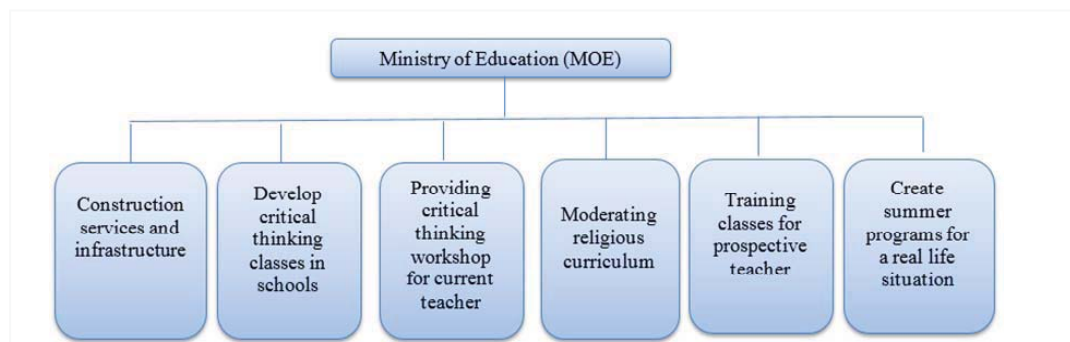


Fig 2. Operational Activity Model

Ethical iss

The countries in the middle east and north Africa need to implement the concept of critical thinking from the backbone, which is education, from an ethical viewpoint. From our observation, the people in positions of power, in the government, are not thinking critically when making ethical decisions concerning the citizens. It is imperative to use critical thinking and ethical decision making in tandem to achieve the optimal result. The balance is a delicate and often complex. It requires a close examination or critically thinking, of all the issues for the community as a whole. For example, Saudi Arabia refuses even to consider allowing women to drive.

a) Four Ethical Lenses:

- **Rights:** Implement critical thinking in educational curricula is important, and The Ministry of Education is committed to ensuring that every student is able to understand the logical connections between ideas that he/she learns from the curricula.
- **Justice:** Justice is served when the benefits in society are distributed in accordance with principles that rational persons would accept as consistent with their interests. Implement critical thinking in all schools will help to achieve this principle by distributing the benefits that meet the interests of students equally.
- **Utility:** Parents want their children to develop good characters, appreciate the good life, and be generally civilized human beings. Of course, they want an exquisite educational environment for their children, and an educational curriculum that allows them to find the necessary life needs of students, and away from radicalism and extremism.
- **Virtue:** Thus, an ethical evaluation of educational services needs to consider the intent of The Ministry of Education and how a particular campaign is executed such as the use of the slogan: "keep calm and be a critical thinker."

Educators have to participate in the construction and development of these countries, and they should contribute by researching to improve and raise the level of education and development projects in their country. The purpose of this study that we would like to facilitate the services in the education system and our goal is to improve the performance and raise the production efficiency of the Ministry of Education. Therefore, we extract some recommendations for the top management in the ministry of education in these countries including:

- Implement critical thinking in the curriculum of the educational system.
- Education should seek to prepare learners for self-direction and not pre-conceived roles. It is, therefore, essential that learners be prepared for thinking their way through the maze of challenges that life will present independently.
- One of the significant aims of education is to produce learners who are well informed, that is to say, learners should understand ideas that are important, useful, beautiful and powerful.
- Another is to create learners who have the appetite to think analytically and critically, to use what they know to enhance their own lives and also to contribute to their society, culture, and civilization.
- Provide in-service training for teachers, and assign mentors to new teachers.
- Allot time for teachers to share effective strategies for instruction; involve experienced teachers in the selection of instructional materials and testing programs.
- Appoint a committee to guide curriculum development.

IX. LESSONS LEARNED FROM THE SYSTEM ENGINEERING STUDIES

Learning again experiences resulting from education over time, and it is an excellent value of the many countries that have been interested in this sector and monitoring and providing both funds and studies for development. Therefore, they can rely on the educational power to promote all their other institutions, including economic, social, political, judicial, and so on. However, they need to focus on the following main points:

- While the traditional role of educational institutions is teaching the many individual topics, they should focus on the new ways of education systems
- It is necessary to understand and manage requirements in order to solve complex problems.
- It is imperative to identify all risks early, to allow the system to be built in a way that reduces potential threats to the integrity of the system.
- Deciding which is the best system to resolve the problem considering all sides requires analysis of the proposed alternatives.

