



# Systemically Approaching Computer Technology Integration in Education

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This research work examines the literature related to computer technology integration in education and the major concepts and principles that underlie the systems approach. Particularly, the study attempts to put the major concepts of the systems approach into practice. Based on the above a roadmap is proposed of introducing and diffusing computer technology integration in the educational systems. The suggested roadmap allows to determine the viability of systemically embedding computers in the educational systems. Additionally, it proposes a new educational approach to computer technology integration, which can improve the application of computers in schools as well as open various educational opportunities to computer technology integration. Finally, the suggested roadmap is a recommendation to policymakers, educators and stakeholders who have the power to advocate for and implement systemic change in order to redesign the educational systems in terms of computer technology integration.

**Keywords:** computer integration in education, systemic change

## 1. Introduction

The walls of the classrooms are torn down. Computers have been making it to classrooms for over four decades now. Many researchers suggest that computer is an essential component of the educational systems as well as represents not only an excellent curricular tool, but also a revolutionary classroom approach that can help students achieve important gains in learning and understanding [11]. Consequently, Ministries of Education around the world are spending enormous amounts of money in order to promote and support computer technology in their practices. However, concerns exist as to whether or not computers have been integrated into classrooms as tools that truly reform and revolutionize classroom instruction; or simply reinforce and support traditional practices. It seems that the educational outcome did not meet the promised expectations. More than a few studies around the world examined and evaluated computer integration in numerous educational settings. Unfortunately, many of them reported failures, repeated mistakes, and inadequate integration of the technology in the educational scope [6, 7, 9]. It revealed that the piecemeal approach applied to computer technology integration significantly contributed to the aforementioned situation.

Computer technology integration is an educational innovation that touches all aspects of a school system such as curriculum, instructional practices, teaching strategies and techniques, classroom settings, materials, resources, teachers' training and professional development, assessment, etc; which have to be redesigned in order to apply and support the reform [3]. Computer technology influences, in one way or another, all stakeholders (principals, teachers, students, parents, Ministries of Education, policymakers and the community in general) and thus needs their involvement.

Based on the above this research work stresses the importance of exploring new approaches in integrating computer technology in education. The current study identifies the need of integrating computer technology in education by applying the systems approach. To ensure better results and increase the possibility that the innovation will have long-term, sustainable results, systemic change seems appropriate [2, 8, 10, 11, 16]. The main purpose of this research work is to develop a suggested roadmap of integrating computer technology in the educational systems by applying the systems approach.

## 2. Literature Review

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## 2.1 Systems Theory

Carr-Chellman [5] supports that systems theory “embraces the importance of global perspectives, multiple components, interdependencies, and interconnections in any system. The recognition that the change in one part of a system necessarily alters the rest of the system, is a cornerstone of systems theory” (p. 371). Banathy [2] mentions that embeddedness and wholeness are central concepts of systems theory.

Similarly, Senge [18] discusses that “every organization is a product of how its members think and interact so if you want to improve a school system, before you change the rules, look first to the ways that people think and interact together” (p. 19). Also, he mentions that “there is always interaction” among the parts of the system and “an effectively operating community or a system is one where people recognize the webs of invisible influence...” (p. 18). In addition to the above, a system is directly influenced by its environment. This relationship causes the following actions: the system changes in response to environmental changes but also the environment changes in response to the systems within it. Social systems, such as educational systems, are open systems. Open systems have direct relationships and interactions and they are influenced by their environment. Banathy [2] suggests that the method to change those systems is through systems design: “the redesign of the system, or the design of new systems” (p. 54).

## 2.2 Systemic Change

Systems theory is the foundation that underlie systemic change. As mentioned by different researchers [4]; [13]; [16] systemic change includes two key principles: 1) understanding how a system works and 2) stakeholder participation. Systemic change suggests changes in all parts of the organization, not as separate entities but as whole. Carr-Chellman [5] defines systemic change as “holistic, contextualized, and stakeholder-owned” and systematic as “linear, generalizable, and typically top-down or expert driven” (p. 370).

