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Evaluation of the
Jordan Education Initiative

Report: Task 1

THE EMERGING PARADIGM OF TEACHING AND LEARNING IN DISCOVERY SCHOOLS

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The Emerging Paradigm of Teaching and Learning in Discovery Schools

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Abbreviations

1–12..... Grades 1–12
ADSL ..... Asymmetric Digital Subscriber Line
CA..... Computer Associates, Inc.
CADER…… ChangeAgent for Arab Development &. Education Reform
CIDA ..... Canadian International Development Agency
e-Arabic……Electronically mediated learning of, or electronic content for learning, Arabic
e-civics…… Electronically mediated learning of, or electronic content for learning, civics
e-content..... Electronic content
e-English…...Electronically mediated learning of, or electronic content for learning, English
e-ICT…….Electronically mediated learning of, or electronic content for learning, information and communication technology
e-learning.... Any technologically mediated learning
e-math……..Electronically mediated learning of, or electronic content for learning, math
e-resources...Any resource delivered electronically or to support electronic learning
e-science….Electronically mediated learning of, or electronic content for learning, science
EDC ..... Education Development Center, Inc.
EFL ..... English as a Foreign Language
EMIS……Education Management Information System
ERfKE..... Education Reform for a Knowledge Economy
ICDL..... International Computer Driving License
ICT ..... Information and Communication Technology
IESCS…....Index of Economic, Social and Cultural Status
IT……..Information Technology
JEI..... Jordan Education Initiative
K-12…….Kindergarten through 12th grade
LAN..... Local Area Network
MoE ..... Ministry of Education
MS Word…. Microsoft Word Processing Software
NGO…..... Nongovernmental Organization
NCHRD……National Center for Human Resources Development
PISA…….Program for International Student Assessment
PMO..... Project Management Office
SES……..Socio-economic status
SJE ..... Supporting Jordan's Education Project
SST……..Subject Specific Training
UNESCO.... United Nations Educational, Scientific and Cultural Organization
USAID..... United States Agency for International Development
WB ..... World Bank
WEF..... World Economic Forum

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1 Introduction

The Jordan Education Initiative was established in 2003 to fulfill a key role in Jordan's educational transformation. To support the Ministry of Education's (MoE) curriculum reform process, Education Reform for the Knowledge Economy (ERfKE), the Jordanian Education Initiative (JEI) was established as a test bed for the introduction of information and communication technologies (ICT) and e-learning resources into Jordanian classrooms to support innovative teaching practice. With initial assistance from the World Economic Forum (WEF), the JEI sought to apply public-private partnerships to improve the application of information and communication technology (ICT) in grades 1–12 in Jordanian schools.

The efforts of this coalition have been coordinated and managed by the JEI Program Management Office (PMO), which is now continuing on as a non-governmental organization (NGO).

The goal of this report is to examine the extent to which a new learning paradigm is emerging in the JEI's approximately 100 Discovery Schools and to understand the factors that have facilitated these changes or hindered teachers' ability to transform the learning environment. This is the first part of a four-part assessment of JEI program strategy and implementation. The four parts of the assessment are as follows:

- Task 1: Assess the impact of using e-learning modules on students/teachers, schools, and the overall educational system;
- Task 2: Assess the role of public-private partnerships;
- Task 3: Assess the hardware and delivery infrastructure employed to deliver e-learning;
- Task 4: Assess the total cost of ownership for employing e-learning as a core part of instruction within the schools.

As the JEI transitions into a new phase as a non-governmental organization (NGO), the two most salient guiding concerns among various stakeholders are to understand if, and to what extent, the JEI has helped foster the emergence of a new paradigm in the Discovery Schools and what the unresolved challenges have been.

This study, designed to address these specific concerns, was designed around three central research inquiries:

1. Are there aspects of a student-centered learning paradigm emerging in the Discovery Schools? What does this new paradigm look like? What does it mean for how teachers teach and how students learn? What has the JEI brought to this evolving paradigm?
2. What are the conditions supporting this new paradigm? And, what the challenges and impediments?
3. What role do the ICT resources and e-content, provided through the JEI, play in promoting this paradigm? What is the role of e-learning in Jordanian classrooms?

2 Jordanian Educational Context

Jordan, like many developing countries, faces a common set of challenges in meeting the increasing economic and social demands of globalization. As a process of economic integration and market openness to external trade, globalization offers the possibility of accelerated economic

growth. Yet, to take advantage of the opportunities that globalization presents, countries must be able to increase their competitiveness[1] by developing a competent and flexible work force. In the early years of the 21st Century, success in achieving greater levels of competitiveness is based on significant and sustained efforts in educational reform.[2] As economic systems require new skills and abilities, education systems must prepare young people to meet these challenges. Jordan is engaged in an on-going and deep reform of its education system that started in the 1990s with a focus on expanding access to basic education. Now, under a program called the Educational Reform for the Knowledge Economy (ERfKE), reform is focused on transforming the very nature of education in Jordan.[3]

The government's National Education Strategy recognizes the importance of human capital in response to the current trend of a global economic market and the necessity to meet market demands through the educational system.

Education is a key factor in encouraging investment in Jordan's economy, since it is the primary mechanism for upgrading labor market quality.

Education is a key factor in encouraging investment in Jordan's economy, since it is the primary mechanism for upgrading labor market quality. The global business environment emphasizes such skills as teamwork, problem solving and the use of information and communication technology (ICT) in managing information and generating and applying knowledge. The education sector must be responsive to employing market demands in key industries and developing critical "Knowledge Economy Skills" at all levels of the education system (p.7).

The ERfKE reforms include updating and revising the national curriculum to move beyond content knowledge towards supporting the development of intellectual and personal competencies among Jordanian students. These "Knowledge Economy Skills" are divided between academic skills such as communication and thinking skills, and personal management skills such as responsibility, adaptability and teamwork[4] (see Figure 2.1, next page).

A recent report by the Supporting Jordan's Education Project (SJE) applied a four stage model of ICT integration including: Emerging, Applying, Infusing; and Transforming. The SJE report considers Jordan to be in the Applying stage, in which schools have computer labs, teachers still dominate the learning environment, and ICT is just beginning to be used in other content areas beyond ICT classes.[5] Moving to the Infusing stage requires a deeper shift in classroom practices. However, the National Education Strategy does not explicitly detail what this new teaching model might look like nor which "learning processes" are to be encouraged. Some policy research suggests that clear articulation of the teaching paradigm in terms relevant to the classroom is important in moving the adoption of reform policies to their implementation at all levels of the system: MoE leadership, the middle layers of the MoE and in the schools.[6] Our research suggests that many teachers do not yet have deep understanding and knowledge of student-centered or active pedagogies. This lack of real understanding of new teaching approaches is certainly a challenge confronting the JEI work. The National Education Strategy of 2006 implicitly calls for a new teaching paradigm and specifically identifies the key principles that "learning processes (learning how to learn) are more important than subject content" (p. 21) and that higher order thinking skills – analysis, synthesis and evaluation – are essential learning outcomes. The strategy

[1] Stiglitz, J. (2002). *Globalization and its Discontents*. New York: Norton.
[2] Kozma, R. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology, 1*(2), 117-156.
[3] Jordan. Ministry of Education. (2006). *National Education Strategy*. Amman: Ministry of Education.
[4] Ibid.
[5] Jordan. Ministry of Education, & Supporting Jordan's Education. (2006). *Classroom and Computer Lab Deployment Strategy in Government Schools Grades 1-12*. Amman: Directorate of Curriculum and Textbooks and Supporting Jordan's Education SJE/CIDA.
[6] Levin, B. (2001). Conceptualizing the Process of Education Reform From An International Perspective. *Education Policy Analysis Archive, 9*(14).

Figure 2.1: National Education Strategy (2006) - Critical Knowledge Economy Skills (p.11)	
Academic Skills • **Communication skills** ▪ Understanding and speaking the languages in which business is conducted ▪ Effective writing and comprehension of charts, graphs, and other technical forms of displaying information • **Thinking skills** ▪ Thinking critically and logically to evaluate situations, solve problems, and make decisions.	**Personal Management Skills** • **Positive attitudes and behaviors** ▪ Self-esteem, honesty, initiative • **Responsibility** ▪ Setting goals and priorities ▪ Planning and managing time ▪ Accountability for actions taken • **Adaptability** ▪ Identifying and suggesting new and creative ideas for doing things differently ▪ Maintaining a positive attitude toward change • **Teamwork** ▪ Using a team approach to problem solving ▪ Understanding and contributing to an employer's goals ▪ Planning and making decisions with others

also provides a central role for ICT in the new education system. The JEI is one of the government's responses to support the integration of ICT into public education.

Another focus of the National Education Strategy is to decentralize the ministry's control and devolve decision-making authority to the schools under the principle that "those who are most affected by decisions are the best placed to make those decisions."[7] Previous research characterized the MoE as hierarchical and rigid, focused on centralized control of the education processes and outputs, and found this to be an impediment to changing practices at the classroom level.[8] Our research in the schools suggests that management is still highly centralized and that officials from the MoE and the Directorate have little understanding of the new models of teaching, although a few principals felt the JEI had given them resources to undertake their own initiatives for change.

These two factors, (1) a lack of deep understanding of new pedagogy and (2) a rigid centralized control, may limit the effectiveness of initiatives like the JEI. In alignment with ERfKE, JEI encourages a new teaching paradigm, yet principals and teachers do not have a deep understanding of this new paradigm nor do they feel empowered to change their practice because of the centralized control. This is a fundamental conclusion of our research, and we will elaborate on these points throughout the report.

[7] Jordan. Ministry of Education. (2006). *National Education Strategy*. Amman: Ministry of Education.
[8] Al-Daami, K. K., & Wallace, G. (2007). Curriculum reform in a global context: a study of teachers in Jordan. *Journal of Curriculum Studies, 39* (3), 339-360, Innabi, H., & Sheikh, O. (2007). The Change in Mathematics Teachers' Perceptions of Critical Thinking after 15 Years of Educational Reform in Jordan. *Educational Studies in Mathematics, 64*(1), 45-68, Mustafa, M., & Cullingford, C. (2008). Teacher autonomy and centralized control: The case of textbooks. *International Journal of Educational Development, 28* 81-88.

2.1 The Jordan Education Initiative

The Jordan Education Initiative was established to support a number of broad social and economic changes that are key to Jordan's transformation to a globally competitive country in the 21st Century. Under the impetus of King Abdullah in coordination with the World Economic Forum, JEI was a response to the call expressed in the Report on Arab Human Development 2002 for public and private collaboration to promote effective change: "The future of the Arab States is to a large extent contingent on the responsiveness and the will of their governments, their businessmen and investors to initiate effective collective action."[9]

The Government of Jordan identified three primary challenges that the country faced in relation to its adaptation to the global environment.[10] First, there are challenges in the disconnect between the education provided in many developing countries and the economy those students enter upon leaving school. Second, there are technical challenges involved in ensuring that ICT for education offers solutions that are modular, scalable, and mutually compatible, in order to provide for a relatively low cost of ownership with maximum flexibility. Finally, they identified two investment and marketing expectations: (1) that new learning resources should both create students who would be self-supporting citizens, and (2) that the JEI process should create a Jordanian e-learning sector that could generate products for export.

Reflecting upon these challenges, the steering committee for the JEI set out four principal objectives for the public-private partnership that were later crystallized into three tracks of work. The overall objectives were to:

- Improve the development and delivery of education to Jordan's citizens through public-private partnerships, and in the process help the government of Jordan achieve its vision for education as a catalyst for social and economic development
- Encourage the development of an efficient public-private model for the acceleration of educational reforms in developing countries based on unleashing the innovation of teachers and students through the effective use of ICT
- Build the capacity of the local information technology industry for the development of innovative learning solutions in partnership with world class firms, creating economic value that will lead to mutually beneficial business opportunities
- Leverage an environment of national government commitment and corporate citizenship to build a model of reform that can be exported and replicated in other countries.[11]

Part of the JEI's role in education was the creation of new locally produced ICT resources, but the JEI was also mandated to support the Government's own reform processes. To support the Ministry of Education's (MoE) own curricula reform process, ERfKE, the JEI established a test bed for the introduction of ICT and e-content resources into Jordanian classrooms that could support innovative teaching practice. The test bed is comprised of a network of 100 schools, called Discovery Schools, in the Amman directorate.

[9] Cited in bin Talal, H. P. H. b. (2004). The Arab Human Development Report 2002: Review and Reform. *Arab Studies Quarterly, 26*(2), 5-20.
[10] World Economic Forum. (2003). *Jordan Education Initiative Baseline Proposal*. Geneva: Author.
[11] Jordan Education Initiative Brochure, October 2004. This text is slightly revised from that found at: World Economic Forum (2003). *Jordan Education Initiative Baseline Proposal*. Geneva: Author.

2.2 JEI Structure and Strategies to Support E-Learning

During interviews with JEI partners from both the public and private sectors, the stakeholders signalled that the creation of the Project Management Office (PMO) was, perhaps, the most important element of the "JEI Model" of public-private partnership. As one long-time board member recalled, the idea of the PMO emerged a few months after the JEI was founded. Since then it has been a key organization to driving the program by overseeing the creation of a master plan to guide activities over time, by providing leadership to maintain the vision of JEI, track progress, build the necessary infrastructure in schools, and hold partners accountable for their commitments. Key stakeholders also felt that it was important that the PMO sit in between the public and private entities and is neither inside any of the key ministries involved, nor attached to any of the private companies. This neutrality offered the PMO flexibility and independence needed to facilitate and support complex discussions among all the stakeholders. Although the PMO coordinates JEI activities in all three tracks of work, this report is focused principally on PMO activities in support of the creation of e-content and the promotion of e-learning more broadly.