X. CONCLUSION

Most of the countries believe that enhancing the education systems will lead to developing the countries and prosperity of other sectors. Therefore, the way how to improve education has become significantly important and the attention of the researchers. While many countries in the Middle East and North Africa give a high priority to developing the education system, many challenges and issues turn off these countries to reach their goal. Education is the process of communication with the human mind to communicate the knowledge, skills, values and societal customs that are produced from generation to generation. Most of the Middle East and North Africa countries' education system is facing real predicament and, with the current system, this cycle will continue from one generation to the other until it completely distorts society on the economic and political level. Saudi Arabia and Libya are still striving to respond to the evolution in education, and they need to work on the current obstacles such as attracting quality teachers, improving the operating environment, lack of scale and professional management. The liberal education environment is an essential step to change the prevailing thinking and fight backward beliefs. Therefore, implement the concept of critical thinking in their education system is essential to widen the intellectual horizons of students, to follow true passions, and cultivate a stronger and healthier environment for the student regardless of the field he or she decides to practice. The critical thinking skills are tools for a cohesive social mission. The benefits of critical thinking transcend school life, enhancing the quality of life and professionalism greatly in the workplace. Thus, Understanding the nature of critical thinking and the current education system will help to ensure the development and delivery of the curriculum in developing countries.

REFERENCES

- [1] R. J. Leary, *Oil and finance: the epic corruption, from 2006 to 2010*. Bloomington: iUniverse, Inc., 2011.
- [2] P. P. Bilbao, L. I. Paz, I. C. Tomasa, and J. B. Rodrigo, "Curriculum development." *Childhood Education* Vol. 81, no. 1, pp 33-35, 2008.
- [3] R. Sedgwick, "Education in Saudi Arabia," WENR, World Education Services, 2001. [Online]. Available: <http://wenr.wes.org/2001/11/wenr-nov-dec-2001-education-in-saudi-arabia>. [Accessed: 21-Dec-2018].
- [4] R. Sedgwick, "Education in Saudi Arabia." *World education news and reviews* 16, 2001.
- [5] "Government budget data for the Year 1433H (2012G)," Ministry of Finance, Saudi Arabia, Available: <http://www.mof.gov.sa/en/docs/stats/docs/book4.xls>. 2015
- [6] R. H. Ennis, "Critical thinking and the curriculum," *Thinking skills instruction: Concepts and techniques*, pp.40-48, 1987.
- [7] "GCC Education Overview: Current Performance and Future Priorities," GCC Education Leaders Conference, 28-Nov-2007. [Online]. Available: <http://www.essamalzamel.com/wp-content/uploads/2007/12/deck-gcc-education-overview-d.pdf>. [Accessed: 23-Dec-2018].
- [8] A. King, "Designing the instructional process to enhance critical thinking across the curriculum," *Teaching of Psychology*, vol. 22. no.1, pp.13-17, 1995.
- [9] P. A. Facione, "Critical thinking: What it is and why it counts." *Insight assessment*, 1992.
- [10] G. J. Roedler, and L. Martin, "Technical Measurement: A Collaborative Project of PSM, INCOSE, and Industry," *Practical Software and System Measurement (PSM) and Measurement Working Group (INOSE)*, Available: <http://www.incose.org/docs/default-source/ProductsPublications/technical-measurement-guide---dec-2005.pdf?sfvrsn=4>. 2005
- [11] C. Haskins "Systems Engineering Handbook A Guide For System Life Cycle Processes And Activities," *INCOSE Systems Engineering Handbook*, INCOSE-TP-2003-002-03, 2006.
- [12] E. Reichtin, "Systems Architecting: Creating and building complex systems." Englewood Cliffs, NJ: Prentice-Hall, Vol. 199, no. 1, 1991.
- [13] S. J. Kapurch, "NASA systems engineering handbook." Diane Publishing, 2010.
- [14] System Requirements. (n.d). Retrieved October 2015 from SEBoK Wiki: http://sebokwiki.org/wiki/System_Requirements
- [15] C.E. Johnson, *Meeting the ethical challenges of leadership: Casting light or shadow*. Thousand Oaks: Sage, 2005.
- [16] G. Stoneburner, A. Goguen, and A. Feringa, "Risk Management Guide for Information Technology System," National Institute of Standards and Technology, Special Publication 800-30, p 1, July 2002.
- [17] C. C. Tang, SELP 530 Lectures. Personal Collection of Professor Charles C. Tang, Loyola Marymount University, February 2015.
- [18] SQA. (2006). *Verification and Validation*. HN Computing. Retrieved October 2015 from http://www.sqa.org.uk/elearning/SDPL03CD/page_16.htm
- [19] L. Wheatcraft. (2012, October 17). *Use of Multiple Verification Methods*. [Web log comment]. Retrieved October 2015 from <http://www.reqexperts.com/blog/2012/10/use-of-multiple-verification-methods/>
- [20] A. Erkki, K. Pitkanen, and P. Sahlberg, "Policy Development and Reform Principles of Basic and Secondary Education in Finland Since 1968. *Education Working Paper Series*. Number 2." Human Development Network Education, 2006.
- [21] H. Morgan, "Review of Research: The Education System in Finland: A Success Story Other Countries Can Emulate. *Childhood Education*," 90(6), pp 453-457, 2014.
- [22] C. Wiczorek, "Comparative Analysis of Educational Systems of American and Japanese Schools: Views and Visions," *Educational Horizons*, Vol. 86, No. 2, pp. 99-111, 2008.
- [23] C. Lewis and I. Tsuchida, "Planned educational change in Japan: the case of elementary science instruction," *Journal of Education Policy*, vol. 12, no. 5, pp. 313-331, 1997.

