SITUATED DECISION MAKING IN MATHEMATICS EDUCATION

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Mathematics education is a social phenomenon, not like a distinct part of the society which could be influenced by social events, but as an evolving and active part of a whole body of society. Non-stopping interaction between changing world, education and mathematics, and the failure of traditional, static programs in mathematics education, emerges the need for more intelligent and efficient decisions to increase desired effects of changes, reduce unwilled ones or/and change the undesired effects to desired and positive effects. These are subtle decisions, which should be situated and dynamic and driven in the entire system of mathematics education .We call them Wise Decisions or WDS. This paper considers the identifications and the important concerns of WDS.

INTRODUCTION

We can not stop social influence on mathematics education. As a matter of fact mathematics education is a social phenomenon, not like a distinct part of the society which could be influenced by social events, but as an evolving and dynamic part of a whole body of society. As Popkewitz(1998) says: " our social conditions contain a host of elements that interact in ways that are never fully specified, predetermined, anticipated, or willed". Brookes also argues that: "The recognition that the world is changing rapidly casts doubt on any programme which depends on rigidly defined propositions embodied in a static educational theory not capable of responding to environmental change." It could be claimed that any static decision made for the sake of mathematics education improvement, distinct from social and cultural concerns, leads to failure.

The relation between society, culture and education is not a one way road. Social and cultural attitudes influence education and consequently, any change in educational attitudes and approaches affects society and culture.

Non-stopping interaction between changing world, education and mathematics, and the failure of traditional, static programs in mathematics education, does mean that the role of human decision for designing successful plans has reduced, but it means that we need more intelligent and efficient decisions to increase desired effects of changes, reduce negative, unwilled ones or/and change the undesired effects to

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desired and positive effects. In this way, we may suppose that: "*what affect mathematics education, might be changed to a facility or even a need in it"*.

Any mutual interrelationship have desired and undesired effects. For example, development of technology and computer science which leads to widespread usage of computers at society affects students' attitudes, behaviour and even mental abilities. This social fact could be used as a useful or even necessary tool for development of education. A good example is CAS (computer algebra systems).(positive application of a social fact) On the other hand, this useful equipment may be even harmful for education in another place, like a small village whose students are not even familiar to basic computer skills.(undesired effect).Of course, improving students' computer skills changes the situation to a positive one, but this is not the immediate sequent of technology in an unskilled society, it needs wise decisions and actions to change the situation to our desired form.

WISE DECISIONS

How can social and cultural factors which influence mathematics education be distinguished and how can be these effects changed to desired ones? The answer is not always as simple as aforementioned situations.

Clarifying the most effective factors and making the best decisions for filtering or changing the negative effects is time-dependent. These are subtle and complicated decisions. We call them *"wise decisions"*. These decisions must be dynamic and situated because of the dynamic nature of society at whole and education as a part of it. Wise decision system is not only responsible to answer the general questions like whether "mathematics curriculum should be global or local" or "which content is more suitable for lesson books" or even "how culture affects education'. Of course these are important questions but what specifies *wise decisions system (WDS)* is the dynamic and adapting nature of them. WDS deals with other important questions like: "How can we make the most benefit from unpredictable international, cultural, social or/and ethnical effects, even if they are not willed, in our educational system?", "How can we reduce undesired negative effects on mathematics education or probably change them to positive effects?" or "How should we make situated and emergent decisions in unpredictable and fast-changing situations?". WDS frequently gets feedback from existing situations and reorganizes itself.

Feedback loops between WDS components needs communication. Detecting the reflected data from each feedback loop, gathering the useful information and making the best decisions due to the situation needs expert manner of well- trained human participants.

Figure 1 shows the filtering function of WDS in changing the undesired effects on mathematics education to desired effects.