2.2.1 Student-centered teaching approaches

In line with the ERfKE reforms, the JEI hopes to support the emergence of more student-centered teaching approaches using ICT. At the core of student-centered approaches is the belief that learning is most meaningful to the students when the students themselves are actively engaged in creating, understanding, and connecting to knowledge.[12] In a student-centered environment, teachers center their planning, teaching, and assessment around the needs and abilities of their students. Teachers work along side their students to facilitate students' learning. Instead of the teacher being the sole, infallible source of information, the teacher shares control of the classroom and students are allowed to explore, experiment, and discover on their own. The students are not just memorizing information, but they are expected to work with and use the information alone or with peers. Their diverse thoughts and perspectives are a necessary input to every class. The students are given choices and are included in the decision-making processes of the classroom. The focus in these classrooms is on options, rather than uniformity.[13] Essentially, "learners are treated as co-creators in the learning process, as individuals with ideas and issues that deserve attention and consideration."[14]

2.2.2 E-content

E-content sits across two tracks of JEI's mission: supporting a Jordanian IT industry and promoting the integration of ICT into public schools. The JEI has developed a model for the creation of e-content that promotes Jordanian capacity to create educational software and e-content that is aligned with the Jordanian curricula. The process is a collaboration of the Jordanian public sector with global companies and local companies as well as the global public sector comprised of foreign government agencies and international NGOs. Once the MoE and the JEI establish a list of content areas to target, the PMO starts to recruit a global entity to become a key sponsor of that curriculum, although Jordanian companies have also started to assume the sponsorship role. The sponsor is then paired with a local company which will develop the e-materials. Once this partnership is established, the MoE provides a team of curricula developers to work with the content production team. The sponsor provides funding, advice and expertise to the developer and the MoE curriculum team.

> The e-content is created through a process of collaboration among the public sector, global and local companies, foreign government agencies, international NGOs and local public government.

[12] McCombs and Whistler (1997). *The learner-centered classroom and school: Strategies for increasing student motivation and achievement.* San Francisco: Jossey-Bass Inc.
[13] Papalia, A. (1976). *Language-Centered Language Teaching: Methods and Materials*. Rowley: Newbury House.
[14] Op cit.

For example, in the case of e-math, Cisco Systems funded Rubicon to develop the materials but they also provided for the support of Cisco Learning Systems and the involvement of math education specialist Dr. Michelle Selinger to work with Rubicon and the MoE e-math curriculum team. In interviews with their representatives, Cisco Systems recognized that the involvement of international expertise, although costly, is fundamental to true transfer of knowledge and the creation of local capacity. This opinion was reinforced during an interview and observation with one of the Jordanian educators who had been on the e-math curriculum team. Not only was he one of the best classroom teachers observed, but he also expressed a deep gratitude for the opportunity to "go deep" into the area of math education with Cisco Systems and Dr. Selinger. He felt it was his responsibility to be a model teacher to promote innovative teaching both with and without ICT.

Figure 2.2: JEI e-content - Stakeholders' participation

E-content Area	JEI Partners' Participation in e-content Development	
	Developer	*Sponsor*
e-Arabic	e-Dimension	France Telecom/Jordan Telecom
e-science	Rubicon	Fastlink (since acquired by Zane)
e-math	Rubicon	Cisco Systems
e-ICT	Menhaj Technologies	Microsoft
e-English		Middle East Partnership Initiative
e-civics		Relief International / Schools Online (Provided the JEI with a proposal to incorporate an e-civics education curriculum and offered to develop the e-geography curriculum)

One sign of the growing sophistication of Jordan's fledgling educational IT industry is that since completing the e-math content, Rubicon has begun developing its second application of e-content for science. We found, based on our stakeholder interviews, teacher and principal interviews and our classroom observations, that this second generation of e-content is much more dynamic, customizable and interactive than Rubicon's first generation product in e-math. There are also indications that the MoE is developing a better understanding of e-resources. Stakeholders reported that the MoE curriculum team and the company integrated new design principles into the process. Instead of starting with a text book as the guide, the design team first identified the topics that are most challenging to teach and attempted to find possible solutions that would use the potential of ICT to create new and different learning opportunities. The PMO staff commented on the increased level of interactivity in these resources, and this was also evidenced in a few of the observations. It would seem that Rubicon, over time, has built internal capacity and has improved its ability to develop high-quality e-content curriculum. However, the improvement of the e-content will present challenges to the networking infrastructure and the current structure of EduWave, as noted by Cressman and Daly[15].

Four e-content development phases:
- Initial development phase
- Pre-pilot phase
- Pilot phase
- Roll out phase

The JEI has a standard four phase e-content development cycle composed of initial content design, pre-pilot, pilot and roll out phases. In practice, however, the cycles may be iterative and content may go back for redesign in pre-pilot or pilot phase depending on the nature of the feedback. According to the PMO staff, since no company would have the capacity to develop a full k-12 curriculum simultaneously, development is

[15] Cressman, G., & Daly, J. (2007). *Evaluation of the Jordan Education Initiative: Review of the Technology Employed to Deliver E-Learning*. Washington, DC: Education Development Center.

normally done two or three grades at a time using priorities set by the MoE.

The phases generally proceed as follows:

Initial development phase: The content team identifies the topics for which they will develop e-content. The MoE curriculum team begins to design the activities and the ICT technicians begin programming the activities.

Pre-pilot phase: Once the activities have been created, the materials go into the pre-pilot phase with one teacher in the target grades in each of six schools. These teachers try out the content for three months. Teacher feedback is collected by MoE supervisors and JEI Netcorps Interns and provided to the e-curriculum team. At the same time, an MoE technical committee evaluates the materials for accuracy, cultural acceptability and educational value. Using the pre-pilot feedback, the materials are redesigned and improved.

Pilot phase: After the redesign, the materials go into pilot phase for one semester with all teachers in the target grades and subjects in 14 schools. Teacher feedback is again collected by MoE supervisors and JEI Netcorps Interns and provided to the e-curriculum team. The MoE technical committee continues to evaluate the materials for accuracy, cultural acceptability and educational value. Using the pilot feedback, the materials will go through a final redesign and proceed to the next phase. If the feedback indicates more complex issues, the materials can be substantially reworked and be re-piloted.

Roll out phase: Once the materials for all grades have been approved from the pilot phase, they will be made available to all schools in the Kingdom. However, the JEI assumes the responsibility to promote only their use in the 100 Discovery Schools.

To date, the e-math and the e-Arabic components are in full roll out and the other content areas are still developing materials for some grades.

2.2.3 ICT Infrastructure and resources

The JEI coordinates with the MoE to provide ICT infrastructure and other resources to the Discovery Schools. The MoE provides the same ICT resources to the Discovery Schools as to the rest of the schools in the Kingdom, but the JEI brings additional resources. There are two principal ICT models used by the JEI: computer labs and teacher laptop computers.[16] Most Discovery Schools have been equipped with multiple computer labs, and the JEI has also distributed laptops and projectors for teachers to use in the classroom. Each Discovery School has six or seven laptop computers which may either be assigned to individual teachers or stored centrally as a shared resource for teachers.

The MoE is in the process of transitioning to a broadband network. Currently, all the Discovery Schools are connected either to the broadband network or with ADSL connections.

2.2.4 Teacher professional development

The JEI has a strand for professional development for teachers, but this is the least developed area of its work to date. A general policy is that the MoE requires that all teachers in Discovery Schools take the International Computer Driving License (ICDL) Course. ICDL is an intensive course to train people in a wide range of software products. Significantly, however, it is not a course designed to address issues of using ICT as a learning tool. According to stakeholder interviews, the content of the course was initially problematic because of the broad range of programs or activities, including data programs, like Access, that teachers felt had no relevance to classroom teaching. Consequently, many teachers had difficulty and did not pass the final tests.

[16] Ibid.

Each content developer is also responsible for creating a training program on its products. Therefore, each product is accompanied by a subject specific training (SST) on how to use that particular e-content. Each SST is generally a two day course. Although the SST is developed by the content developers, the trainers come from the MoE and eventually the MoE training directorate manages the training. From interviews with teachers, most felt that the SSTs were focused on logistics and navigating the e-content, used a lecture format and did not cover teaching strategies to use with the tools.

> Teaching strategies were provided by other training programs that are focused on teaching with ICT: Intel Teach to the Future, World Links Teacher Professional Development and CADER.

In addition to these core professional development programs, the JEI has a relationship with other training programs that are focused on teaching with ICT: Intel Teach to the Future, World Links Teacher Professional Development, and a program offered by ChangeAgent for Arab Development & Education Reform (CADER). Each of these programs is present throughout the Kingdom but each has an agreement for a special quota of teachers from the Discovery Schools.

2.3 Prior Research on the JEI

A review of existing evaluation reports offered an understanding the context and the impact of the JEI activities on teaching and learning in Discovery Schools and helped to situate the current study. EDC reviewed the following studies to offer a summation of what is known to date about the JEI:

- Building Effective Public – Private Partnerships: Lessons Learnt from the Jordan Education Initiative, McKinsey & Company (2005);
- Jordan JEI Project: A baseline report prepared for the British Council in Amman: Centre for Successful Schools, Keele University (2006);
- Evaluation of the Discovery Schools' Experiment, National Center for Human Resource Development, (2006);
- The Effects of Teaching: e- Math on the Learning of Students: To Excel Consulting (2007).

The McKinsey & Company report[17] was a review of the lessons learned with a particular focus on the public-private partnership model and the private investments made through the JEI structure. Although the authors felt it was too early to look for any profound impact in the classrooms, the McKinsey report found that the JEI has had considerable success in meeting its objectives of involving public and private partners in supporting education in Jordan, in creating e-content and moving ICT resources into schools and in building a local IT capacity in education.

The McKinsey report identified the JEI's governance structures as an important advance with the emergence of the PMO and clear mechanisms of transparency. It highlighted the ability of the JEI through the PMO to provide a clear vision for partners that was key in maintaining partners' motivation to participate and to fulfill their initial promises. Additionally, the coordination among activities and commitments to fully leverage each partner's competencies that the PMO provides is crucial to success.

As of 2005, the JEI mechanism had resulted in a transfer of $3.7 million to Jordanian companies to create e-content or provide services to the Discovery Schools. These resources had supported the creation of a full complement of e-math materials, and the amount of e-content available has only increased since then with the completion of e-Arabic and substantial progress on e-ICT, e-science, e-English and e-civics. Along with the creation of e-content, there is now a sizeable IT industry capacity in educational technologies since three different companies have worked in the creation of

[17] McKinsey and Company. (2005). *Building Effective Public - Private Partnerships: Lessons Learnt from the Jordan Education Initiative*. Geneva: World Economic Forum.

e-content alone. Additionally, the JEI has helped equip the Discovery Schools with the necessary IT infrastructure.

In 2006, the Centre for Successful Schools at a Keele University released a draft version of its baseline study[18] of the JEI. The report is based on a survey study of teachers and principals in the Discovery Schools and focused mostly on the educators' expectations for ICT use in their classrooms and their satisfaction with professional development they had received. The teachers and principals reported to be very motivated to learn about and to use ICT in their classrooms. Generally the educators were happy with the ICT trainings they had received and generally felt confident in their ability to use ICT. Most teachers expected to find the JEI resources useful, but the study did not ask them if they were currently using the resources. The survey found that teacher and principal views of ICT were that it would help motivate their students and give them a chance to collaborate, but they did not identify any other learning benefits from ICT (i.e. visual representations of difficult/abstract topics, access to information, student authoring, or supporting different learning styles or paces).

The study also found that that traditional teacher-centered practice still predominated in the classrooms, according to teachers and principals. Additionally, the Keele University researchers found that three professional development programs were the most common: ICDL, Intel Teach to the Future, and the SST trainings.

The study conducted by the National Center for Human Resources Development (NCHRD) offers a more thorough view of the impact of the JEI programs in classrooms.[19] The study was based on observations, interviews and artifact analysis conducted in eleven randomly selected Discovery Schools. NCHRD also found that the traditional teaching strategies were the norm and that computerized lessons were still mostly teacher-centered. Teachers did not have a strong understanding of student-centered learning. The NCHRD recommended that the MoE "operationalize" the concept of student-centered teaching and provide teachers with more support and training to reach those goals.

The final study reviewed was a small evaluation done on an e-math unit by To Excel Consulting.[20] The objective of this pilot study (p. 3) was to assess the impact of the e-math curriculum on the learning and achievement of the students, and to assess the teachers' and students' level of interaction with the new technology and engagement with the new methodology. Given the small sample size and the fact that the study only evaluated one unit, it is difficult to determine what, if any, real impact the e-math curriculum had on student learning in mathematics or student performance. However, the report offers the following results:

1. ICT enhances student engagement in learning;
2. There is no difference in student performance between the e-math classes and traditional classes;
3. Teachers need more training to make more effective use of ICT in their classrooms.

2.4 Examination of the PISA 2006 for the Discovery Schools

Separate from the evaluation presented here, EDC was asked to conduct a preliminary analysis on the Jordanian 2006 Program for International Student Assessment (PISA) data that was compiled and shared with EDC by NCHRD. For our analysis we selected only those students who were in public schools in Amman (Directorates Amman 1, 2 3, and 4), giving us a sample of 2,471 student scores. All students were in the 10th grade and came from 84 different schools, 65 Discovery

[18] Centre for Successful Schools. (2006). *Jordan JEI Project: A basleine report prepared for the British Council in Amman*. Keele, UK: Keele University.
[19] National Center for Human Resources Development. (2006). *An Evaluation of the Discovery Schools' Experiment: an Executive Summary*. Amman: National Council for Research on Human Development.
[20] To Excel Consulting. (2007). *The Effects of Teaching: e- Math on the Learning of Students*. Amman: To Excel Consulting.

Schools and 19 non-Discovery Schools. The Discovery Schools came from the following directorates: 31 schools from Amman 1, 24 from Amman 2 and 10 from Amman 4. The non-Discovery School sample contained 2 schools in Amman 1, 5 in Amman 2, 3 in Amman 3 and 9 in Amman 4. The sample contains 1,390 female students and 302 male students.

An initial look at the data found significant difference between the mean test scores of Discovery and non-Discovery schools (see Table 2.1). However, recent analysis on the PISA 2006 data[21] found that socio-economic status was a noticeable source of between-school variation. We wanted to examine the effect of SES on PISA performance between the Discovery Schools and the non-Discovery Schools. To probe more deeply, we ran a simple regression analysis.

Table 2.1: Mean results on PISA 2006 study for Discovery and non-Discovery Schools - (Amman public schools only)

Subtest Subject	Discovery Schools n=1897	Non-Discovery Schools n=574
Math	406.51 Std. dev. 70.4	385.35 Std. dev. 70.42
Reading	437.25 Std. dev. 76.4	408.59 Std. dev. 78.62
Science	445.38 Std. dev. 76.99	423.02 Std. dev. 77.25

Data Source: PISA 2006, NCHRD

Preliminary analysis revealed a significant correlation between the Index of Economic, Social and Cultural Status (IESCS) and a student's performance on all three tests (see Table 2.2). To analyze the impact of attending a Discovery School on PISA scores, a regression model was built with a student's IESCS being entered as a control, followed by their school status (Discovery School or non-Discovery School). This was performed for each PISA subtest (math, reading and science). In all three regression models, a student's IESCS score was a more significant predictor of their PISA score than their attendance in a Discovery School. Attending a Discovery School was a much smaller, but still a significant predictor of their PISA score (see Tables 2.3-2.5). Our analysis suggests that being in a Discovery School may account for 1% - 2% of the performance difference on PISA (change in R^2 ranges from .01 to .02). However, this is only a preliminary look at the data; given the variation in the use of e-content that the current study encountered, this question and analysis merits a closer examination.