- [24] F. Kitagawa and J. Oba, "Managing differentiation of higher education system in Japan: connecting excellence and diversity," *Higher Education*, vol. 59, no. 4, pp. 507–524, 2009.
- [25] W. K. Cummings, *Education and Equality in Japan*. Place of publication not identified: Princeton University Press, 2016.
- [26] N. S. Ahmad and S. S. G. *, "Changes, problems and challenges of accounting education in Libya," *Accounting Education*, vol. 13, no. 3, pp. 365–390, 2004.
- [27] A. Othman, C. Pislaru, T. Kenan, and A. Impes, "Analysing the effectiveness of IT strategy in Libyan higher education institutes." *International Journal of Digital Information and Wireless Communications (JDIWC)* 3, no. 3, pp 114-129, 2013.
- [28] A. Tamtam, F. Gallagher, A. G. Olabi, and S. Naher, "Higher education in Libya, the system under stress," *Procedia - Social and Behavioral Sciences*, vol. 29, pp. 742–751, 2011.
- [29] H. Delinda, "Libya: Looking Toward a Post-Lockerie Future; Libya Invests in Its People's Education." *The Washington Report on Middle East Affairs* 20, no. 2, 58, 2001.
- [30] M. Fetouri, "In Libya, the education system suffers more than most," *The National*, 15-Nov-2016. [Online]. Available: <https://www.thenational.ae/opinion/in-libya-the-education-system-suffers-more-than-most-1.211393>. [Accessed: 20-Dec-2018].
- [31] H. A. Zaher, "Libya's education minister decries war-wrought devastation on students | Hassan Abdel Zaher," *The Arab Weekly (AW)*, 18-Mar-2018. [Online]. Available: <https://thearabweekly.com/libyas-education-minister-decries-war-wrought-devastation-students>. [Accessed: 20-Dec-2018].
- [32] A. M. Alzain, S. Clark, and G. Ireson, "Libyan Higher Education system, challenges and achievements," 2014 IEEE 6th Conference on Engineering Education (ICEED), 2014.
- [33] "Legatum Prosperity Index 2016," 2016. [Online]. Available: https://www.prosperity.com/download_file/view_inline/2857. [Accessed: 20-Dec-2018].
- [34] "Legatum Prosperity Index 2017," 2017. [Online]. Available: <https://lif.blob.core.windows.net/lif/docs/default-source/default-library/pdf55f152ff15736886a8b2ff00001f4427.pdf?sfvrsn=0>. [Accessed: 20-Dec-2018].
- [35] "Legatum Prosperity Index 2018," 2018. [Online]. Available: https://prosperitysite.s3-accelerate.amazonaws.com/2515/4321/8072/2018_Pro Prosperity_Index.pdf. [Accessed: 20-Dec-2018].
- [36] A. M. Elkaseh, K. W. Wong, and C. C. Fung, "The Acceptance of E-learning as a Tool for Teaching and Learning in Libyan Higher Education." *IPASJ International Journal of Information Technology (IJIT)*, Volume 3, Issue 4, pp 1-12, 2015.
- [37] N. Azoury, *Business and society in the Middle East: exploring responsible business practice*. Cham, Switzerland: Palgrave Macmillan, 2017.
- [38] [001] J. Hemsley-Brown, "'The best education in the world': reality, repetition or cliché? International students reasons for choosing an English university," *Studies in Higher Education*, vol. 37, no. 8, pp. 1005–1022, 2012.