In systemic change it is extremely important to examine the relationship among the different parts of the organization. As Banathy [1] points out “systemic change is guided by the principle that any change in a part of the system affects the whole system, and any change in the whole, affects all its parts” (p. 149). Systemic change views an organization as a whole with its parts all interrelated with each other. Therefore, the sum is more than its parts. Each part of the system is related to the other and influenced by each other. Since the parts of the system are interconnected with each other, a change in one part of the system automatically requires changes in the other parts of the system. To achieve systemic, holistic or comprehensive change everything needs to change [13]. Change needs to happen at all levels of the organization and involves all stakeholders of the entire system.

As suggested previously, to introduce, adopt and diffuse an innovation systemically, it is important that all stakeholders are prepared and involved in the decision, design, development and implementation process of the systemic change. Stakeholders from all levels of the system as well as those outside the system are involved in designing the new system. In addition to the above, Jenlink et al. [11] discuss that systemic change goes beyond the classroom, it is difficult, it needs guidance and requires stakeholders participation.

## 3. The Roadmap: The Processes of Systemic Change

Many researchers [1, 10, 11, 14, 19]) describe specific steps of what the processes and principles of the journey towards systemic change are suppose to be. The current study integrates the various steps presented by the researchers as the foundation to develop the roadmap.

Any kind of innovation needs careful design, development and implementation as well as persistence, patience, collaboration among the stakeholders and a common vision that everyone agrees upon and

1 pursue. It is really important that computer technology integration is not approached as a piecemeal  
2 improvement that only takes into account a portion of a system or a group of stakeholders. Quick-fix  
3 approaches do not help policymakers and educators achieve their goals. In order to re-design the  
4 educational systems to head towards the ideal system we need to develop a plan. The plan consists of  
5 a series of deliberate steps to involve stakeholders in preparing, planning, and implementing a new  
6 approach in integrating computer technology into the educational systems.

### 7 3.1 The Need and the “Fuzzy Idea” of Computer Technology Integration

8 First of all, the need for integrating computer technology into the educational system should be real-  
9 ized and recognized. The authorities, for example the Ministries of Education, should develop a “big  
10 picture”, fuzzy image [1, 10] of how computer technology should be integrated into the curriculum.

### 11 3.2 The facilitators’ team

12 Building the facilitators’ team is the second step. The authorities select a facilitator, otherwise referred  
13 to as a change agent or consultant that will be responsible to guide the process [10, 11, 14, 15, 19].  
14 The lead-facilitator should be educated in computer technology, as well as systemic change (or related  
15 fields). Additionally, the lead-facilitator is responsible in deciding the need of other facilitators.

16 The researchers call the process of becoming familiar with the system as the “Preparation Phase” [10,  
17 11, 14, 16, 19]. Through this phase the leader-facilitator is responsible to make initial contact with the  
18 system, inform stakeholders about the innovation. In addition to the above, the lead-facilitator needs  
19 to learn how the system works, introduce himself to the major – key stakeholders of the system such  
20 as the teachers’ unions, parents’ representatives, etc. In general, the lead-facilitator should be visible  
21 and aparent in the system, create realationships with the major stakeholders, and make visits to the  
22 different districts/schools and discuss with the principals, teachers and staff.

23 The facilitators’ major responsibility is to “guide” the stakeholders through the effort of systemically  
24 integrating computer technology. Based on Jenlink et al. [11] the major challenge of the facilitators is  
25 to help stakeholders to transcend and evolve their mindsets regarding computer technology integration  
26 and advice on how to approach educational reform, create and take ownership, promote commitment  
27 and take over responsibilities and roles. Finally, the facilitators’ team should make an effort to gain  
28 and build political support from the teachers’ unions and parents’ associations.

### 29 3.3 Readiness of the System

30 The next step suggests that the facilitators’ team assesses the readiness of the educational system re-  
31 garding computer technology integration and move on accordingly. Through assessing the readiness  
32 of the system it is easier to better understand the interrelationships between the educational system  
33 and the community and assess the threats and opportunities to integrate computer applications in the  
34 system [11, 15]. The assessment gives insight and formal information on how to approach the innova-  
35 tion based on the stakeholders’ views and beliefs. Based on the results, the appropriate design, strate-  
36 gies and action plans will be employed.

