Practicing theory of constraints' thinking processes to develop distance education system

Article - May 2012

3 authors, including:

Leyla Şenol
Kocaeli University
13 PUBLICATIONS 4 CITATIONS
SEE PROFILE

Akman G.
Kocaeli University
36 PUBLICATIONS 319 CITATIONS
SEE PROFILE

Some of the authors of this publication are also working on these related projects:

Evaluation of alternative public transportation systems in İzmit urban transportation via axiomatic design method View project
Practicing theory of constraints’ thinking processes to develop distance education system

Vasfi Nadir Tekin*, Leyla Senol, Gulsen Akman
Kocaeli University, Kocaeli Vocational School, Kocaeli, Turkey

Abstract

Distance education in Turkey was first carried out with correspondence and then was followed with Distance Education System on TRT. However, thanks to the internet it is now tried to be performed concurrently and nonconcurrently. Due to some problems occurred in schools where distance education system has just been established, it is not possible to make use of this system as expected. It is accepted that theory of constraints is a suitable management philosophy for establishing and developing the systems. In this article, theory of constraints is used to improve current distance education system in a public university in Turkey. So as to do that first the adverse effects of previous system are defined. Then by applying steps of thinking processes, it is indicated how to develop current distance education system.

Keywords: Theory of constraints, Thinking processes, Distance education system

1. Introduction

Distance education (DE) is a teaching system in which communication and interaction between planners and practitioners of educational studies and learners are carried out from a specific center in specially designed teaching units and through various contexts on such conditions. The classroom activities cannot be managed due to the restrictions in traditional education system [1].

In other words, DE is a system of education where student and teacher communicate at the same or different time in different places thanks to the advanced technological tools. This system is practised by some universities and private institutions. Like all the other systems, since many problems come up while applying DE, it is not possible to benefit from the system as aimed. Therefore it is necessary to find out positive and negative sides of current applications, to improve positive sides, and to co-ordinate negative sides. For achieving this, the best method is thinking process of Goldratt’s theory of constraints. According to this method, first thing to do is identifying the root causes in production processes in manufacturing and service establishments by using current reality tree. Afterwards, it is demonstrated how to get rid of these causes with evaporating clouds. Later on, with pre-requisite tree, future reality tree and transition tree how to solve the problems in the system and how to establish the system expediently are indicated.

2. The past and content of the subject

In DE, students can provide their education needs by themselves. Even though the teacher and the student do not exist in the same place they can communicate with eachother via computer.

DE studies in Turkey trace back to 1920s. In the forth National Education Council assembled in 1949, some ideas were put forward regarding the education of large mass of people out of school. As of this date this idea has been tried to be improved with several practices. "The Correspondence Education Center" established in 1961, sustained its operation as an subsidiary of Ministry of Education. This institution gave education in various fields such as radio, hotel management, nutrition, electricity, cooperation. By 1975 “Common Higher Education Council” was established by Ministry of Education. Although this council maintained its services successfully, due to some reasons it was closed in 1980s. The DE practice was given to Anadolu University on July 20, 1982. In 1990 Firat University established a television in order to give education to the local community. With this development worldwide interest for DE appeared in Turkey as well. Hence, many universities still continue their practices in terms of this issue. In Turkey there are lots of universities carrying out undergraduate, postgraduate, doctor’s degree and many certificate programmes. Moreover, the number of such universities is increasing. [2]

The most important advantages of DE are: 1. Information can be sent to the whole world from the education center. 2. Student can get a more detailed feedback sooner than expected. 3. Having no time limits strengthens student’s motivation. 4. Method of scoring and assessment can be done objectively. 5. Learning distance is reduced since the student can get information from wherever he/she is. Since a great number of students are provided with education with less material consumption, the cost is reduced.

The restrictions of DE are: 1. It is not possible to make face to face interaction (eye contact) which is considered significant in learning environment. 2. The problems which occur during learning process cannot be solved right away. 3. There is difficulty of planning for the students unaccustomed to studying on their own. 4. Since the number of student is quite a lot, there can be communication problems. 5. The financial cost of substructture preparations can be high.