Table 2.2: Correlations between the IESCS and results on the PISA 2006

	Math	Reading	Science
Index of Economic, Social and Cultural Status	.332*	.273*	.309*
*p < .001			

Data Source: PISA 2006, NCHRD

Table 2.3: Regression model summary for IESCS and Discovery status on students' math score

Regression Model	R	R Square	R Square Change	Beta*	
				IESCS	*Discovery*

[21] Organization for Economic Co-Operation and Development. (2007). *PISA 2006: Science Competencies for Tomorrow's World: Executive Summary*. Paris: OECD.

IESCS	.33	.11	.11**	.33**	-
IESCS and Discovery status	.35	.12	.01**	.32*8	.10**
Standardized Coefficient **p < .001, * Standardized Coefficient					

Data Source: PISA 2006, NCHRD

Table 2.4: Regression model summary for IESCS and Discovery status on students' reading score

Regression Model	R	R Square	R Square Change	Beta*	
				IESCS	*Discovery*
IESCS	.27	.07	.08**	.27**	-
IESCS and Discovery status	.30	.09	.02**	.26**	.14**
Standardized Coefficient **p < .001, * Standardized Coefficient					

Data Source: PISA 2006, NCHRD

Table 2.5: Regression model summary for IESCS and Discovery status on students' science score

Regression Model	R	R Square	R Square Change	Beta*	
				IESCS	*Discovery*
IESCS	.31	.10	.10**	.31**	-
IESCS and Discovery status	.32	.11	.01**	.30**	.10**
* Standardized Coefficient **p < .001, * Standardized Coefficient					

Data Source: PISA 2006, NCHRD

2.5 A Vision of ICT in Education for the JEI and ERfKE

An issue of concern for the EDC researchers is the JEI's lack of a clear, precise vision of the role of ICT in the classroom. Earlier research on the success of educational ICT projects around the world suggests that a clearly defined pedagogical vision for the role of ICT in the classroom is crucial to long-term success.[22] Classroom teachers need to feel that these tools will make a meaningful difference for their students. Although the MoE is proactively developing the reform strategy that incorporates the JEI as one approach to explore ways to prepare students for the knowledge economy, the vision and the legitimacy of the integration of ICT in the education system is not clearly articulated in the ERfKE policy documents nor is it clearly reflected in the early JEI documents. The objectives of the JEI and the outcomes that should be achieved through the JEI in terms of classroom practice remain ambiguous.

The objectives of the JEI do not clearly explain the reason why ICT should be integrated into all levels of the education system and why adoption of e-curriculum in all subjects improves learners' creativity and innovation. For example, one of the four primary objectives is to "improve the

[22] Ely, D. (1990). Conditions that facilitate the implementation of educational technology innovations. *Journal of Research on Computing in Education, 23*(2), 298-305, Hawkins, J., Panush, E. M., & Spielovogel, R. (1996). *National Study Tour of District Technology Integration Summary Report* (CCT Reports No. 14). New York: Center for Children and Technology, Light, D., & Manso, M. (2006). *Educational Technology Integration in Developing Countries: Lessons from Seven Latin America SchoolNets.* Paper presented at the Association of Educational Research of America, Seattle, Pérez, P., Light, D., Vilela, A., & Manso, M. (2003). Learning from the pioneers: A Study on the Best Practices of the network TELAR. *Interactive Educational Multimedia*(6), 17-39.

development and delivery of education to Jordan's citizens through public-private partnerships, and, in the process, help the government of Jordan achieve its vision for education as a catalyst for social and economic development." This broad vision is sufficient for private and governmental partners to understand the value of their involvement. However, it does not articulate how classroom practice will be improved and what kind of benefit educators as well as students can obtain through the reform. Without clear vision and goals, it will be difficult to convince teachers of the importance of adopting ICT in schools and classrooms and to create the desired positive behavioral changes.

3 Research Questions and Methodology

Current research on educational technology integration shows that the introduction of ICT alone cannot transform the teaching and learning environment.

One of the objectives for the Jordan Education Initiative is to support the Ministry of Education's curricula reform process, Education Reform for the Knowledge Economy (ERfKE), and to support changes in daily classroom practice to include the use of ICT and e-content as well as the use of new teaching practices. Current research on educational technology integration shows that the introduction of ICT alone cannot transform the teaching and learning environment.[23] Teachers need to know how to structure the curriculum, select resources, guide activities, and support this learning process, and many traditionally-trained teachers are not prepared to take on these tasks. As Bransford, Brown, & Cocking[24] point out, to use technology effectively, the pedagogical paradigm needs to shift toward more student-centered learning, and this shift is not trivial or easily accomplished, particularly in countries with teacher-centered educational traditions.

The MoE and the JEI requested a more descriptive study that would help them understand the current practices in schools and serve as a guide to future strategies for JEI activities.

The research questions and methods selected for this study were shaped by a number of important external factors: the MoE's understanding that Jordan is in the earliest stages of moving the reform process into classrooms; the absence of baseline data on classroom practice in the Discovery Schools; and JEI's own internal measures suggesting that teachers are not using the ICT resources as expected. Because of these concerns, the MoE and the JEI requested a more descriptive study that would help them understand the current practices in schools and serve as a guide to future strategies for JEI activities. In the initial planning meetings for the current study, the MoE leadership commented that they already knew that teacher practice throughout the Kingdom was still within a traditional teacher-centered paradigm, and they were more interested in EDC using its resources to identify what student-centered practices were emerging around ICT that might be present in the Discovery Schools and what factors might favor this development. In order to accomplish the goal of finding these "innovative" practices, the EDC research team suggested using a "best practices" approach.

This research was designed to offer an understanding of the extent to which there is a student-centered learning paradigm present in the Discovery Schools and to understand the factors that have facilitated these changes or hindered teachers' ability to transform the learning environment. Three central research inquiries drive the evaluation plan:

[23] Kozma, R. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology, 1*(2), 117-156, Webb, M., & Cox, M. (2004). A Review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education, 13*(3), 235-286.
[24] Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How People Learn: Brain, Mind, Experience, and School*. Washington, DC: National Research Council/ National Academy Press.

1. Are there aspects of a student-centered learning paradigm emerging in the Discovery Schools? What does this new paradigm look like? What does it mean for how teachers teach and how students learn? What has the JEI brought to this evolving paradigm?
2. What are the conditions supporting this new paradigm? And, what the challenges and impediments?
3. What role do the ICT resources and e-content, provided through the JEI, play in promoting this paradigm? What is the role of e-learning in Jordanian classrooms?

In order to offer insights in response to these questions, the research design was built around case studies of schools and teachers whom the JEI consider to best represent the goals of the program. This will allow the evaluation to develop an understanding of where the forefront of change in classroom practices is and what factors have helped and hindered teachers' abilities to effect change in their daily practice.

3.1 Sample selection

The evaluation used a purposive sampling strategy to identify schools and teachers that were considered to be frequent users of ICT and best represent what the JEI and MoE would hope to achieve as part of the initiative. Selected "best cases" were used because the objective of the research was to understand the factors and conditions that facilitate or impede instructional change. The JEI staff members developed a list of 20 schools that were working to experiment and integrate ICT and e-content and teachers, in those schools, they considered to be exemplary. They made their selection using data on how many teachers were using ICT in each school and on reports from the field about specific teachers known to be trying out ICT-rich activities. From this list EDC selected a final sample of ten schools balanced to represent male and female schools and different grade levels from 2nd to 10th grade. We excluded grades 11 and 12, the grades considered "high school" in Jordan, because many students in Jordan are new to those schools since they transfer in at that point and pressure to prepare for the Tawjihi Exams often inhibit teachers from innovation. Discovery Schools that were identified offered a range of successful teachers working across the key content areas of mathematics, Arabic, science, English and ICT from 2nd to 10th grades. The exemplary schools were part of these case studies.

Additionally, a sample of 10 randomly identified schools was chosen from the remaining Discovery Schools to participate in the survey study. These schools were selected from the 80 Discovery Schools which were not candidates for the case studies.

3.2 Case study and the random sample schools

The two samples of schools have similar demographic characteristics. There were 10 schools in each sample: the case study and random groups. The principal difference between the two groups of schools is that the case study population has four schools with four or more labs.

Table 3.1: Demographic characteristics of selected case study Discovery Schools and a random sample of Discovery Schools

Case Study Schools (n = 10)		Comparison Group Schools (n = 10)	
Gender		*Gender*	
Male	3	Male	4
Female	5	Female	3
"Mixed"	2	"Mixed"	3
Student Population		*Student Population*	
250-500 students	2	250-500 students	1
501-1000 students	5	501-1000 students	5

>1001 students	3	>1001 students	4
Computer Labs		*Computer Labs*	
Two labs	3	Two labs	1
Three labs	3	Three labs	7
Four or more	4	Four or more	2
Internet Access		*Internet Access*	
Yes	9	Yes	7

Data Source: Principal Survey, N=20

3.3 Data Collection

A case study approach consisting of school visits, teacher and principal interviews, focus groups with students and structured observations was used in the ten exemplary schools.

The initial school visits were conducted by the core research team, including international and local educational researchers. The day was spent conducting formal interviews with the principal, lab technician(s) and three teachers, a school "walk about" and informal observations of classrooms. Student focus groups were in a selection of the schools with ninth or tenth grades.

3.3.1 Case Study

Interviews: In each school, interviews were conducted with the school principal (when available), the lab technician, and at least three teachers who use ICT in their teaching. All the interviews were conducted by a team of researchers composed of one EDC researcher and one Jordanian researcher, who translated and facilitated the interviews and was a key source of contextual understanding. The interviews used structured protocols to guide the subjects' discussion but the interviewers probed for in-depth information throughout the interview. All teacher interviews were conducted in private without the presence of the school's principal.

The list of interviewed teachers was developed using a purposive sampling strategy. For each school, the PMO staff identified all the teachers who were known to be actively trying out new ICT activities and/or new teaching approaches. Generally this meant that the PMO staff had had personal interactions with these teachers, had visited their classrooms or had seen their work. From that broader list in each school, EDC then selected three teachers per school to interview. The EDC's selection criteria required that final choices had all been trained in e-content, were balanced across grade ranges, and targeted the core subjects of Arabic, science, math and English.

We conducted a total of 51 interviews with educators in the ten case study schools: 43 teachers and lab technicians; 8 principals, and 2 assistant principals (for schools where no principal was available). Among the 51 teacher and principal interviewees, 35 were female and 16 were male. The teachers represented a full range of grades since Jordanian teachers teach multiple sets of grades. The number of teachers interviewed, by grade, is represented in Table 3.2.

Table 3.2: Teachers interviewed by grade

Grade	Teachers	Grade	Teachers
1st	1	7th	6
2nd	1	8th	3
3rd	1	9th	9
4th	6	10th	8
5th	2	11th	7
6th	6	12th	6

Data Source: Interview, N=51

We selected teachers from the content areas that have e-content: Arabic, math, science, English and 1st-3rd grade classroom teachers, who teach multiple subjects. Additionally, we selected a small number of ICT teachers.

Table 3.3: Teachers interviewed by subject			
Subject	Teachers	Subject	Teachers
Arabic	4	Lab technician	11
Classroom	6	Math	5
English	6	Religion	2
ICT	2	Science	5

Data Source: Interview, N=51

Focus groups: Focus groups are a common collective interview strategy that allows for a more open and relaxed conversation, which is particularly effective when working with teenagers. EDC trained a team of young bilingual (Arabic-English) researchers, one male and one female, to conduct the focus groups, and an EDC researcher observed all the focus groups. The team conducted six student focus groups with tenth grade students from three of the exemplary Discovery Schools and three schools from the random sample of Discovery Schools. The focus groups were either all male or all female, depending on the school. To ensure a wider variability of student experience, students did not come from the same class: three students were selected from one 10th grade class and three other students were drawn from a second 10th grade class. The selection of the students was left to the principal, who was asked to select students who were "talkative." We also coordinated our teacher interview list to be sure that we interviewed at least one teacher who taught these students.

Formal Classroom Observations: EDC trained a team of ten MoE supervisors to conduct the classroom observations. The observers worked in teams of two to follow the experience of one classroom of students three hours a day for three days, observing all teachers who taught those students during the hours observed. The time spans were selected to ensure the exemplary teachers who had been interviewed would also be observed. Also, some observation teams were assigned to observe computer labs.

The ten observers conducted a total of 184 classroom observations from November 4 to15, 2007, and from December 2 to 13, 2007, at the ten exemplary Discovery Schools. Observers used a structured protocol and wrote field notes. The data was quantified and crosschecked with the field notes. Each school experienced at least 16 classroom observations during the evaluation period (see Table 3.4).

Table 3.4: Number of observations conducted in each school		
School Name	Number of Observations	%
School One	18	9.8
School Two	16	8.7
School Three	18	9.8
School Four	18	9.8
School Five	18	9.8
School Six	18	9.8
School Seven	18	9.8
School Eight	25	13.6
School Nine	18	9.8
School Ten	17	9.2
Total	184	100.0

Data Source: Observation Report

Math and Arabic were the two most commonly observed subject areas, comprising 21% and 20% of the observed lessons, respectively. Another 15% of the lessons were English and 14% were in Science. Only 7% of the observations were conducted in ICT classes.

However, 27% of the observations were conducted in the Computer labs observing content teachers using the ICT resources. And two observations (1%) were in a school's Multimedia Room. The remaining 67% of the observations were conducted in students' classrooms.

The class sizes ranged from 16 to 52 students. Approximately 40% of the classes consisted of 30 to 35 students, 11% of the classrooms had 20 to 30 students while 22% of the classrooms had 40 to 50 students. All of the classrooms consisted of single sex students and a teacher of the same sex. The majority of the observed classrooms (70%) were all-female classrooms. Male teachers conducted only 30% of the observed lessons.