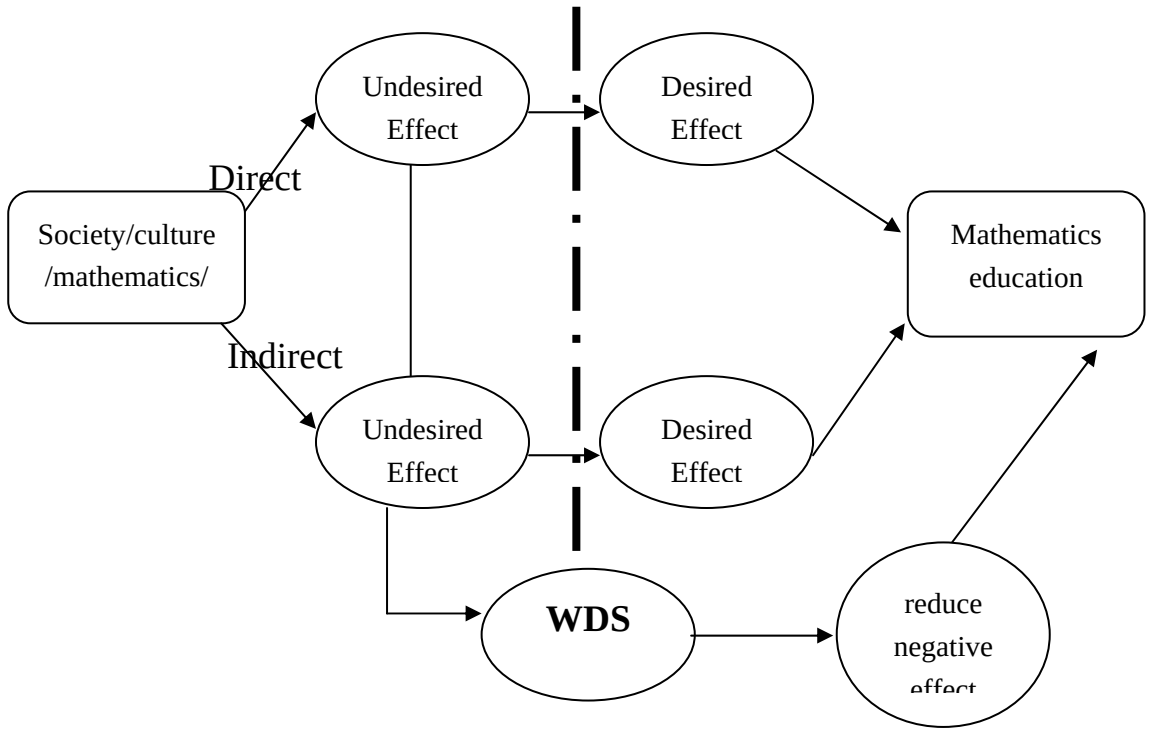


Figure 1. Deriving desired effects from undesired situations

MAIN CONCERNS OF WISE DECISIONS

In “MAPS” model introduced by Hingginson Mathematics education is supposed to be a point whose position changes each time among the inner space, edges or vertexes of a polygon. Vertexes are “M” for mathematics, “A” for anthropology, “P” for psychology and “S” for society, as affecting factors on mathematics education. We claim that this point never locates exactly on edges or vertex but only inside the polygon. There are fuzzy boundaries between the affecting factors on mathematics education. How ever, we improve and use these factors as the aspects which might be concerned in “wise decisions”.

The important concerns of wise decisions seem to be:

1. Mathematics
2. Psychology
3. Anthropology
4. International trends
5. Society and Culture

We have added the “international trends” as an affecting factor on mathematics education, because approaches and attitudes in Mathematics and mathematics

education differ in many aspects in international societies. There might be even many contradictions between mathematicians and mathematics educators' views, but both, the international accepted results of studies in mathematics education and universal Mathematics introduced by mathematicians, affect the mathematics education in a society.

The link between these items is "education" which has caused more interaction between the affecting factors on mathematics education. Even in content- oriented approaches, such as "new mathematics", no content of mathematics could be applied in lesson books without being" chosen" or "modified". On the other hand, the recent "new-new mathematics" which was strongly criticized because of paying less attention to the basics of mathematics in education, still needed some mathematics to be taught in so called" new-new" methods.

Kemmis and McTaggart(1998), have argued that in the case of mathematics education and cultures, the main criterion to be employed for choosing a culture and then improving it, should be " rationality and justice".

However, these items should be in conformity with "rationality" and "justice", i.e. any wise decision considering the main concerns of mathematics education (mathematics, society, values...) should pass "rationality" and "justice" filters.

For example, intending values in mathematics education should not contradict to rationality. On the other hand, Conformity with national trends is rational but it should be justified through social, cultural and anthropological concerns of a region or a nation. Whatsoever, the frequent balance and interaction between "rationality" and "justice" would be the final passing filter for any decision, and is mostly due to human conscious.