- [39] [002] D. Broomfield and G. M. Humphris, "Using the Delphi technique to identify the cancer education requirements of general practitioners," *Medical Education*, vol. 35, no. 10, pp. 928–937, Dec. 2001.
- [40] D. Vandewalle, "Libya since independence: oil and state-building," Cornell University Press, 2018.
- [41] S. Almalki and L. Ganong, "Family Life Education in Saudi Arabia," *Global Perspectives on Family Life Education*, pp. 381–396, 2018.
- [42] R. H. Ennis, "A concept of critical thinking," *Harvard Educational Review*, vol. 32, no. 1, pp. 81-111, 1962.
- [43] R. H. Ennis, "A logical basis for measuring critical thinking skills," *Educational leadership*, vol. 43, no. 2, pp. 44-48, 1985)
- [44] R. H. Ennis, H. Robert "Critical thinking assessment." *Theory into practice* vol. 32, no. 3 179-186, 1993.
- [45] M. Wilgis, and J. McConnell, "Concept mapping: An educational strategy to improve graduate nurses' critical thinking skills during a hospital orientation program," *The Journal of continuing education in Nursing*, vol. 39, no. 3, pp.119-126, 2008.
- [46] B. J. Daley, C. A. Shaw, T. Balistreri, K. Glasenapp, and L. Piacentine, "Concept maps: A strategy to teach and evaluate critical thinking," *Journal of nursing education*, vol. 38, no. 1, pp. 42-47, 1999
- [47] N. C. Burbules, and R. Berk, "Critical thinking and critical pedagogy: Relations, differences, and limits," *Critical theories in education: Changing terrains of knowledge and politics*, pp. 45-65, 1999.
- [48] D. Kuhn, "A developmental model of critical thinking," *Educational Researcher*, vol. 28, n. 2, pp.16-46, 1999.
- [49] B. J.Daley, C. A. Shaw, T. Balistreri, K. Glasenapp, and L. Piacentine, "Concept maps: A strategy to teach and evaluate critical thinking." *Journal of nursing education*, vol. 38, no.1, pp. 42-47, 1999.
- [50] C. Thompson, "Critical thinking across the curriculum: Process over output," *International Journal of Humanities and social science*, vol. 1, no. 9, pp. 1-7, 2011.
- [51] B. Brende and World Economic Forum, "Why education is the key to development," *World Economic Forum*. [Online]. Available: <https://www.weforum.org/agenda/2015/07/why-education-is-the-key-to-development/>. [Accessed: 09-Jan-2019].
- [52] T. Thomas, "Re: Re: How do we improve the education system?," *Big Think*, 06-Oct-2018. [Online]. Available: <https://bigthink.com/re-re-how-do-we-improve-the-education-system-3>. [Accessed: 09-Jan-2019].
- [53] R. Khalifa and R. Stewart, "Survey of value assessment programs within transportation construction projects in US." 2016 Portland International Conference on Management of Engineering and Technology (PICMET). IEEE, 2016.
- [54] M. Saadatmand, M. Dabab and C. Weber, "Dynamics of Competition and Strategy: A Literature Review of Strategic Management Models and Frameworks." 2018 Portland International Conference on Management of Engineering and Technology (PICMET). IEEE, PP. 1-14, 2018.