Table 3.5: Number of observations by subject areas

Subjects	Number of Observations	%
Arabic	36	19.6
Classroom (grades 2 or 3)	3	1.6
English	27	14.7
Geography	12	6.5
History	4	2.2
ICT	12	6.5
Math	39	21.2
Science	25	13.6
Other	26	14.1
Total	184	100.0

Data Source: Observation Report

3.3.2 Survey Study

To offer a broader contextual understanding of the JEI experience and to help interpret the case studies, the evaluation design included a survey study of teachers, administrators and students. Teachers and administrators, the staff from the ten exemplary schools and ten randomly selected Discovery School were surveyed during the fall of 2007.

Teacher Survey: A paper survey was developed and administered to all teachers in the ten exemplary schools and the ten randomly selected schools during September of 2007. The survey covered issues of technology practices, teaching beliefs, leadership and infrastructure. Responses were collected from 476 teachers in grades 1-12 from the selected schools; 65% of the respondents were female while 35% were male. The majority of the teachers surveyed (68%) held the rank of Teacher.

Table 3.6: Teacher's official rank

Rank in the Ministry	Percentage
Assistant Teacher	22%
Teacher	68%
First Teacher	4%
Expert Teacher	0%

Data Source: Teacher Survey, N=476

Table 3.7: Teachers surveyed by subjects	
Subject Taught	*Percentage*
Arabic	17%
Math	16%
Science	14%
Foreign language	13%
1st, 2nd, or 3rd grade*	13%
Social studies	10%
Religion	10%
Informatics or computer science	2.7%
Other subjects	11%
Special education and remedial studies	1%

*Teachers in these grades teach all subjects
Data Source: Teacher Survey, N=476

The teachers were distributed relatively evenly across the distinct subjects and grade levels. The responses from teachers were distributed across all subjects taught equitably, as was the distribution of which grades the teachers taught. The two most frequently occurring subject areas taught were Arabic and math at 17% and 16%, respectively.

Table 3.8: Teachers surveyed by grades	
Grade	Percent of Teachers in each grade *
1	6.5%
2	9%
3	8%
4	20%
5	25%
6	28%
7	30%
8	29%
9	30%
10	25%
11	13%
12	14%

Data Source: Teacher Survey, N= 476
* Total is more than 100% because many teachers teach multiple grades

Table 3.9: Teachers' reported highest level of education	
Highest Level of Formal Education	Percentage
Community College Diploma	12%
Bachelor's Degree	70%
Higher Education Diploma	6%
Master's Degree	5%
Doctoral Degree	<1%
No response	5%

Data Source: Teacher Survey N=451

Table 3.10: Years of teaching experience	
Years Teaching	Percentage
1-2 years	7%
3-5 years	22%
6-10 years	22%
11-15 years	19%
More than 15 years	25%
No response	4.5%

Data Source: Teacher Survey, N=454

Table 3.11: Years teaching at present school	
Number of Years	Percentage
1-2 years	27%
3-5 years	33%
6-10 years	21%
11-15 years	9%
More than 15 years	5%
No response	5.5%

Data Source: Teacher Survey, N=450

Almost three-quarters (70%) of the teachers surveyed have received a bachelor's degree as their highest level of formal education. Conversely, less than 1% of the teachers surveyed had earned a Doctoral degree.

One quarter of the teachers surveyed have been teaching for more than 15 years, but fully 81% of the teachers surveyed have been working at their current school for fewer than 10 years. Only 5% of teachers surveyed have been teaching at their current school for more than 15 years, while 60% of teachers surveyed have been at their school for less than 5 years. Below are two tables explaining the professional experience of teachers surveyed.

Principal Survey: With the help of the local research team, we surveyed 20 principals using a paper-based survey: 10 from case study schools and 10 from the comparison schools. Among the 20 principals, 12 were female and 8 were male. Of the 20 participating principals, 8 led female schools, 8 led male schools and 4 led "mixed" schools (generally female schools with some boys attending in kindergarten through third grade in coeducational classrooms).

The survey results indicate that there was no significant difference in the educational background of the principals from the two samples: 75% of principals surveyed had a Higher Education Diploma, while 35% of participating principals had a Master's Degree or higher.

Table 3.12: Principal's highest level of education received			
	Exemplary Discovery Schools	Random Discovery Schools	Total
Higher Education Diploma	8	7	15
Master's Degree	2	2	4
Doctoral Degree	0	1	1
Total	10	10	20

Data Source: Principal Survey, N=20

We also learned that the turnover rate for school leaders is relatively high. About 65% of principals have been a principal for at least 3 to 6 years, and 45% have been engaged in the position at the current school for 1 to 5 years.

Table 3.13: Years being a principal at this school

	Exemplary Discovery Schools	Random Discovery Schools	Total
Less than a year	1	5	6
1-2 years	4	1	5
3-5 years	1	3	4
6-10 years	2	1	3
More than 10 years	2	0	2
Total	10	10	20

Data Source: Teacher Survey, N=20

Student Survey: Since all Discovery Schools have Internet access, an on-line student survey was administered to 10th grade students from selected schools between December 10th and December 24th, 2007. Because of concerns around creating an age-appropriate survey and varying literacy levels, EDC decided to conduct the survey with only the 10th grade students. The survey was administered to all of the case study and random schools that had a 10th grade. A total of 432 10th grade students at 13 Discovery Schools (eight case study schools, and five from the randomly selected group) participated in a survey questionnaire. Among the 432 students, 291 (68%) were female and 137 (32%) were male.

The number and percent of student survey participants and what school they attend – case study or comparison group – are displayed below:

Table 3.14: Number of students surveyed by school

School Name		Number of Participants	%
Case study schools	School Seven	40	9.3
	School Two	52	12.0
	School Six	33	7.6
	School Eight	29	6.7
	School Ten	29	6.7
	School Four	40	9.3
	School Three	40	5.6
	School Five	38	8.8
Comparison group	School Eleven	20	4.6
	School Twelve	26	6.0
	School Thirteen	34	7.9
	School Fourteen	29	6.7
	School Fifteen	38	8.8
Total		432	100.0

Data Source: Student Survey

4 Introduction to the Findings

Many teachers were able to use the e-resources but with a teacher-centered approach. A rich practical knowledge of student-centered instruction can only develop through practice over time.

Throughout our interviews and visits with principals and teachers in the case study schools, we met many motivated educators who struggle with the day-to-day challenges in the classroom and efforts to integrate radical new tools, like ICT and e-content, and to use complex and innovative approaches to teaching, like student-centered learning or project-based education. They are striving to create profoundly different learning environments for their students, but this new environment is just barely beginning to emerge in a few of the classrooms and schools. From our interviews and observations, the overarching challenge for the classroom educators we worked with is a need for a clear vision of the new teaching approaches and the role of ICT within that vision, and then to develop the practical knowledge of how to implement new teaching practices into their classroom. Many teachers were able to use the e-content and some of the other e-learning resources, but it was often used within a traditional teacher-centered approach. And, much of the e-content easily allows teachers to slip back into teacher-centered use. In part, a rich practical knowledge of student-centered instruction can only develop through practice over time. Many of the teachers in Jordan are at the beginning of this process. However, the teachers also need richer and more varied learning opportunities to engage with both the new technologies and the new teaching paradigm in meaningful ways.

The following sections report on the characteristics we found in the exemplary Discovery Schools.

5 Inside the Classroom

As the JEI has made progress on its mandate to support the creation of local e-learning resources and the emergence of Jordanian educational technology capacity, the JEI and the MoE are increasingly focusing on the integration of these resources into daily practices and changes in teaching practice to support both the ICT and Jordan's ERfKE reform.

5.1 E-Learning resources: How much are they used?

E-content resources are used by teachers with much greater frequency than other ICT resources such as productivity software or the Internet.

Data collected during our study offer insight on the extent to which e-learning resources are being integrated into teachers' daily practice and the nature of that use. The data presented first indicate the extent to which ICT has been adopted so far and the variety of resources being used. A reasonable number of teachers have begun to include ICT among their teaching resources, although the frequency and the variety of resources used are still limited. Moreover, e-content resources are used with much greater frequency than other ICT resources such as productivity software (MS Word, PowerPoint, Excel) or the Internet.

Teachers were asked if they used technology for their own planning and preparation, and if they used ICT with their students (see Table 5.1). Incorporating ICT into their own planning activities is often an easy step for teachers. The responses indicate that more teachers have integrated ICT into their planning and preparation (73.1%) compared to integrating it into their students' activities. On the surveys, 66.4% of the responding teachers reported that they used technology with their students. For the case study schools, not only are both percentages higher with 75.7% indicating

they have used ICT with their students and 78.9% having used ICT in their planning, but those percentages are nearly equal. This suggests that teachers in those buildings have been able to move further along in the process of enacting changes in the classroom.

Table 5.1: Teachers' reported use of ICT for educational purposes

	Case Study Discovery Schools	Random Discovery Schools	Total
Use ICT for their own planning	78.9%	67.8%	73.1%
Use ICT with students	75.7%	58.1%	66.4%

Data source: Teacher Survey, N=476

Table 5.2: Teachers' reported use of e-content in regular classrooms

	Case Study Discovery Schools	Random Discovery Schools	Total
Never	27.5%	37.9%	32.9%
Seldom	6.9%	10.3%	8.7%
Often	65.6%	51.7%	58.4%

Data source: Teacher Survey, N=334

To explore what e-Learning resources are being used in the classroom, teachers were asked about their use of a variety of resources with their students. The most frequently used resources are the subject specific e-content resources. Among teachers in content areas where e-content is available, 58.4% reported using e-content often (once a month or more frequently) and another 8.7% used them infrequently. Those percentages are higher for teachers in the case study schools.

Looking more broadly at other ICT resources, like productivity software (i.e. Word or PowerPoint), and the Internet, the responses are less positive. None of these resources are being used by more than 20% of the teachers overall. MS Word and PowerPoint are the most commonly used software packages at just under 20% each. The Internet is used by 17.9% of all teachers, and search engines, in particular, are used by 16.2% of all teachers. As would be expected since use of e-content was a selection criterion, the frequency of use is slightly higher for the case study schools.

Table 5.3: Teachers who report using software with students

		Case Study Discovery Schools	Random Discovery Schools	Total
Word	Never	42.5%	57.2%	50.2%
	Seldom	33.2%	27.6%	30.3%
	Often	24.3%	15.2%	19.5%
PowerPoint	Never	37.6%	55.2%	46.8%
	Seldom	37.2%	30.8%	33.8%
	Often	25.2%	14.0%	19.3%
E-mail	Never	73.5%	84.4%	79.2%
	Seldom	15.9%	12.4%	14.1%

	Often	10.6%	3.2%	6.7%
Internet	Never	47.3%	69.6%	59.0%
	Seldom	27.9%	18.8%	23.1%
	Often	24.8%	11.6%	17.9%
Internet searches	Never	51.8%	69.2%	60.9%
	Seldom	26.5%	19.6%	22.9%
	Often	21.7%	11.2%	16.2%
Multimedia encyclopedia	Never	72.6%	77.6%	75.2%
	Seldom	16.8%	14.8%	15.8%
	Often	10.6%	7.6%	9.0%

Data source: Teacher Survey, N=476

So that our understanding would not be based on only teacher perceptions, we also surveyed 10th grade students to hear from them what ICT resources *they* used in their classes. The student data tends to corroborate the teachers' reporting that usage is relatively low but still that the case study schools have substantially higher use. Keeping in mind that 10th grade students in Jordan typically have eight teachers, even a few teachers that use technology would give a lot of students some experience with e-learning resources. The results suggest that not all students get to use computers in their learning.

Table 5.4: Tenth grade students' reported experience using computers in each content area (percentage)

Content Area	Case Study Discovery Schools	Random Discovery Schools	Total	% Difference
Science	50%	14%	38%	+36%
Mathematics	72%	35%	59%	+37%
Arabic	35%	14%	28%	+21%
Social Studies	43%	8%	31%	+35%
Religion	23%	8%	18%	+15%
Informatics or Computer Science	77%	61%	71%	+16%

Data source: Student Survey, N=432

Excluding ICT classes, Math is the content area with the highest ICT use with 59% reporting computer use in math class, most likely because e-math has been rolled out to all Discovery Schools. Science and social studies follow next with 38% and 31% usage respectively.

When we examine the differences between the students in the different groups of schools we see that more students use computers in more subjects in the case study schools than in the comparison group schools. Social Studies and Science are interesting cases since the results are substantially higher for the case study schools. Given that these are two content areas that do not have a full range of e-content available for 10th grade, the higher rate of usage of ICT suggests that the science and social studies teachers in the case study schools see value in ICT as a resource for their students, even without e-content. The case study schools tended to have strong leadership and were engaged in a school wide conversation about the value of technology as a teaching tool. The strong leadership in these schools encouraged teachers to attend trainings and to share new ideas with their colleagues and this may be influencing teachers in subjects and grades that are not directly involved in e-content. For example, in one school we spoke to a tenth grade science teacher who used many online resources for her students. She even used e-content designed for a lower grade as a review activity for her tenth grade students. Additionally, we also saw geography teachers using Google Earth to teach geography.

A more complex pattern emerges when we take a closer look at students' use of specific applications (PowerPoint, Excel, Word, etc.) and the use of e-content. Students in both groups of schools had similar experiences (see Table 5.5). The greater exposure of students in the case study schools to e-learning is linked to the e-content. While students in the case study schools reported using certain applications in their classes with slightly greater frequency than their peers in the comparison group schools (like PowerPoint and the Internet), most applications were used at a similar rate (like Excel and Word). The e-content use is the only notable difference with the case study schools showing higher usages, but their use of e-content was a factor in their original selection as "case study schools." The productivity software may show similar levels of usage because they are covered in the ICT classes and it is the e-content results that indicate that the case study schools are more successfully integrating e-learning resources into the classroom.