Due to the fact that DE system is a new system, there are many problems. That is why many studies are carried out to find and remove those problems.

According to Cigdem and Birgül’s research DE decreases the education cost of open source softwares, develops the education tools and enhances the education standards. [3]

Karaagaci studied the positive and negative sides of distance education considering the multitude of classrooms and lack of teachers in his research. According to Karaagaci, DE has more advantages than classical education system. Students can get education where they study. Education cost can be reduced. Students can be provided with personal and independent learning environment. Large masses of people are able to receive education. Access to information is fast and easy. There are no physical obstacles in terms of the distance. There is no psychological pressure that the student feels in traditional classroom environment. DE is necessary and people should take advantage of this. Together with this students getting DE should also make use of the first hand information. DE should be supported with such activities as meetings, summer interlalps, summer schools and night schools. [4]

Dincer stated that people should use technological developments in education system and that in DE computer cannot replace teaching. Because in DE the communication between the student and the teacher is not proper. What arouses the student’s interest and who makes the student love the lesson is the lecturer. Considering all these DE should be managed with computer support. [5]

According to Karagaci and Erden, “while in traditional education students are parallel to each other in terms of learning with equal methods, period and rate, in computer aided DE students are able to review their lessons as much as they like. While planning the education process student’s needs should be taken into account. Studies should be done so as to get the students’ attention.” [6]

Ozturan, Egeli and Darcan compared traditional education with computer aided DE. They make experimental and control groups from students. After applying classical education to one group and computer aided DE to the other group, it is understood that there is no difference between the two methods. [7]
DE has been applied in Kocaeli Vocational School for two years. The essential data for identifying and removing the main problems of this system has been collected by discussing face to face with the instructors who are applying this system online. These data prove that this newly established system has many challenges. If a system does not achieve its goal, current problems are found, various offers are set to remove those problems, these offers are applied and finally the system is restructured to succeed. For doing this theory of constraints’ thinking processes are widely used. To develop any kind of system, theory of constraints is based on finding the negative effects in the system, managing and resolving them.

According to Goldratt the constraints which prevent the establishment from making profit are: (1) Politics, (2) Procedures, (3) Measurement mistakes. Goldratt improved the thinking process approach so as to solve general politics constraints [8].

Thinking process approach deals with three questions which are; 1. What will change? 2. What will it become? 3. How will this transition happen? With “What will change?” question the basic problem is defined. This situation is expressed with “Current Reality Tree”. With “What will it become” question simple and practical solutions are provided. These solutions are expressed with “Evaporating Cloud” and “Future Reality Tree”. With “How will this transition happen” question the solution is performed. These solutions are expressed with “Pre-Requisite Tree” and “Transition Tree”. According to Goldratt’s theory of constraints this process is formed of these stages: (1) Find out the constraints in the system. (2) Decide how to use the constraints in the system. (3) Subtract all the rest of the things to the decision above. (4) Remove the constraints from the system. (5) Attention! When the constraint is removed in previous stages, go back to the first stage but do not let the lethargy to create new constraints in the system.

Current reality tree is used for analyzing the present situation of the system and understanding the problems better. It helps to discover the root cause which raises adverse effects in the system. In other words, current reality tree is formed of adverse effects. Namely, by using the adverse effects the root cause is found.

EVAPORATING CLOUD

This process is used for removing the root causes of undesirable effects in the system. These effects are identified by “current reality tree” and are transferred from the present situation to the desired stage. Future reality tree shows the cause and effect relationship between the changes done according to the current situation and the consequences occurring as a result of those changes. Future reality tree aims at defining the benefits of the suggested change, adverse effects of this change and how to remove these effects. Pre-requisite tree shows how to practice the application step by step which is used for eliminating the obstacles for the suggested solutions to end the conflict. Transition tree is a step by step application. Process being analyzed is transferred from the present situation with this structure. It indicates how to reach the decisions which are identified with pre-requisite tree and provide the transition to the desired situation. So, transition tree can be considered as a guide [9].