### 37 3.4 Establishment of the Core Team

38 The next step is to develop the Core Team as mentioned by Jenlink et al. [11] and Hawley [10] or the  
39 Strategic Leadership Team (SLT) team as mentioned by Duffy et al. [8]. The facilitators need to se-  
40 lect the members of the Core team, based on their initial evaluation of the system. The Core team  
41 represents the various stakeholders groups. Hawley [10] mentions that the Core team should be as  
42 diverse as possible and include other nontraditional decision makers.

43 It is suggested that facilitators should find representatives from the following stakeholders groups:  
44 teachers’ unions, teachers from pre-primary, primary and secondary education, parents’ organizations,  
45 university representatives, private colleges representatives, ministry of education representatives from  
46 all the levels of the K-12 system, curriculum developers, policymakers and financial advisors, and last  
47 but not least students’ representatives. All the above stakeholders should be involved in the process,  
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1 take responsibility and develop ownership. The Core team has to develop a coherent vision, create a  
2 core of shared beliefs and a culture within the system, and build relationships [8, 10, 11, 17].

3 As Jenlink et al. [11] mentions, the Core team goes more in depth in the system and uses its connec-  
4 tions to get more information and identify trends and patterns regarding computer technology integra-  
5 tion. It also tries to establish more relationships within the system as well as expand its relationships  
6 and make its self more apparent and visible to the system. Finally, it evaluates existing beliefs, as-  
7 sumptions and mindsets regarding computer technology in schools.

### 8 3.5 Establishment of a Coherent Vision

9 A shared vision among the stakehodlers of the ideal computer integration should be developed [10,  
10 11, 14]. Wagner [19] refers to this as the common framework. As mentioned above, the facilitators,  
11 are responsible to help the Core team to develop a coherent vision of the ideal computer technology  
12 integration. The Core team needs to put the “fuzzy image” into the specific context and practice. The  
13 Core team that has representatives from the different stakeholder groups needs to develop a coherent  
14 vision that represents their thoughts, beliefs, values, demands and needs in terms of computer  
15 technology integration. The coherent vision should highlight the major aspects of the reform as well  
16 as the new mindset through which computer technology integration is approached [8, 17]. The vision  
17 should also be articulated to stakeholders, insiders and outsiders in a language that is comprehensive  
18 by all.  
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### 20 3.6 The Design Team

21 The following step is to expand the Core team into the Design team. The Design team members  
22 should come from the same groups of representatives as the Core team, but there is involvement from  
23 more stakeholders from each group. The major purpose of the Design team is to work towards the  
24 design of a system that through systems approach will incorporate in its practices computer technol-  
25 ogy based on the vision previously developed. The Design team should realize that they are working  
26 towards designing and developing new processes and procedures regarding computer technology  
27 integration and not fixing the ones that are now up and running.  
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29 The major Design Team will be further divided into multiple Design teams based on the different  
30 major aspects of the system that should be addressed through the change process. Multiple design  
31 teams need to be as diverse as possible. Jenlink et al. [11] suggests that the facilitators are responsible  
32 to train and enculturate the design teams. Finally, the teams need to realize that the “design is a con-  
33 tinuous process of solution finding” ([1], p. 50). The members of the design teams should develop  
34 ownership of the educational reform and realize that the new system will be developed as a result of  
35 everyone’s support and efforts.  
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37 Each design team is responsible to redesign a specific area according to the coherent vision developed  
38 above, and the appropriate people should be part of that design team. The different design teams work  
39 independently as well as collaborate with each other in order to ensure consistency with the vision and  
40 ensure that the educational reform is guided by the processes of systemic change.