Table 5.5: Tenth grade students' reported experience using software program (percentage)

Software Program	Case Study Discovery Schools	Random Discovery Schools	Total	% Difference
Word	64%	63%	64%	*+1%*
Excel	61%	57%	60%	*+4*
PowerPoint	66%	57%	63%	*+9%*
Internet	60%	49%	56%	*+11%*
E-Content				
E-math	70%	34%	58%	*+36%*
E-Arabic	27%	10%	21%	*+17%*
E-English	58%	21%	45%	*+37%*
E-science	29%	10%	22%	*+19%*

Data source: Student Survey, N=432

5.2 New learning environments: Teaching and learning practices in the classroom

The interviews and observations of teachers in the case study schools offer us more insight into the ways in which these resources have been integrated into classroom work with students. In accordance with the four-stage model of integration developed by UNESCO[25], the general nature of practice is still teacher-centered. Although teachers are generally motivated and desirous of change, they are still working within the traditional paradigm. During the observations conducted in the case study schools, only 62 lessons (34%) involved the use of computers – either the teacher working with the computer (laptop and projector) or the students working on the computer. Only 10 (8%) of observations in standard classrooms (i.e. not in the computer labs) involved computers, and these were all with a laptop and a projector. The majority of these computer-supported lessons, 75% or 49 lessons, took place in the computer labs (see below for a more detailed discussion of computer labs).

The use of computers inside standard classrooms is shaped by the access to technology in these classrooms. Most schools in Jordan do not have computers in their classrooms and the JEI has been giving laptops to teachers as one strategy to create access in classrooms - 31% of the teachers surveyed reported access to laptops. Of the principals surveyed, nine of twenty principals said they had school policies that allowed teachers to sign out laptops.

[25] Cressman, G., & Daly, J. (2007). *Evaluation of the Jordan Education Initiative: Review of the Technology Employed to Deliver E-Learning*. Washington, DC: Education Development Center.

Although there were relatively few ICT-mediated activities, the classroom observations offered a picture of how the computers were used in the classrooms. If we include the informal observations that occurred during our day-long school visits for the interviews, there are three overall patterns of usage:

1. Teachers using student-centered approaches in their teaching and integrating e-learning resources in student-centered ways.
2. Teachers using student-centered approaches in their teaching but integrating e-learning resources in teacher-centered ways.
3. Teachers using teacher-centered approaches in their teaching and integrating e-learning resources in teacher-centered ways.

Four of the most interesting classes representing student-centered uses of ICT were in School Five. In two classes, science and Islamic studies, groups of students prepared PowerPoint presentations related to the lesson topic that they then used to "teach" their peers. The students gave a short presentation after which they asked their classmates questions, as well as answered questions from fellow students and the teachers on what they had just taught. In the grade 9 Islamic studies class, students challenged their audience of peers with the question: "How can we encourage others to read the biography of the honorable prophet?" They then used a presentation to support a discussion about how to answer the question. These examples show the emergence of a new learning paradigm centered on students assuming a more active role in their learning and an effective use of technology to enable students to create artifacts reflecting their own knowledge and to present their perspective to peers. Another teacher used the projector to display a three- dimensional figure in physics and pose a problem to her students, who then broke into small groups to try and solve the problem. In her interview, the principal of this school spoke about the professional development program where some of her teachers learned about this teaching technique. The faculty, after their professional development, then shared what they had learned with their peers. Three different teachers were observed using the technique of making students responsible for part of the lesson and consequently their learning.

In some of the schools selected as case studies, a new learning paradigm is emerging that is centered on students assuming a more active role in their learning and an effective use of technology to enable students to create artifacts reflecting their own knowledge.

Another set of observations with a second grade classroom teacher reveal a second pattern of use related to the e-content. In her interview, this teacher described how she struggles to create a more active, student-centered learning environment. This teacher had worked in the United Arab Emirates for a few years and spoke about a professional development course she had taken there that encouraged student-centered learning. She was trying to teach this way. In her interview, this teacher explained to us her blended learning model as: 1) students learn by doing, 2) e-content and 3) the text book. But, the observations reflected a tension between the active parts of her lesson (the "learning by doing"), and a return to whole class, rote instruction when she introduced the e-Arabic resources. One of her lessons started with the students engaged in a physical activity - performing a short play about olive trees out in the garden - but then returned to their seats in the classroom to read in unison from text projected by the computer. This example points to one of the concerns that was cited in the Task 3 report of the JEI Evaluation[26] that the e-content easily facilitates teachers--even teachers who are trying to work differently--devolving into a traditional teacher-centric paradigm,.

The JEI supported e-content easily facilitates teachers--even teachers who are trying to work differently--devolving into a traditional teacher-centric program,.

In a final example, we visited a classroom where we were escorted by the principal to observe a third grade teacher who was using e-math. The teacher was projecting an illegible e-math image

[26] Ibid.

onto a wall while her entire class was seated in a big circle on the edges of the classroom so that they could see the screen. The teacher selected a student to come up to the laptop. This student would listen to the instructions being given through the computer's speakers and complete the task, while the rest of the students sat passively watching the blurry image on the screen. The task was supposed to teach students about place values in math, the images on the screen were digits, and the computer voice was asking the student to create a number, like 324, with those digits. This e-math activity could be a reasonable activity for students to do individually or in small groups were they can discuss the answers, but, as done in this observation, it was ineffective as a whole class activity. None of the fellow students could possibly see or hear either what was on the computer or what their classmate was doing. Not only was this a teacher-centered use of the e-learning resources, it was a particularly ineffective use of those resources.

5.3 New learning environments: Why use ICT?

Teachers' beliefs about teaching and learning and the role ICT plays in supporting learning are essential determinants in how teachers will use ICT with their students.[27] We investigated teachers' beliefs about ICT and learning through the surveys and interviews. We surveyed teachers who had used ICT with their students about their most important objectives for using computers and ICT in their teaching. In the case study schools, the top responses all center on the acquisition of content knowledge and discrete skills, instead of learning objectives targeting 21st Century Skills and competencies like collaboration, communication/presentation, or research and analysis. Mastering skills and remediation (47.7% and 35.3%) are the most common. The evidence suggests that most teachers who use ICT principally perceive it as a tool to support student memorization and practice, and not as a productive tool for student-centered learning.

Table 5.6: Teachers' pedagogical objectives for using ICT

(Only teachers who use ICT in their teaching are included)

	Exemplary Discovery Schools		Random Discovery Schools		Total	
	Total	*Percent*	*Total*	*Percent*	*Total*	*Percent*
Mastering skills just taught	73	47.7	56	44.1	129	46.1
Remediation of skills not well learned	54	35.3	38	29.9	92	32.9
Student self-expression	51	33.3	42	33.1	93	33.2
Finding out about ideas and information	50	32.7	48	37.8	98	35.0
Analyzing information	18	11.8	15	11.8	33	11.8
Presenting information to an audience	45	29.4	28	22.1	73	26.1
Improving computer skills	32	20.9	40	31.5	72	25.7
Learning to work collaboratively	43	28.1	38	29.9	81	29.0
Learning to work independently	45	29.4	40	31.5	85	30.4
Provide opportunity for authoring	42	27.5	27	21.3	69	24.7
Total	153		127		280	

Data source: Teacher Survey, N=292

During the interviews, we were able to talk with teachers about their vision of teaching and learning and the role of ICT in more detail. We asked teachers to describe their idea of good teaching and to share an example of an activity or lesson that exemplified it. Most teachers were unable to give a deeper description of good pedagogy beyond "knowing the content" and speaking or presenting clearly. Additionally, when we asked these teachers what benefits ICT brought to the classroom, they generally saw ICT as a way to "motivate" or attract the students into doing traditional practices.

[27] Honey, M., & Moeller, B. (1990). *Teacher's Beliefs and Technology Integration: Different Understandings* (No. 6). New York: Center for Technology Education, O'Dwyer, L. M., Russell, M. K., & Bebell, D. J. (2004). Identifying teacher, school and district characteristics associated with elementary teachers' use of technology: A multilevel perspective. *Education Policy Analysis Archive, 12*(48).

As a fourth grade math teacher commented: "(ICT) motivates the students. It makes the classes light." This suggests that the primary vision of teaching is still based on the teacher's transmission of information to students. Research on change in teacher practice has found that teachers' pedagogical beliefs will determine how they use teaching resources, regardless of the original intent of the resource designers.[28] Currently, in the Discovery Schools, the data suggest that the e-learning resources are mostly being integrated into the traditional paradigm rather than provoking a shift in the overarching vision of pedagogy.

However, there were a small number of teachers who envisioned student-centered learning processes. For example, these teachers spoke about creating lessons where students explored and debated the material in groups, where students found their own solutions to scientific questions or identified mathematical patterns or properties, or where they might have responsibilities to teach each other. We spoke to a third grade teacher who said it was important to have the students talk together about what they were learning and to puzzle it out together. She said that, "these strategies really help students remember the material for the test." This educator said she uses computers and technology in her teaching, but she would make a lot of her own resources from the Internet. One of her goals for this year is to create an activity for her students to use Paintbrush drawing software. Although she did caution us that she does "not use EduWave (e-content) because e-content is very similar to the book and it does not have enough illustrations" for her young students, she did have some complimentary remarks for the e-content. E-content, in her opinion, offers various benefits for her students. First, some of the e-content has "real" images of things, which is good for young children like hers. For example, the activities on money and units allow her children to work with real piasters and dinars. Second, there are a lot of activities in the e-content that students can do in groups. Finally, if there is time for students to work individually, the e-math activities can be good remediation for the weaker students who can benefit from practice and being able to move at their own pace (an example of differentiated instruction). This teacher likes to use the lab twice a week for e-ICT and e-math and tries to schedule a third session as often as she can.

5.4 Professional development

Research demonstrates that the effective use of ICTs is dependent on teachers' ability to select instructionally appropriate ICTs and to use them in the context of effective instructional strategies.[29] Therefore, teacher education, both pre-service and in-service, is central to introducing these new ICT resources and to support the transition in the pedagogical paradigm.[30] In our research we asked the teachers about their professional development experiences. Similar to other recent studies in Jordan[31], we found that teachers have received relatively little professional development and most of it has been focused on technical skills instead of how to use them in the classroom or how to integrate student-centered approaches.

On the survey, 97% of the teachers reported that they had taken the ICDL training, which is a requirement for teachers in the Discovery Schools. The next most frequent training was the ERfKE training which has been taken by 52% of respondents and 39% of teachers have taken the Intel Teach Essentials Course (see Table 5.7). The ICDL is an intensive technical training course that has very little if any content on teaching with ICT. In interviews, JEI's partners expressed concern that the ICDL was inappropriate because it took too much time teaching programs that would never

[28] Ball, D., & Cohen, D. (1999). Developing Practice, Developing Practioners: Toward a Practice-Based Theory of Professional Education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession : handbook of policy and practice* (pp. 3-32). San Francisco: Jossey-Bass Publishers, Cohen, D., Raudenbush, S., & Ball, D. (2000). *Resources, Instruction and Research* (CTP Working Paper No. W-00-2). Seattle: Center for the Study of Teaching and Policy.
[29] Webb, M., & Cox, M. (2004). A Review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education, 13*(3), 235-286.
[30] Cohen, D., Raudenbush, S., & Ball, D. (2000). *Resources, Instruction and Research* (CTP Working Paper No. W-00-2). Seattle: Center for the Study of Teaching and Policy.
[31] Al-Daami, K. K., & Wallace, G. (2007). Curriculum reform in a global context: a study of teachers in Jordan. *Journal of Curriculum Studies, 39* (3), 339-360, Mustafa, M., & Cullingford, C. (2008). Teacher autonomy and centralized control: The case of textbooks. *International Journal of Educational Development, 28* 81-88.

be used in the classroom and provided no discussion on pedagogy. The ERfKE training presents the MoE's new curriculum and discusses the new teaching model, but in interviews with principals they considered that training to be too short and too theoretical to have any practical effect on teachers' actual practice. Indeed, in the interviews, none of the teachers who had taken that workshop were able to explain in much detail what they had learned from it.

Table 5.7: Teachers' reported participation in professional development programs (since 2003)

Program	Case Study Discovery Schools	Random Discovery Schools	Total
ICDL	98.1%	96.2%	97.1%
ERfKE	52.3%	51.9%	52.1%
Intel Teach to the Future	40.7%	37%	38.8%
e-math	26.6%	23.8%	25.2%
e-Arabic	15.3%	16.4%	15.8%
Misc.trainings	16.4%	9.4%	12.7%
e-science	14.5%	7.7%	10.9%
e-EFL	8.4%	8.5%	8.5%
e-ICT	9.3%	7.7%	8.5%
World Links Arab Region	7%	5.1%	6.0%
ERfKE Support Program by CADER	3.7%	5.5%	4.7%
ICT in Education Diploma by CADER	2%	2.1%	1.6%
Cisco Systems	2%	2.1%	1.6%
Diploma in ICT	.5%	1.3%	0.9%
Teaching for Understanding Training	1.4%	0	0.7%

Data source: Teacher Survey, N=449

A number of teachers have taken the subject-specific trainings (SST) that are provided in the e-content areas. Here again, teachers described these two-day trainings as principally focused on explaining where to find the e-content and how to navigate each e-content site, but not providing a deep review of the pedagogical approaches to using the resources. The three professional development offerings that focus on ICT and pedagogy are Intel Teach Essentials, World Links and ICT Diploma by CADER. But the combined percentage of participation in these courses does not include even half of the teachers, and teachers can only take one of these courses.

These reported rates of participation in professional development are very revealing when considered in connection with the students' reported use of ICT and e-content in their classes (see Tables 5.4 and 5.5). Even though teachers in both the case study and comparison groups report similar participation rates in technology-centered training, the extent to which they use it in their classrooms (as reported by students) is much lower in the random schools. Helping teachers change their practice is a long and difficult task, and these results suggest that the trainings alone are not enough. To effect a true change, teachers need to rethink almost everything they do with their students from seating arrangements and class dynamics, to the creation of learning activities and the presentation of information, to questioning strategies and assessments. By themselves the trainings currently available have little to do with the JEI, per se, and are not sufficient to support this change.

6 Inside the Computer Labs

The computer lab is the primary ICT implementation model used by the JEI to ensure equitable access for students to computers and the Internet. All Discovery Schools have at least one computer lab and many have multiple labs. Each lab has 10 to 20 desktop computers and a server. Via the servers, every lab is connected to LAN and then to EduWave. The quality of the connections varies depending on whether the school is connected to the National Broadband Network or is still using an ADSL modem.[32] Another element of the JEI program is that each Discovery School also has at least one lab technician to maintain the labs and to support their use.

We collected data about how the computer labs are used and how this resource is integrated into the daily life of Jordanian schools. We used multiple strategies - teacher surveys, teacher and lab technician interviews and lab observations - to get a deeper understanding of how the labs are used. Through these three lenses we saw – more or less – the same images.