The reason why Goldratt’s “Theory of Constraints” thinking processes are used is to clarify all the constraints in all the establishments producing material and service and remove those constraints.

Sak et al. applied thinking processes to shorten the period of adjusting imported oil to the national standard Goldratt’s theory of constraints’ thinking processes are applied. With the help of evaporating clouds the constraints, which are found out by current reality tree, are resolved. Finally by using future reality tree and transition tree it is discussed how to shorten the period and decrease the cost for making the imported oil suitable for the national standards [10].

With respect to Unal et al.’s study it is indicated how to unveil and remove the constraints in production process in order to increase the companies’ profit. As a result of the researches done in a manufacturing firm by using theory of constraints, it is indicated that the sales and the whole process increased, semifinished goods stock decreased and accordingly the orders can be provided properly and in time [11].

In Akman and Karakou’s study they try to clarify the reasons for not being able to provide customers’ need during the software development process. They also make suggestions for coordinating those reasons with the help of theory of constraints’ thinking process. It is decided that the most important constraints of product development process are due to political constraints. According to the article, thinking processes are really useful for solving the problems which occur especially because of political constraints [12].

With reference to Yukel study, it is stated that theory of constraints’ thinking processes are essential for finding the root causes in manufacturing and service firms and also for recovering the processes by removing these root causes. In this study, the use of theory of constraints’ thinking processes is explained for defining the factors which affect the production process and for clarifying the relationship between those factors in a manufacturing firm. The purpose of this study is to show the practice of theory of constraints’ thinking processes in recovering the production process. By using current reality tree, the root causes leading to adverse effects in production process are defined. Moreover it is evaluated how to make use of the evaporating clouds for removing the root causes [13].

In study of Akman et al. they apply theory of constraints so as to identify the bottlenecks and constraints which affect the performance of the production and service firms in their goals. Together with this they also apply this theory to develop solutions for removing these constraints. The global oil and automotive firms which are the leading companies as future alternatives of fossil fuel energy sources not commonly used today, foresee that 21 Century is the year of hydrogen fuel. In this research theory of constraints’ thinking processes are examined for finding, managing and removing the bottlenecks which prevent the proliferation of hydrogen fuel vehicles [14].

Kocaeli Vocational School used the theory of constraints’ thinking processes approach for identifying and resolving the adverse effects in distance education one by one.

5. Application of thinking processes

Goldratt’s theory of constraints’ thinking processes approach has been performed in Kocaeli University Vocational School by; (1) Forming the current reality tree, (2) Forming the evaporating clouds, (3) Forming the future reality tree, (4) Forming pre-requisite tree, (5) Forming the transition tree.

5.1. Undesirable effects

According to Goldratt [15], the first step of the process is to list several undesirable effects that currently exist. The process of building the CDT focus on on the effect-cause-effect relationships of the list of undesirable effects. An analysis of the DE system in in Kocaeli Vocational School’s DE system identified the following undesirable effects:

1. Lack of technical equipment.
2. There are no technical staff.
3. Due to the fact that the person in charge of distance education deals with all the problems, he/she is not able to solve all the challenges.
4. The teaching staff is incapable of computer literacy.
5. The number of students registering the system is inadequate.
6. Since there are no technical staff, the technical troubles cannot be solved instantly.
7. Present software system is not proper.
8. There is no technical staff experienced in graphic drawing and making active images.
9. There are no packaged software consisting of active and inactive images about course contents.
10. There is not a distance education studio.
11. The course presentations prepared by the lecturers are not suitable for distance education system.
12. There is lack of technical data and skill for beginning and managing the course session (Fig. 1).