WISE DECISION IDENTIFICATIONS

The lack of wise decision system (WDS), results in undesired effects on the system of mathematics education. International trends and decisions in mathematics education impose themselves to local educational system. Any conflict between adopted curriculum from international societies in one hand, and culture of a region in the other hand, makes embarrassing situations for teachers and students.

In the case of poor decisions, some solutions and decisions might be dictated to each part of the local educational system, including teachers and students. These would be, as Clements and Elerton declare, *top-down* decisions. But it is not always easy to separate the decision makers from the processes of decision making and any separation would be artificial. In fact, each part of the mathematics education system could be a potential decision maker. In real situations, the entire system of mathematics education (researchers, administrators, teachers, students...) deals with frequently renewed problems and solutions. The events and processes in human life at whole and mathematics education system in particular, are characterized by

complex nonlinear dynamics - they arise, evolve and disappear as a direct result of interaction of many interwoven factors. These are the same factors which influence human decision-making in WDS. WDS dictates no certain solution, nor even problem, but it can aid decision making by providing information relevant to the decision and to the decision makers.

According to Vladimir Dimitrov, decision making requires division and separation. The decision maker needs to extract out of the available information (related to a decision situation under concern) at least three independent constituents:

(1) set of alternatives to choose from;

(2) set of criteria to satisfy;

(3) a goal (or set of goals) to achieve.

After analyzing the above constituents, a specific procedure is sought in an attempt to connect them in an 'optimal' way. These are general characteristics in any domain of decision making including mathematics education. Many goals and sub goals as well as alternatives for decision making, in the case of mathematics education might be identified, the main criterion for justifying decisions, as was argued before, might be rationality and justice. WDS includes all these constituents but specifically it provides facilities for decision making in real dynamic and unpredictable situations. In such conditions, there might be few alternatives to choose from and even the goals might be emerged in situation.

As a matter of fact, in real situations, as Vladimir Dimitrov declares, *decision emergences* are needed rather than decision making. He says: "*Decision emerging* does not require division and separation - on the contrary, it depends crucially on the ability of the *decision-initiators* (persons or groups responsible for initiating the process of decision-emerging) to fully experience decision situations. The emergence is never in past or in future. Decision emerges *now* - in parallel with the act of experiencing the unfoldment of life. That is why the personal (or group) awareness (alertness, vigilance) is a vital factor in decision emergence."

Similarly, in-time decisions of teachers emerge from in-time interaction between teachers and students. WDS is responsible to prepare and train teachers for confronting decision emergences.

Briefly, WDS should provide following capabilities for each part of the system:

1. situateded Decision (action in time.)
2. prediction
3. communication and interaction
4. wareness
5. self organizing and adapting nature

Communication between parts of WDS is of great importance. Mathematics education researchers, mathematicians, administrators, teachers and … should frequently interchange information and experiences to be aware of the recent problematic of mathematics education and suggesting solutions. Communication increases the knowledge of each part. By enough amount of information and knowledge, prediction is possible.

Figure 2 represents a model for the communication between some components of mathematics education system; there are certainly much more interacting components in the system of mathematics education.