We observed almost 50 computer lab sessions and found that overall these classes mirrored traditional (non-computer lab) classrooms in that they were still teacher-centered with relatively minimal hands-on activities for the students and lacked the pedagogy we might deem necessary to foster 21st Century skills.

6.1 E-Learning resources: How much are they used?

For our analysis of the computer lab practices, we started with a theoretical model of the type of activities we would expect to see in a lab setting. Because the labs provide access to computers and connectivity, we would expect to see students using the computers or the Internet (either individually or in small groups) frequently. We would also expect the teachers to use the technology as well. We would expect to see variations of student-centered practices that one might not see in a traditional class setting because they lack the necessary resources: technology and connectivity.

For instance, we would expect technology to be used by teachers and students in all (100%) of lab sessions. Indeed, we found that the computers were used in 96% of the observed computer labs. However, in only slightly more than half, 26 of the observed lab sessions (52%) were students working directly on the computers, usually in groups. We examined this figure more closely, removing the observations of ICT classes (10 observations), and the number of computer lab sessions where students used the computers on their own dropped to merely 30% (16 observations).

Table 6.1: Computer lab observations - Number of observations in which students or teachers used the computers by content area

	No Computers Used	Only Teacher Use	Only Students Use	Both Teacher and Student Use	Total
Arabic	0	7	0	1	8
English	0	5	1	1	7
Geography	0	2	0	0	2
ICT	0	1	5	5	11
Math	0	2	4	4	10
Science	1	4	1	2	8

[32] For more detailed technical information, see section 5.1 in Cressman, G., & Daly, J. (2007). *Evaluation of the Jordan Education Initiative: Review of the Technology Employed to Deliver E-Learning*. Washington, DC: Education Development Center.

Other	0	1	2	0	3
Number of observations	1	22	13	13	49

Data Source: Observation Reports, N=49

For instance, in one school the principal proudly escorted our evaluation team to observe one of their best teachers in the computer lab with her class. We walked in to find a group of 32 second graders gathered on the floor in the middle of the darkened computer lab. The teacher projected the e-ICT content onto a screen in the front of the classroom, showing a collage of computer-related images (keyboard, mouse, monitor, etc). The teacher would point to an image and ask the class to repeat in unison what part of the computer she was pointing to. At important moments in the class, the teacher would select a student to come up and point to the part on a real computer. She even explained to them how a mouse works, and one student was allowed to come up and touch the mouse. All around the students, there were about 20 computers sitting in the dark, about a handful of them with protective covers. The students themselves did not get to turn on the computers, use the mice or the keyboards. To the surprise of the researchers, the students actually seemed interested in this entire activity even though they were probably not learning much. Focus groups we did with older students helped explain why the students liked going to the computer lab, even if they were not very active. One group of 10th grade girls explained that if they did not go to the computer lab, they might spend "their whole day inside the same walls". Additionally, they felt the text book "was more boring."

The School Three lab technician reported that many teachers fear the technology is a distraction and do not want the students on the computers "so that they will focus on the lesson."

There are a number of factors that help explain why many teachers may not put their students on the computer and some of those factors are vetted below. The observational data confirmed the perception of the lab technicians who frequently told us that many teachers did not have students use the computers. For example, in an interview, one of the lab technicians at School Three described the activities in the two labs she oversees. In her estimation maybe 75% of teachers only used the projector, and in sessions where the students used the computer it would be, at most, half of the session. She reported that many teachers fear that the technology will be a distraction and do not want the students on the computers "so that they will focus on the lesson."

Teachers also expressed hesitancy in having students use ICT because they are uncomfortable not being in control of the learning process.

Teachers also expressed hesitancy in having students use ICT because they are not sure if these e-learning activities help students learn and they are uncomfortable not being in control of the learning process. A second grade teacher we interviewed never has her students do the e-math on their own because she "cannot check what they are actually learning." Instead she does the e-math activities as a whole class using the projector. She does, however, allow the students to do the e-ICT self-assessment activities for 15 minutes in groups of three on the days she goes to the lab.

There are also logistic or scheduling reasons why teachers may not use the computers when they are in the computer labs. School leadership faces challenges trying to schedule lab time for so many classes and teachers. In most schools, lab use is scheduled by the lab technicians under the direction of the principals and not by the teachers. Therefore, lab use is not coordinated to teachers' lesson plans nor the topics they are teaching, nor when they need to access e-learning resources. One principal says she assigns a different grade to the lab for each day of the week. For example, Tuesdays is the day the second grade classes are sent to the lab (see the section below on resource management for more detail).

6.2 E-Learning resources: Which ones are used?

Used in 52.9% of the observed sessions, e-content is the most consistently used resource in the lab. PowerPoint was used in 30% of the observed classes and we observed that teachers frequently used PowerPoint as a "digital blackboard". Teachers' use of PowerPoint is probably closely connected with extension of a teacher-centered pedagogy from the classroom to the labs. Word and Excel (both desktop applications), were both used in less than 10% of the observations. Only 4.1% of the observed classrooms used the Internet (outside of EduWave).

Table 6.2: Computer lab observations - number of observations in which students or teachers used the computers by e-learning resources used

	No Computers Used	Only Teacher Used	Only Student Used	Both Teacher and Students Used	Total
E-math	0	18.2%	45.5%	36.4%	22.4%
E-science	0	33.3%	33.3%	33.3%	12.2%
E-English	0	33.3%	33.3%	33.3%	6.1%
E-Arabic	0	100.0%	0%	0%	6.1%
E-ICT	0	33.3%	0%	66.7%	6.1%
TOTAL e-content use					52.9%
Word	0	100.0%	0%	0%	6.1%
Excel	0	0%	100.0%	0%	4.1%
PowerPoint	0	92.3%	0%	7.7%	26.5%
Access	0	0%	0%	100.0%	6.1%
Internet	0	0%	50.0%	50.0%	4.1%
Other software	0	0%	66.7%	33.3%	6.1%
Other multimedia resources	0	100.0%	0%	0%	2.0%
No software	1	0%	0%	0%	2.0%
Number of observations	1	22	13	13	49

Data Source: Observation Reports, N=49

Although this observation sample is much too small to draw firm conclusions, we also see that teachers using e-math, e-ICT and the Internet were more likely to have their students using technology on their own than teachers who use E-Arabic, MS Word and PowerPoint.

6.3 New learning environments: Teaching and learning practices in the computer labs

In alignment with the ERfKE reforms, the JEI wants to promote a change in classroom practice towards student-centered learning. Since the labs provide sufficient access to computers for student work, we would expect to see some of these new practices emerging within this environment. The data already presented indicate the students are not always using the computers, but there are other teaching practices we might also expect to see in the labs. In addition to using technologies in a meaningful way, we would expect to see teaching and learning practices that are indicative of a learner-centered classroom environment. For instance, we would expect to observe students working more in small groups or as teams, or we would expect to see students trying to solve or answer complex, open-ended questions or problems. There are other areas of student activity that we might expect to observe among teachers focused on teaching 21st Century skills: students reviewing information on their own, students exploring a concept, students solving a problem, students using a variety of learning materials and tools, student collaboration and project work.

Although there is an incipient use of some more student-centered practices, the observations indicate that the traditional teaching paradigm still predominates.

Table 6.3: Computer lab observations - Number of observations in which these activities occurred

Activities	Percentage
Teacher–Centered Activities	
Answering teacher questions	93.9%
Teacher leading whole class discussions	91.8%
Reading	83.7%
Teachers using any technology	71.4%
Taking notes	59.2%
Practicing a skill	59.2%
Reviewing information in pairs/small groups	55.1%
Writing (a report, essay)	32.7%
Completing a paper-based assignment	26.5%
Student-Centered Activities	
Students demonstrating their understanding of content/concept	53.1%
Engaging in small group discussions	44.9%
Reviewing information on their own	36.7%
Creating a presentation	20.4%
Exploring a concept/topic	18.4%
Using a variety of materials and tools for learning	12.2%
Solving a problem	4.1%
Collecting data	4.1%
Project work	2.0%

Data Source: Observation Reports, N=49

The two most salient concerns for JEI and the ERfKE reform at large are (1) to know if and to what degree teachers are moving their classrooms from a more traditional teacher-centered environment to a more student-centered environment and (2) whether teachers are fostering skills associated with 21st Century Learning.

6.4 Teacher-centered vs. student-centered

The results reported (see Table 6.3) suggest that teacher-centered practices still predominate in the observed computer lab sessions. Even though roughly half of the observed classes engaged in some student-centered activities (such as “students demonstrating their understanding of a concept” or “engaging in small group discussion”), over 90% of observed classes engaged in more traditional and teacher-centered activities (such as, “teacher leading whole class discussions” or “answering teacher’s questions”). Additionally, there were other student activities that were associated with non-“wired” classrooms, such as students reading (84%), and students doing paper-based assignments (27%) that were relatively high in our observed computer lab sessions. Student-centered classroom activities where students were working with the technology to produce

something, like creating a presentation (20.4%), exploring a concept or topic (18.4%), or student project work (2%) - occurred much less frequently. The most common student activity was demonstrating understanding (53.1%) which often merely consisted of students answering a teacher question or solving a problem during a teacher lecture.

When technology was used in computer lab classrooms, it was often used as a digitized version of paper-based lessons. This is an important identifying feature in the computer lab to note and understand. The teachers' combination of projector and laptop to project their notes was used in roughly 80% of the observed computer lab classes. The field notes indicate that usually a teacher would create lecture notes in a PowerPoint file and then project the lecture notes on to a screen or whiteboard, or the used e-content in a similar way. In this ICT usage model, the teacher was generally the only person using a computer, and this occurred in almost three-quarters of the observed computer lab sessions. In our interviews, teachers commented that they liked to put their lecture notes into a PowerPoint presentation.

While this is not the intended usage model of the e-Content nor the teaching strategies that the JEI and the MoE wish to promote, this does represent an introduction of new resources, and an indication that teachers are beginning to use ICT. There were times when students did have opportunity to use the e-learning resources and take a more protagonist role in their learning by performing some functions on the computer. On the student survey, among the students from all schools surveyed who reported using each of the following e-content areas, 85% liked the e-math a little or a lot, 75% liked e-Arabic and 78% liked e-English (see Tables 6.4 to 6.6).

Table 6.4: Student survey - Percent of students who like e-math

(only those students who reported using e-math are included)

	Not at All	A Little	A Lot	Total
Case study Discovery Schools	13.6%	43.5%	42.9%	191
Random Discovery Schools	18.8%	35.4%	45.8%	48
Total	14.6%	41.8%	43.5%	239

Data Source: Student Survey, N=239

Table 6.5: Student Survey - Percent of students who like e-Arabic

(only those students who use e-Arabic are included)

	Not at All	A Little	A Lot	Total
Case study Discovery Schools	27.4%	38.4%	34.2%	73
Random Discovery Schools	21.4%	35.7%	42.9%	14
Total	26.4%	37.9%	35.6%	87

Data Source: Student Survey, N=87

Table 6.6: Student survey - Percent of students who like e-science

(only those students who use e-science are included)

	Not at All	A Little	A Lot	Total
Case study Discovery Schools	19%	35.4%	45.6%	158
Random Discovery Schools	41.4%	20.7%	37.9%	29
Total	22.5%	33.2%	44.4%	187

Data Source: Student Survey, N=187

6.5 Managing the lab resources

Scheduling access to the labs is a critical problem for schools. In the case study schools, the labs appear to get more use, with 70% of the teachers surveyed indicating they took their students to the computer labs at least once during the school year compared to 60% of teachers from the randomly selected schools. In interviews, the principals and the lab technicians in our case study schools explained how they scheduled the labs. Some principals had well-thought-out strategies to coordinate the scarce ICT resources to ensure equitable time in the labs. A few principals worked with their lab technicians to identify all content and grades that had e-content, and scheduled the appropriate sessions in the labs. At the beginning of the year, School Three identifies all the classes that will need to be in the lab for e-content and for how many sessions per week (see Table 6.7). Teachers in those grades and subjects are required to go to the lab on the pre-assigned days, and they must use the e-content. If the e-content does not fit with their lesson plans on that day they are allowed to cancel the session. According to the lab technician, teachers who want to use other e-learning resources need to schedule extra lab sessions. This approach is equitable in that all students in grades with e-content will have access to that e-content. However, the timing of when they will get to use those resources may or may not be pedagogically relevant. The decision to use e-learning resources is not made by the teacher, by the person who most closely knows students' learning needs. In other contexts, the lab technician is solely responsible for scheduling the computer lab.

Table 6.7: Calculations of lab sessions needed at School Three, grades 1 to 12

Math 1st -12th grades	1 period
English 7th -10th grades	1 period
ICT 1st -3rd grades	1 period
Arabic 4th grade –	1 period
Physics 10th, 11th grades –	1 period
ICT general 7th -11th grades	2 periods

However, other schools either had no clear process for scheduling lab time or approaches that were relatively random. As mentioned above, one school assigns a different day to each grade level and the sections of students' cycle through the lab on that day.

At least one school we visited had a process to schedule lab access that was driven by the teachers. At School Two, the lab technician sits down with teachers who want to use a lab or the multimedia room and arranges a time for them. The lab technician reviewed her sign-in book and found that all 26 teachers in the building had used the lab in recent weeks. This particular school has strong leadership and has four computer labs, a multimedia room and computers in its science labs.

6.6 The lab technicians

We interviewed more than 10 lab technicians in 10 schools (since some of the schools have more than one lab technician) and found them to be adequately trained, motivated, and expert to run an effective computer lab(s). Almost all of them had degrees in computer science or a related field. Many worked in the private sector before taking a position as a lab technician. In interviews, the teachers and principals all considered the lab technicians to be a great resource to students, teachers, administration and the school leadership. Among their duties, they kept the labs running smoothly, had the computers prepared prior to

> Lab technicians' duties: keep labs running smoothly, have computers ready for each class's arrival in the lab, and help teachers and students with EduWave.

each class's arrival in the lab, and many helped teachers with EduWave and worked with the students.

The lab technician we interviewed in one of the more exemplary schools seemed to genuinely enjoy the challenges of running a fully functioning computer lab. She had a very useful system for managing the lab's resources and who used the resources. Additionally, she had time to assist and tutor new teachers and teach elective classes for students on programs like Photoshop. This same school has built a strong culture around technology because the school leadership has stressed the importance of technology as a necessary tool for life. The computer labs in this school were active and in use throughout the school day, even during the break (when most students at most schools are outside).