The list was determined, undesirable effects were linked together in a cause-and-effect relationship. These cause-and-effect relationships were then used to construct the Current Reality Tree that defined the core problem.

5.2. Current reality tree

After the undesirable effects were organized in an effect-cause-effect analysis, a current reality tree took shape that identified undesirable effects as shown in Fig. 1.
According to the current reality tree, there are five root cause leading to adverse effects in the system. These root causes are:

1. The person in charge of distance education is also responsible for the formal education. That is why he/she cannot spare enough time for the instructors who are incapable of computer literacy. That is why problems arise in starting and managing the course sessions. Also technical breakdowns cannot be fixed instantly.

2. Owing to the fact that current software is old and insufficient, instructors are not able to transmit the symbols and graphics into course texts properly.

3. Since distance education system does not have a fully equipped studio for giving the lessons, it takes a lot of time to prepare the necessary equipment for the course sessions.

4. As a result of lack of packaged softwares with active and inactive images, lecturers’ way of teaching becomes monotonous.

5. It is not commonly known by the environment that the school has distance education system. Therefore the number of students registering the system is low.

5. 3. Evaporating clouds

The next step is the formation of an evaporating cloud. An evaporating cloud leads to the solution needed to create the win-win solution. An evaporating cloud is a conflict statement with a common objective but no apparent solution. An evaporating cloud is read from left to right, starting with the top portion, using “In order to . . . , they must” syntax [16].

Evaporating clouds are made by considering the current reality tree. Furthermore, each conflict in each cloud is removed with injections.

In the Evaporating Cloud-1 there is a conflict between two options about beginning and managing the course sessions properly and solving the technical problems right away. So as to achieve the goal, on the one hand it is suggested that at least one technical staff should be hired for the lecturers to develop their skills. On the other hand it is suggested that person in charge with distance education should help the instructors to develop their skills. Here, by hiring at least one technical staff for distance education system resolves the conflict and enables to begin the course sessions without any problems and provides technical challenges to be fixed instantly. The injections in the first evaporating cloud are “Forming a fully equipped studio” and “Hiring technical staff to the system” (Fig. 2).

In the Evaporating Cloud-2, there is a conflict between two options about transmitting the symbols and graphics into course texts expeditiously and without any problems. So as to achieve the goal, on the one hand it is suggested that after changing the current software lecturers should be taught to use this programme practically. On the other hand by continuing using the current software, it is suggested that the technical staff should help the instructors adding the symbols and graphics into the course texts. Here, the conflict is resolved by buying a new programme instead of the current software and by the training of the lecturers by technical staff. Therefore symbols and graphics can be added into the course texts with success. The injections in the second evaporating clouds are “Buying a new software” and “Giving lecture about the using the new software” (Fig. 3).

In the Evaporating Cloud-3, there is a conflict between two options about increasing the number of the students in distance education programme. One of the options is making advertisement in local and national press and the other is making announcement in university’s website. Here, the conflict is resolved by making advertisement in local and national press instead of making announcement in university’s website. Also by doing this the number of the students registering the distance education programme. The injection in the forth evaporating cloud is making advertisement (Fig. 5).

5. 4. Future reality tree

With the injections and the logical cause and-effect relationships, the desired effects can be connected and the future outcome developed. This technique is the
The future reality tree [16]. According to Goldratt [17], the future reality tree enables a person to construct a solution that, when implemented, and replaces the existing undesirable effects with desirable effects. The purpose of the future reality tree is to graphically represent the conflict resolution. After identifying how to remove the conflicts with injections in the evaporating clouds, the changes which will be done and their advantages are shown with future reality tree.