### 41 3.7 Design of the New System

42 The design of the new system is one most complicated and difficult processes of the roadmap towards  
43 computer technology introduction. The importance of the design in the process of integrating com-  
44 puter technology systemically into classroom practices is given through almost all of the research  
45 studies that present principles and processes of systemic change [1, 10, 11, 14, 15, 16]. Banathy [1]  
46 emphasizes on designing the system and specifically designing the transformation of the system. The  
47 big picture given by the authorities, has been converted into an ideal, coherent vision by the Core team  
48 and now through design it is time to bring the vision into practice and apply it into the specific con-  
49 text. Through the design process the major components of the system are redesigned in order to sup-  
50 port and promote computer technology integration in its instructional practices.  
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### 52 3.8 The Implementation Plan

1 Once the design blueprints are finalized, the facilitators and the design teams develop action plans that  
2 define how the reform will be delivered. The action plans should be designed with as much detail as  
3 possible, but because this is a new design, it is very difficult to foresee every obstacle. Before imple-  
4 menting the action plans the feasibility of the plans should be evaluated. Each plan is evaluated ac-  
5 cording to current available resources, such as budget, human resources, time, and space, to ensure its  
6 feasibility. After there is a feasible model for the new system, implementation should be planned. The  
7 facilitators must ensure that the revised plans are still aligned with the original vision so that the out-  
8 comes of the designs are what every stakeholder expects.

### 9 3.9 The Evaluation and Assessment of the Process

10 An evaluation team should be developed, in order to lead this process. The evaluation team is respon-  
11 sible to determine and assess the completeness of each part/step of the process. The evaluation ensures  
12 consistency with the vision and that the process reflects systemic thinking and design of the innova-  
13 tion. Members of the Core team constitute the Evaluation team such as Ministry officials, principals,  
14 teachers, and curriculum developers, parents, students, and certainly the facilitators. Finally, the  
15 Evaluation team needs also to design a system for evaluating the results of computer technology  
16 integration as a continuous process.

17 When the implementation is completed, evaluation should take place in order to assess how the sys-  
18 tem performs and how it evolves. Hawley [10] recommends doing a summative evaluation after at  
19 least five years. Reigeluth [14] recommends summative evaluation after a minimum of three years.  
20 Through the evaluation process the line of communication should be constantly open between the  
21 design committees, the authorities, facilitators, and stakeholders. As the new system continues to  
22 evolve, it should be continuously evaluated and revised.

## 23 4. Conclusion

24 Given the current situation regarding computer technology integration, we have yet to understand that  
25 the piecemeal and quick-fix approaches would not help us achieve long-term and successful computer  
26 integration aligned with the requirements of the Information-Era. In addition, in order to be able to  
27 systemically integrate the innovation by addressing society's demands stakeholders' needs, beliefs,  
28 values and opinions, becomes evident the application of the above suggested roadmap. Having as a  
29 goal to help students and future citizens of a global world/economy not only become computer literate  
30 but also realize the importance and value of computer technology in their lives, the educational sys-  
31 tems have major, critical and challenging roles to play. In order to better achieve the goal of the inno-  
32 vation, the cultures of the systems needs to change; the entire have to be adjusted accordingly. The  
33 goal is to develop the appropriate "culture" in the educational systems that will support and promote  
34 computer technology integration by focusing in ways that fundamentally transform education.

35 The study provides important suggestions and guidelines for computer technology integration to poli-  
36 cymakers as well as the educators – teachers, principals, curriculum developers – and other stake-  
37 holders – parents and the community. The suggested roadmap has important policy as well as practical  
38 implications for the future regarding computer technology integration in education. The purpose is to  
39 "guide" the policymakers, educators, parents and the community in making proactive actions towards  
40 the innovation.

41 The stakeholders who have the power to advocate for and implement systemic change should examine  
42 the situation carefully, and recognize that integrating computer technology is of vital importance. The  
43 principles and processes which will be necessary in order to achieve systemic change have been illus-  
44 trated, and the results which would ideally occur through systems approach are outlined as well.  
45 Change of such a magnitude in a school system is never easy, however, the results of this research  
46 work provides the basis for further development and expansion of the systems approach to computer  
47 integration. It is also acknowledged that this kind of reform takes a long period of time. Systemic  
48 change involves a high degree of risk and challenge as well. Systemic change creates a new environ-  
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ment, a new way to do things in the system. This kind of change comes gradually, and needs a lot of persistence and strength.

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