However, there were some instances where the school leadership had assigned the lab technicians to complete data entry tasks on various databases the schools have been asked to keep (EduWave and Education Management Information System, or EMIS). We are not sure if this is the most efficient and effective use of the lab technician. For example, one lab technician reported spending every day since the beginning of the school year creating and maintaining the student and teacher databases. He told us that he had little time to get to the computer lab to "fix even the littlest of problems" because the principal had him constantly entering data into the EMIS database.

6.7 Technical challenges

Every lab technician we interviewed encountered at least a few challenges in maintaining the computer lab(s). The most common challenges that the lab technicians faced were:

- Bandwidth – there were often complaints about the speed of the Internet;
- Connectivity – desktop and laptop computers often lacked connection the Internet. It should be noted that most of the lab technicians said that rarely were there issues with intranet connections;
- Viruses – while every lab technician complained about viruses, it seemed that they had the expertise to solve those problems themselves;
- Outdated resources – lab technicians complained about old computers that were repaired quickly but broke frequently.

7 Leadership

School-level leadership plays an integral role in ensuring that the school premises and classroom conditions allow for teachers to experiment and innovate. Research on technology integration and pedagogic reform across many countries suggests that teachers who had made the most progress in changing their practice had supportive, engaged and visionary school-level leadership.[33]

School principals can help mediate multiple challenges ranging from:

[33] Hawkins, J., Panush, E. M., & Spielovogel, R. (1996). *National Study Tour of District Technology Integration Summary Report* (CCT Reports No. 14). New York: Center for Children and Technology, Light, D., McMillan Culp, K., Menon, R., & Shulman, S. (2006). *Preparing teachers for the 21st Century classroom: Current findings from evaluations of the Intel Teach to the Future Essentials Course*. New York: EDC/Center for Children and Technology, Pérez, P., Light, D., Vilela, A., & Manso, M. (2003). Learning from the pioneers: A Study on the Best Practices of the network TELAR. *Interactive Educational Multimedia*(6), 17-39, Teacher Foundation. (2005). *A Comparative Study of ICT Leadership in Schools: A Case Study of 4 Government-aided Schools in Gujarat.* Bangalore: Author.

- Logistic and resource issues such as infrastructure, computer access for classroom teachers, and planning time;

- Curricular and supervisory issues such as shielding teachers from often conflicting and contradictory demands from the Ministry to both adhere to traditional curricula and practices and to innovate and take risks (all innovation contains an element of risk); and

- Professional development and instructional needs such as helping teachers acquire a clear understanding of the new teaching paradigm and develop practical knowledge of student-centered teaching strategies.

In our research, we interviewed and surveyed principals and teachers about these different leadership issues. We learned quite a lot about the challenges principals face, how they meet these challenges, how their teachers are effected and about their own needs for more support.

Professional characteristics
The results from the Principal Survey allow us to look across the case study schools and the comparison group schools for differences between these two groups. The principals of the case study schools, which were selected because the JEI staff consider them to be schools furthest along the path to integrating ICT and the new teaching paradigm, are noticeably different on a number of important demographic traits. First, the principals of the case study schools have longer tenures at their current schools compared to the comparison group schools (see Table 7.1). Half of the principals in the comparison group have been at their school for less than a year while only one principal among the case study schools had been at the school for that same amount of time. Six of the case study principals have been leading their schools for more than six years. Not only have these principals gained years of experience learning how to lead their schools, but they have also established meaningful connections with the teachers, students and community at their schools--the kind of connections that may be important to help navigate a complex organization like a school through a process of change.

Table 7.1: Length of tenure as principal at current school

	Case Study Discovery Schools	Random Discovery Schools	Total
Less than a year	1	5	6
1-2 years	4	1	5
3-5 years	1	3	4
6-10 years	2	1	3
More than 10 years	2	0	2
Total	10	10	20

Data source: Principal Survey, N=20

Second, although both groups of principals have similar levels of formal education (see Table 7.2); the case study principals have substantially more training in the way of workshops or school leadership programs (see Table 7.3). Since 2003 all of the case study principals have taken ICDL, six have taken a program about the community, five have taken Intel Teach to the Future, a planning and implementation course, and four have taken a human resources management course, whereas few of the comparison group principals have taken any training besides ICDL.

Table 7.2 - Highest level of education received			
	Case Study Discovery Schools	Random Discovery Schools	Total
Higher Education Diploma	8	7	15
Master's Degree	2	2	4
Doctoral Degree	0	1	1
Total	10	10	20

Data source: Principal Survey, N=20

Table 7.3: Principals' reported participation in professional development programs (since 2003)			
	Case study Discovery Schools	Random Discovery Schools	Total
ICDL	10	9	19
Human resource management	4	1	5
Financial resource management	4	1	5
Planning, implementation and evaluation	5	1	6
Relation with local community	6	2	8
Intel Teach to the Future	5	3	8
School development unit	5	0	2
Other	1	1	2
Total	10	10	20

Data source: Principal Survey, N=20

In relation to personal familiarity and comfort with ICT, the case study principals also report a slightly wider range of strategies to acquire technological skills (see table 7.4). In particular it is interesting to note that four of the case study principals learn about ICT through conferences and six say they learn from their teachers – both very proactive approaches to building capacity. This reflects another phenomenon that we observed and documented during our interviews and visits, that in the best case study schools there was a visible sense that the teachers and principals were part of a professional learning community – a dedicated group of professionals deliberately and meaningfully sharing and learning together about new ways of teaching.

Table 7.4: Principals' reported strategies for learning about technology			
	Case Study Discovery Schools	Random Discovery Schools	Total
Self-taught	3	2	5
Professional training programs	5	4	9
Trainings on technology	9	8	17
Instruction provided by software company consultants	1	0	1
Help from other principals	2	0	2
Conferences or workshops on own time	4	0	4
Spouse and/or friend	2	1	3
Teachers at my school	6	2	8
Other	1	1	2
Total	10	10	20

Data source: Principal Survey, N=20

7.1 Instructional Leadership

> Whereas teachers had, for the most part, not been able to articulate a vision of student-centered learning, the principals were more likely to have a sense of student-centered teaching.

Schools are complex social organizations that can be highly resistant to change because any one segment can block change.[34] Fullan suggests that effective change comes when schools approach the challenges as a community.[35] Fullan argues strongly against the idea that instructional improvement is only a matter of policy changes. He believes that school change will only come as part of a school culture of mutual respect and caring, a common vision of teaching and learning and commitment to change and improve.[36] Instructional leadership is important for a school to successfully change its practice. A key part of instructional leadership is the leader's vision of teaching and learning. A central focus of our interviews with principals and teachers was around the idea of good teaching. We asked principals to share with us their vision of good teaching and to talk about what they looked for when they observed their teachers. Whereas the teachers had, for the most part, not been able to articulate a vision of student–centered learning, the principals were more likely to have a sense of student-centered teaching. The leadership in two case study schools still had a vision of teaching as arriving on time, covering the curricula, maintaining a silent classroom and writing clearly on the chalkboard, and these principals were not providing much instructional leadership. The technology-using teachers we spoke with in these buildings felt unsupported by their principals, but the exemplary schools had more innovative and supportive leadership.

> Good principals expected to see students working in groups, discussing and debating problems and presenting information back to teachers and peers.

As instructional leaders, these principals spoke about giving the student more autonomy and more of an active role in learning. In their observations, they expected to see students working in groups, discussing and debating problems and presenting information back to teachers and peers. One principal, who collected students' work books to see what type of work they were being assigned, said she wanted to see that students were making artifacts about what they learned and not just doing rote exercises. Some of the principals spoke about what they did not want to see: teachers who lectured the whole time; were unprepared; or only focused on the good students.

An instructional leader also has to provide more than just a vision. In the best of the case study schools we visited, we found principals with a vision of good teaching, warm relationships with their teachers and an emerging community of learners centered on experimenting and promoting innovative teaching practices.

Relations with the Teaching Faculty

The case study principals appear to have a more positive perception of their teaching faculty and feel that they and their teachers share a common vision of teaching and learning. On a set of simple survey questions about the quality of the teaching faculty, the case study principals tend towards more positive attitudes (see Table 7.5). All ten are confident in their teachers' abilities, all feel that their teachers understand their vision for the school and share a sense of community. Eight

[34] Cuban, L. (1993). *How Teachers Taught: Constancy and Change in American Classrooms 1890-1990*. New York: Teachers College Press.
[35] Fullan, M. (1997). Emotion and Hope: Constructive Concepts for Complex Times. *Yearbook (Association for Supervision and Curriculum Development), 1997*, 216-233, Fullan, M. (2001). *The new meaning of educational change* (3rd ed.). New York: Teachers College Press.
[36] Fullan, M. (1997). Emotion and Hope: Constructive Concepts for Complex Times. *Yearbook (Association for Supervision and Curriculum Development), 1997*, 216-233.

feel their teachers can meet high standards and nine report that their teachers have an understanding of how children learn.

Table 7.5: Principals' opinions about the quality of the teaching faculty at their school

		Case Study Discovery Schools	Random Discovery Schools	Total
You are confident in the expertise of your teachers	Disagree	0	2	2
	No opinion	0	1	1
	Agree	10	7	17
Teachers in your school have a clear vision of your expectations for meeting school educational goals	Disagree	0	0	0
	No opinion	0	3	3
	Agree	10	7	17
Teachers in your school understand the vision for the school	Disagree	0	1	1
	No opinion	0	1	1
	Agree	10	8	18
Teachers in your school are able to meet high standards for teaching	Disagree	0	0	0
	No opinion	2	5	7
	Agree	8	5	13
Your teachers understand how students learn	Disagree	0	1	1
	No opinion	1	3	4
	Agree	9	6	15
Teachers share a sense of community	Disagree	0	1	1
	No opinion	0	2	2
	Agree	10	7	17
Total number of principals				20

Data source: Principal Survey, N=20

The teachers in the case study schools also appear to have been given a larger role in developing the school's educational development plan and its technology plan. More democratic involvement is important in creating a shared vision of change and getting teachers to commit to the hard work that change entails. Expanding on the principals' views of their teachers, we asked about the extent of teachers' involvement in creating school reform plans and technology plans (see Table 7.6). Eight of the case study schools have developed formal reform plans and formal technology plans with at least some teacher involvement. This indicates that the leadership and teaching faculty are working together as a community to support reform and ICT integration.

Table 7.6: Formal plans for educational improvement and technology integration (principal responses)

	Case Study Discovery Schools	Random Discovery Schools	Total
Does Your School Have a Plan for Education Development?			
o A formal written plan developed by and shared with teachers and administrators	6	2	8

o A formal written plan helped by some teachers but some teachers have not	2	4	6
o Not written but clearly discussed and shared with administrators and teachers	0	1	1
o Not written and a number of teachers are not aware of the plan	1	0	1
o No plan	0	2	2
Does Your School Have a Vision for How Technology Should Be Used to Improve Teaching and Learning?			
o A formal written plan developed by and shared with teachers and administrators	5	2	7
o A formal written plan helped by some teachers but some teachers have not	3	4	7
o Not written but clearly discussed and shared with administrators and teachers	2	2	4
o Not written and a number of teachers are not aware of the plan	0	1	1
o No plan	0	1	1
Total	10	10	20

Data source: Principal Survey, N=20

The results from the Teacher Survey indicate that the teachers in the case study schools are more likely to be aware of their schools' reform and technology plans, and more likely to report that they had a role in developing those plans. For the teachers in the case study schools, 88.7% are somewhat or very much aware of their schools' reform plan and 76% helped develop the plan. Regarding the technology plan, 76% of the teachers are familiar with the technology plan and 68.6% helped develop those plans.

Table 7.7: Teachers' knowledge of school's education development plan and their involvement in developing the plan

		Case Study Discovery Schools	Random Discovery Schools	Total
To what extent are you aware of your school's education development plan?	Unsure	6.3%	18.3%	11.7%
	Not at all	5.0%	6.1%	5.5%
	Somewhat / Very much	88.7%	75.6%	82.8%
To what extent have you contributed in developing your school's education development plan?	Unsure	15.1%	19.8%	17.2%
	Not at All	8.8%	13.0%	10.8%
	Somewhat / Very much	76.1%	67.1%	72.0%

Data Source: Teacher Survey, N=290

Table 7.8: Teachers' knowledge of school's technology integration plan and their involvement in developing the plan				
		Case study Discovery Schools	Random Discovery Schools	Total
To what extent are you aware of your school's technology integration plan?	Unsure	20.1%	40.5%	29.3%
	Not at All	3.8%	1.5%	2.8%
	Somewhat / Very Much	76.1%	58.1%	68.0%
To what extent have you contributed in developing the goals of your school's technology integration plan?	Unsure	22.0%	45.0%	32.4%
	Not at All	9.4%	6.1%	7.9%
	Somewhat / Very Much	68.6%	48.8%	59.7%

Data Source: Teacher Survey, N=275

Creating a Learning Community

Most of the principals we interviewed said they sent their teachers to trainings, but teachers in the schools where we saw more innovative practices went beyond just attending trainings (see Table 7.9). These principals have developed a number of strategies to get teachers to discuss, share-out what they have learned, and collaborate on instructional improvement and innovation.

Table 7.9: Incentives principals use to encourage teachers to take professional development (includes MoE offered incentives, as well as school-based incentives)			
	Case Study Discovery Schools	Random Discovery Schools	Total
Release time for planning the use of technology	6	3	9
Schedule changes so teachers have time to learn and plan collaboratively	6	4	10
Classes or workshops related to technology integration	9	7	16
Expectations/requirements that professional staff use technology for research and learning	6	1	7
Ability to check out school laptops for use over the summer months, after school hours or on Saturdays	4	5	9
Funding or grants for classroom-based and media center technology resources	3	2	5
Access to technology-based administrative or student information system	9	8	17
Technology certification for teachers	6	8	14
Salary incentives for teachers participating in technology related professional development	5	5	10

Public acknowledgement or recognition of effective teacher uses of technology	9	5	14
Total	10	10	20

Data source: Principal Survey, N=20

In the interviews, some of the strongest principals spoke about how they supported their teachers in learning about new teaching strategies and about technology. One strategy was to create shared planning time for teachers in the same grades or same departments, and then create expectations for teachers on how they would use this time. The principal of an 8th through 12th grade school explained that she schedules a shared planning period for teachers in the same department. She commented that "the scheduling is not impossible, but it takes work." She felt that many principals did not value planning time, and only wanted their teachers to "cover the text book" but she feels that planning time is important to raising the quality of the teaching.