![Fig. 3. The evaporating cloud-2.](image)

![Fig. 4. The Evaporating Cloud-3.](image)

![Fig. 5. The evaporating Cloud-4.](image)

The future reality tree is read from the bottom up using if-then statements in a logical format:

1. If lecturers’ computer literacy is enough and also technical staff is hired, the lecturers can begin and manage the course sessions without any problems. Also technical problems can be fixed immediately.
2. If a new software is bought and lecturers are trained, symbols and graphics can be transmitted into course texts properly.
3. If distance education system has a fully equipped studio, it becomes easy and quick to enter course sessions.
4. If packaged programmes with active and inactive images are bought for the distance education system, the courses become more attractive.
5. If advertisements are made about the distance education system in the school, sufficient number of students register.
6. If distance education system has enough staff, knowledge, experience, and equipment, it can function according to its purpose properly (Figure 6).

5. 5. Pre-requisite tree

With pre-requisite tree it is shown how to clear the obstacles for applying the changes which are indicated with future reality tree. The pre-requisite tree is read from the bottom up in a logical format:

1. Lecturers and the person in charge with distance education system clarifies the necessities of computer literacy first individually then by collaborating.
2. Lecturers first find the necessities of softwares and packaged programmes with active images. Then, they come together with the person in charge with distance education so that they can clarify the situation.
3. Lecturers and the person in charge with distance education clarifies the necessities for a fully equipped studio first individually then by collaborating.
4. By having the support of school management, lecturers and person in charge of distance education indicates the advertisement needs.
5. By having the support of school management, lecturers and person in charge of distance education indicates the needs to make the distance education system suitable for the purposes (Fig. 7).
5. 6. Transition tree

With transition tree it is shown how to reach the desired situation step by step in order to fulfill the goals indicated by pre-requisite tree.

The transition tree is read from the bottom up in a logical format.

1. The lecturers should be able to do the presentations properly. In order for that, lecturers should be trained about computer literacy in a fully equipped studio. It is necessary to consult the experienced ones so as to define the needs of computer literacy. Studies should be done regarding editing programmes and software with active and inactive images.

2. After considering the general situation of distance education, the changes and regulations which will be done should be determined by collaborating.

3. First the advertisement which will be given to the newspaper is prepared. Then, by discussing with the newspaper, the latest form of the advertisement should be published (Fig. 8).

6. Conclusion

By discussing with the lecturers, the malfunctions in the distance education system which has been practiced in Kocaeli Vocational School for two years are identified. In current reality tree formed according to these adverse effects, the factors for insufficiency of distance education system are shown. These effects are lack of technical staff, lecturers’ being insufficient in computer literacy, not being able to fix the technical problems, inefficiency of the software, unqualified course presentations and not having a fully equipped studio.

After clarifying the adverse effects caused by five root causes, they are removed as a result of the conflicts between the two options and evaporating clouds. Then, the changes which will be done in the current situation is shown in future reality tree with cause and effect relationship. In pre-requisite tree the solutions for solving the solutions are shown. Lastly, by completing the necessary applications so as to reach the goal with transition tree it is indicated how to manage the distance education system with an ever-growing structure.

In order for distance education system to be successful, the lecturers should be able to do their presentations properly. So as to achieve this, it is necessary to work on softwares with and without active and inactive images. It is required to consult the experienced ones about computer literacy needs. Lecturers should be trained about computer literacy in a fully equipped studio. By always considering the current situation of distance education system, necessary regulations should be done. So as to introduce the distance education system in the school, advertisement should be made and published in the press. There are different studies anad articles for education system and universities [18, 19].
The theory of constraints is not luck but a systematic application of the five thinking processes to break constraints and improve the efficiency of a company. The theory of constraints is a management technique developed by Eliyahu M. Goldratt and is focused on identifying and removing constraints in systems. The theory is based on the principle that the performance of a system is limited by its weakest link, and by understanding and managing these constraints, the overall performance of the system can be improved.

The five thinking processes are:
1. Find the constraint.
2. Exploit the constraint.
3. Subordinate all other activities to the constraint.
4. Augment the constraint.
5. Shift the constraint.

The theory of constraints is used in various fields such as manufacturing, healthcare, and even in software development. It has been applied to improve the efficiency of companies and processes by identifying and addressing the constraints that limit performance.