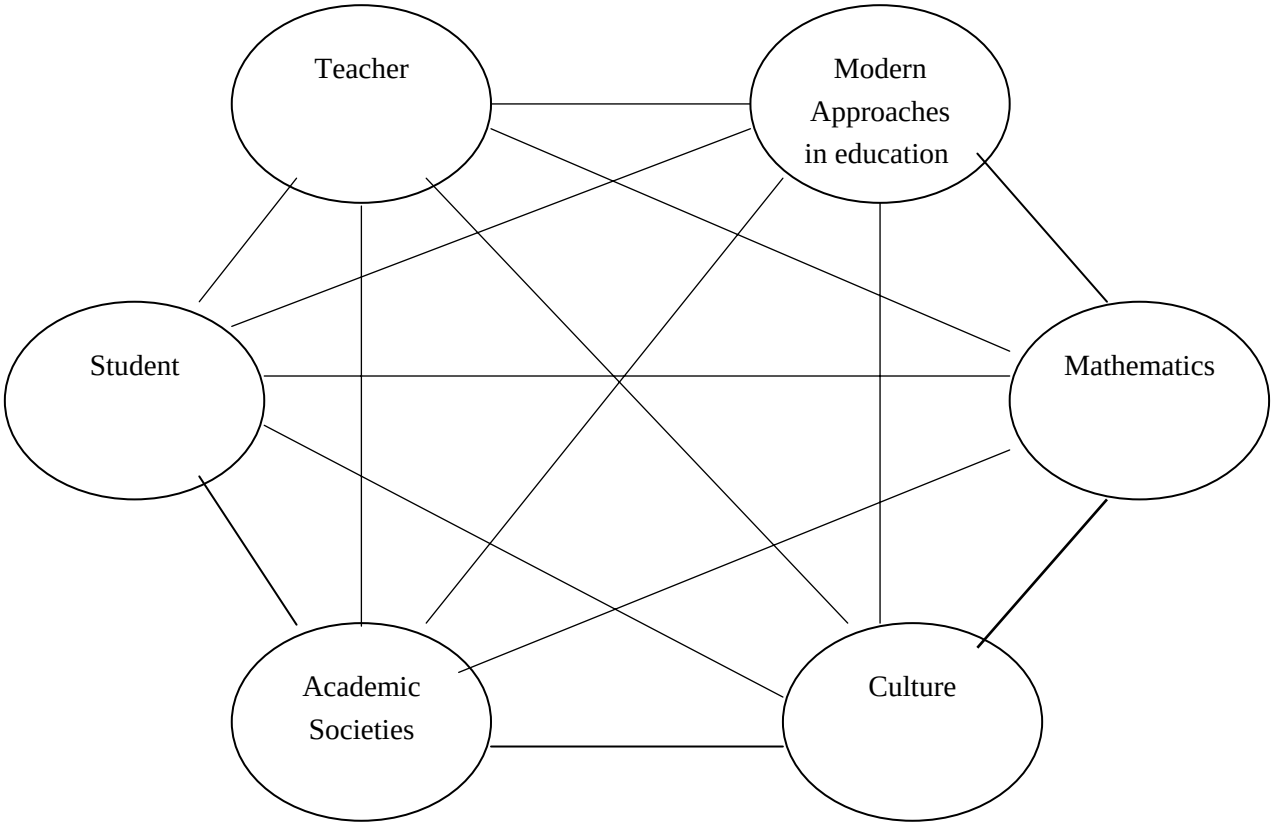


Figure2. Diagram of WDS communication

It may seem that this diagram represents an ideal and impractical situation. Of course the links between *modern approaches* and *academic societies* is not the same as *modern approaches* and *students*. In fact there may be no direct link between *modern approaches* and *student*, but this connection is not either impossible. So the connecting links between components might be assumed weighted. WDS is to improve the links of communication between the components whose interaction have the most influence on mathematics education.

ILLUSTRATING EXAMPLE

Now we consider one of the main concerns of mathematics education, i.e. “mathematics for all” and “mathematics for elite” and the local and international possible reactions, decisions and possible problems related to these matters, as an

example. Meanwhile, we show that most of related decisions are not wise decisions in the case of local situations.

C1- International trend: equity in mathematics education, non- Elite mathematics

Decision: international conferences, meetings, plans (UNESCO report in 1984; NCTM standards, Mathematics for all; designing research for developing non-elite curriculum).

WD: attempting to internationalize the results of studies, seeking for more communication ways between different countries.

C2- Academic Mathematics: mathematics knowledge has decreased among college students.

Possibility: most students have not been qualified enough in mathematics before entering universities and colleges./ They are not interested in mathematics.

Decision: more and more students should be failed in final exams of universities to take the matter serious.

Decision: examinations should be easier in order that more students could pass the exams.

WD: setting more communication opportunities between mathematics professors and mathematics education experts, seeking for the roots, trying to modify students' attitudes. (Communication, situated action)

C3- Educational administration: the majority of the high school students show little interest in mathematics.

Possibility: Teachers can not motivate students to learn mathematics.

Possibility: Students are not successful in mathematics examinations.

WD: setting more in- service teacher training courses to inform teachers from newest approaches of mathematics education and the results of researches. (i.e. Mathematics for all, developing non-elite curriculum(communication)/ changing the format of school examinations(studies shows that there might be a relation between elitist views on education and achievement tests.)

C4- Teachers: most high school students are not interested in mathematics/ few students are able to use their mathematics knowledge in real life/mathematics is science of elite

Decision: taking more difficult exams in order that the majority non- elite try their best to pass the final exams.

Decision: taking easier exams in order to satisfy school principals and students' parents by the results of the exams.

Decision: do nothing at all and waiting for top-down decisions

WD: consulting with experts, getting information about equity in mathematics or non-elite mathematics from different resources, trying to modify students' attitudes toward mathematics. - One simple way is to tell some stories about the mistakes that great mathematicians have done in history .This may break the huge wall of the *elite* which does not allow students to learn mathematics. (Situated action)

C5- Local mathematics education researchers: awareness of recent educational reforms, mathematics for all. / Mathematics should not be concerned as an elitist discipline any more.

Decision: Doing their own studies without any concern of the realities in schools of Iran.

Decision: Doing something about the teachers' and students' attitudes toward mathematics as a solution for increasing the interest in mathematics, among the students.

WD: Giving consult to educational administrations, / conducting pre/in- service teacher training courses to inform teachers./ being a mediation between international and local societies of education./ designing and conducting studies related to this subject and reporting the results to all.

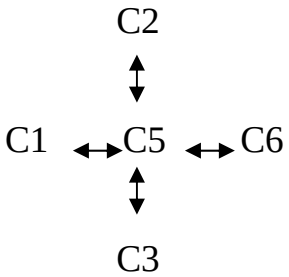
C6- Parents and students: Mathematics is necessary for students' future progress in society / mathematics is the science of **elite**

Decision: parents blame their children for being not talent in mathematics and force them to try hard, / parents encourage their children to attend in out-school institutions for increasing their mathematics knowledge.

Decision: students try their best/ they become disappointed. They feel that they are not able to learn mathematics and give up.

WD: getting consult from experts in the field of mathematics education through communication

Obviously, some links in WDS communication network are more significant than the others. For instance, the connections:



might be more significant than the connection: C1 ↔ C6 ↔ C2.

Many Iranian teachers and students think very high about mathematics. A recent study in the district 1 of Tehran education department shows that about 80% of mathematics teachers believe that "*Mathematics is the science of Elite"* (C4). Iranian students and educational administrators believe more or less the same (C1 and C3). This belief affects teachers' behaviour. Also, teachers' beliefs about students' ability and learning greatly influence their instructional practices. Teachers with this attitude do not attend to make decisions for changing the top- down imposed elitist mathematics program for the benefit of the non-elite majority. In these circumstances situated decisions are meaningless. By this view, students who are not Elite (nearly most of them), do not deserve themselves to be qualified in school mathematics and do not try hard, and educational administrators do not make serious decisions for the benefit of the majority *non-Elite*, because it is useless! Parents also do nothing except blaming children for being not talent and hard working. (C6)

The problem that "Mathematics *for Elite*" has caused in education has been an international concern since 1980s' and is not a new one. (C1)

D'Ambrosio (1985,1989) have argued that, in the past, school mathematics has been an elitist affair, especially suited for the preparation of middle- class males for prestigious professions such as engineering and natural sciences. According to Clements and Elerton, what is needed, D'Amborsio (1984, 1994) has argued, is a totally new approach whereby different mathematics curricula are developed, always with the specific needs of existing group and potential learners in mind. The NCTM Curriculum and Evaluation Standards for School Mathematics advocates "mathematics for all" as a central idea in education reform. The Draft for "Standards 2000' from the NCTM (NCTM 98) calls for increased equity by exposing all students, not just the elite, to challenging mathematics. (Decisions on C1) In-service Teacher Training is a suitable way of informing teachers from recent problematic of mathematics education and equipping them with suitable techniques for making decision in-time.(WDS)

In short, many of decisions in mathematics education of Iran are not wise decisions. Teachers are obliged to execute the top-down decisions in their classrooms. For this reason they have little opportunity to make decisions and act due to the occurred situations on their own authority. Almost the entire Teachers 'in-service training in Iran deals with developing teachers' scientific or professional knowledge domain. Training courses give little information about recent educational approaches in the world. They are not even in touch with local academic societies and mathematicians. (Lack of communication) Mathematics education is a new branch in universities of Iran. Most of the academic studies in this field reflect little about the reality of mathematics education in Iranian schools. The main concerns and purposes of the academic studies in mathematics education are determined by international trends rather than by local situations. (Lack of communication)

The first and the most important step for establishing a network of WDS in Iran seems to be communication. Mathematics education researchers should play the role of a media and a coordinator between international trends, and local societies of education. Teachers should be trained and equipped for deciding and acting in unpredictable, dynamic conditions by their own authority. Students will need to be more equipped to generate and work with their own accounts of the realities they face rather than rely too heavily on the accounts provided by their elders. Curriculum designers, meanwhile, perhaps need to be motivated more by needs and possibilities, based on movement from existing practices.

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