Another principal of one of the exemplary schools used a number of different strategies. First, she encouraged teachers to work in teams to create lessons and materials and to create a culture of sharing successful ideas. Second, she has a formal staff meeting every two weeks where she specifically praises and thanks teachers who have been using technology or experimenting with new techniques and where teachers share experiences. This principal was very familiar and comfortable with technology and personally worked with teachers who lacked confidence with technology to help them build their own technological capacity. This school was also the school where teachers experimented with students preparing presentations so they had the opportunity to "teach" sections of the content to their peers.

Strategies like these are important to helping teachers implement what they learn in trainings because a training course, alone, is seldom sufficient since change requires much more support inside the classroom.[37] As one principal commented, "the MoE trainings are too abstract and boring" to be of actual use, but with the support from their peers, teachers can begin to transfer abstract information into practical knowledge that can be effective in the classroom.

> A training course alone is seldom sufficient since change requires much more support inside the classroom. Proactive principals who support professional development are crucial.

7.2 Institutional Leadership

Another important facet of the principal's job is the administrative and managerial work of running a complex organization. These aspects have implications for classrooms and teacher practice for everything from resource management, to maintaining the physical installations, to funding all the incidental costs that can come with technology.

> Duties of the principals:
> - Resource management
> - Technical support
> - Funding

Resource management

The most complex resource to manage that the principals spoke about in the Discovery Schools is the computer lab. This is still a limited resource that is under high demand – or should be under high demand if all teachers were making use of it. Throughout this report, we have detailed different strategies that principals have developed to schedule their teachers through the labs. Some of the plans were "top down" assignment of lab sessions to classes with relatively little input from teachers. This may result in teachers having lab sessions at times when

[37] Garet, M., Porter, A. C., Desimone, L., Birman, B., & Yoon, K. S. (2001). What Makes Professional Development Effective? Results from a National Sample of Teachers. *American Educational Research Journal, 38*(4), 915-945.

the resources did not fit into their lesson plans. Those scheduling plans that appeared most effective were the ones that involved the classroom teachers in the process. This took more work on the part of the principal and lab technicians, but the two schools that had this type of process also reported nearly constant usage of the labs. Additionally, these were schools with more innovative teaching practices happening in the labs. Some of the principals included the laptops as part of the ICT resources available for their teachers and students. Although laptops were originally given to the teachers trained in e-content, some school communities decided these resources could be used more effectively as a shared resource for all teachers.

Another set of resources that was problematic for some teachers was the physical environment of their classrooms. Items that appear relatively simple, such as curtains or electrical outlets, are important for teachers to be able to use the data projectors effectively. In interviews teachers complained about not being able to project a visible image on the walls of their classroom without curtains and without working electrical outlets in their classrooms.

Technical support
The principals and lab technicians reported a number of on-going challenges with technical support. The only substantial problem with connectivity, which everyone reported, was the Internet speed. This is a systemic problem outside their control (see Cressman and Daly 2007). They all complained that it was often quite slow, and one lab technician said that, at times, she simply disconnects the labs if the connection is too slow. Some schools also reported a slow response time for repairs from the directorate (where the local MoE technical support staff was housed), especially concerning replacement parts. The strongest case study school principals were using other strategies to provide technical support to their labs. Generally, the lab technicians were able to maintain and repair the equipment, but some schools were also able to reach out to parents with IT skills to help. Also, many schools were buying their own replacement parts whenever possible because the response time from the MoE was considered to be too long.

Funding
None of the principals reported having difficulties covering the costs of related materials like printer paper, printer ink, batteries, etc., that come along with ICT use. Principals used resources from their own funding in addition to collecting money from students for the materials for specific projects. Most reported that although they monitor the use of items like paper and ink, they are able to allow their students to print and make artifacts. However, none of the principals had thought about replacement costs for the hardware and assumed this would be covered by the MoE or other sources like the JEI. Some teachers with less supportive leadership reported insufficient funding for some basic resources that the principal did not see as necessary (i.e. batteries, curtains, printer ink, and printer paper).

7.3 Interfacing with the MoE

The final key activity we noticed among the principals of the most exemplary of the case study schools was a proactive relationship with the MoE. This aspect connects their roles as an instructional leader and an institutional leader. Institutionally, these principals were active in seeking out more ICT resources from the MoE, getting their teachers into training programs or pushing to get faster technical support. But the principals also interacted with the MoE and the directorates in such a way as to create space for their teachers to experiment or innovate with new practices.

> Many teachers were still worried about deviating from what they had done in the past. Principals must work with them to encourage innovation.

Despite the on-going ERfKE reforms, many teachers were still worried about deviating from what they had done in the past. One principal, for example, works with the supervisors and teachers to discuss collaborative projects and new practices to reinforce the notion that innovations are acceptable.

Many teachers complained about the amount of time taken up in filling out reports to the MoE, indicating that they did not have time to plan new lessons or work together to learn new strategies, but principals found different solutions to this. Many principals centralized the process of entering data into EduWave under a small group of teachers or lab technicians so that not all teachers were tied up entering data (at one exemplary school, entering data was a joint venture between the teachers *and* the lab technicians, so as not to overly burden one group or the other). Although this ameliorates one problem, it may not be the best use of those resources. The principal from one of the best schools we visited approached the reporting problem from a different perspective. Jordanian teachers are required to document daily lesson plans at the school for review by the MoE. Typically, teachers rewrite their lesson plans into this book. This principal, however, asked her teachers to instead use this process to write their own reflections on their week's lessons, identifying successes, challenges and things they might do differently. In this way, the principal is trying to transform an "accountability" process into an activity to support professional growth. This principal has to continuously intervene with the MoE supervisors to explain why her teachers are doing something different.

8 Conclusions

We reviewed the ten schools that had been selected because they were making a concerted effort to use ICT and the new e-learning resources in the classroom. The familiarity we gained from our interviews, surveys and observations in these schools helped us understand where the Discovery Schools and the JEI are on the path to integrating ICT into their schools and promoting the ERfKE reforms at the classroom level. The JEI has been able to mobilize its network of partners to provide the Discovery Schools a broad range of ICT resources, including hardware and software. While the student-computer ratio is still higher than that of wealthier nations and there are on-going challenges to providing stable connectivity, the data show that teachers are able to use the ICT resources they have.

Despite the substantial success at creating and providing e-learning resources to schools, the common uses of these new resources do not yet align with the vision of use desired by the JEI and MoE. Returning to the UNESCO's four-stage model,[38] this study would support the SJE conclusion that Jordan's education system is in the phase of "Applying" ICT in education. From the interviews, most educators still have a traditional view of their role as a teacher. Teacher-centered practices still predominate among most of the teachers we interviewed and observed. Many teachers expressed concern about taking a chance and being penalized or "fined." However, within the case study schools, there are a number of principals and teachers who are integrating student-centered practices and using the e-learning resources in more innovative ways. Our research suggests a number of factors that have facilitated and supported these changes.

Factors facilitating student-centered practices and the use of e-learning resources in innovative ways:

- Leadership
- Pedagogical vision
- Professional development
- Resource management

Leadership: The findings suggest that the principal plays a critical role in promoting the use of the e-learning resources and in promoting the integration of student-centered practices. The principals in the most exemplary of our case study schools were strong instructional leaders and strong institutional leaders. As instructional leaders, they had a clear student-centered vision of "good teaching" and had developed multiple strategies to invite their teachers to share this vision (i.e.:

[38] Jordan. Ministry of Education, & Supporting Jordan's Education. (2006). *Classroom and Computer Lab Deployment Strategy in Government Schools Grades 1-12*. Amman: Directorate of Curriculum and Textbooks and Supporting Jordan's Education SJE/CIDA.

external and in-house professional development programs, teacher collaboration). An important task for these principals was to mediate between bureaucratic requirements and pedagogical innovation. Making change is risky and teachers need to be assured that they will not be penalized for taking risks. As institutional leaders, the strongest principals were able administrators of the limited ICT resources available and strong advocates with the MoE, the JEI and the community to get more resources for their teachers and students. These are important attributes to ensure that the teachers have the best access possible to the school's resources. When we compare the case study principals to the principals in the comparison group schools, we see two important differences: one, the principals in the case study schools have had substantially more leadership training than their peers in the comparison group and, two, they have been in their schools for a longer period of time.

Pedagogical Vision: An educator's vision of teaching and learning and beliefs about the teacher's role shape instructional practice in the classroom. The educators we spoke with who had a fuller understanding of student-centered learning were more likely to attempt to use more innovative approaches. There are also a certain series of factors that appear to support teachers in developing a new vision of teaching and an understanding of student-centered learning such as, giving teachers a voice in decisions that influence their day-to-day practice, giving teachers opportunities to experiment and take risks, and giving teachers opportunities to be a part of a community of learners.

Professional Development and Ongoing Support: According to the surveys, the teachers in the case study schools have had similar levels of professional development as the teachers in the comparison group schools, yet the use of e-learning resources is substantially different between the two groups. This suggests that professional development certainly plays a role but that other factors are involved in meaningfully integrating ICT and fundamentally changing practice. Building off of the leadership of strong principals in the most exemplary case study schools, we found that those schools had created multiple opportunities for teachers to learn and share about new practices they had experienced during professional development opportunities. This intersects with the importance of a pedagogical vision, since these multiple learning opportunities help create a shared vision of the new learning environment. In addition to external trainings, these schools had created internal workshops, shared planning time and teacher mentoring and collaboration. These schools were developing learning communities focused on improved teaching where student-centered innovation was encouraged and an over-reliance on teacher-centered techniques was discouraged.

> The most successful schools had several opportunities for professional development, which were important in developing a shared vision of the new learning environment.

Resource Management: Our case study schools had more teachers reporting they used the lab and more students reporting they used computers. When we visited the schools and interviewed principals and lab technicians, we found that the best of those schools had developed various strategies to effectively share resources in an attempt to ensure that teachers had access to the technology when it fit into their curricular needs and that teachers could plan for technology access in the lab or in their classrooms. Many of the principals in the best schools were actively seeking out more ICT resources to create more labs, or to provide computers for the library or the science labs. But even with their current resource level, the best schools had coherent processes and strategies for scheduling the computer lab – that included the input from all the salient stakeholders (the principals, the teachers and the lab technicians) – to ensure that teachers who actually needed the lab, had access. Some schools had reorganized the laptops as a school-wide resource that teachers could sign out in order to provide computer access in more classrooms.

> The best schools had developed various strategies to effectively share resources to ensure that teachers had access to the technology when it fit into their curricular needs.

9 Recommendations – Challenges and Opportunities

In this section we present recommendations for JEI to consider on strategies that might help the organization more effectively extend its programs to teachers and principals to promote both new teaching models and the effective use of e-learning resources.

9.1 Develop JEI Capacity

9.1.1The JEI needs to expand and deepen its vision of the role of ICT and clearly communicate this vision to students, teachers, principals and other educators.

> The JEI should work closely with the MoE in developing a more "practical" vision of how JEI's efforts and resources can support quality teaching.

The current success of the JEI in motivating widespread excitement and collaboration among global and local partners to support Jordanian education suggest[39] that the JEI's vision and mission are relevant to those stakeholders. But in order for the JEI to effectively reach teachers, principals and eventually students, the JEI needs a clear message of how ICT can support teaching and learning in a language that is both meaningful to educators and aligned with the MoE's ERfKE reforms. To ensure the relevance and utility of the JEI e-resources to classroom educators, the JEI should work closely with the MoE in developing a more "practical" vision of how JEI's efforts and resources can support quality teaching that would be meaningful and relevant to teachers and educators. The JEI needs to present clear and consistent messages that, among other things, ICT can provide access to more and better information, can support a learning paradigm were students, with teacher support and guidance, are active learners, and can extend communication and learning outside the classroom. Strategies to effectively share this message with educators might include activities such as school based awareness workshops, school principal conferences, and videos or images of exemplary Jordanian teachers and printing materials about what ICT can do. These later suggestions could take advantage of the group of innovative teachers who participated in this study.

Not only would this help energize those educators who already share aspects of that vision, it would help other educators begin to understand how the e-Learning resources and the new teaching strategies could help their students. Other research suggests that teachers are more likely to embrace change if they understand how it is helpful to their students.[40]

9.1.2 The JEI needs to create an internal research/evaluation capacity.

As an organization that oversees a test bed for ICT and educational innovation, the JEI should establish an internal capacity for formative research around the new products and approaches that are being piloted in the Discovery Schools. The PMO staff has identified the need for a more detailed understanding of what is happening in the classroom and they have trained the NetCorps interns to provide a basic level of observational data from the classrooms, but this research capacity should be formalized and expanded. Developing a research and evaluation capacity would allow the JEI to give feedback and guidance to the content developers, the schools and MoE.

[39] McKinsey and Company. (2005). *Building Effective Public - Private Partnerships: Lessons Learnt from the Jordan Education Initiative*. Geneva: World Economic Forum.
[40] Hawkins, J., Panush, E. M., & Spielovogel, R. (1996). *National Study Tour of District Technology Integration Summary Report* (CCT Reports No. 14). New York: Center for Children and Technology, Pérez, P., Light, D., Vilela, A., & Manso, M. (2003). Learning from the pioneers: A Study on the Best Practices of the network TELAR. *Interactive Educational Multimedia*(6), 17-39.

9.2 Provide more learning opportunities for principals and teachers

9.2.1 The JEI should support the development of a wider variety of high quality professional development programs for principals and teachers.

Research demonstrates that the effective use of ICTs is dependent on teachers' ability to select instructionally appropriate ICTs and to use them in the context of effective instructional strategies.[41] Therefore, nations engaged in educational reform must make teacher education, both pre-service and in service, a high priority for investment, since the quality of instruction is central to improving academic achievement.[42] A key factor in successful professional development around reform efforts is its relevance to the particular context in which teachers work and teachers' ability to make a connection between the content and their own interests and experience.[43] Increasingly, research is substantiating that for professional development to have lasting impact, teachers need professional development experiences that give them the opportunity to make sense of the ideas upon which reforms are based, to experiment with them in their own classrooms, and to develop an understanding of how the reform ideas and practices can support student learning.[44]

Nations engaged in educational reform must make teacher education, both pre-service and in service, a high priority for investment, since the quality of instruction is central to improving academic achievement.

Given the importance of professional development to the JEI's long term goals and to Jordan's education reform, the JEI should consider investing as much energy and focus on encouraging the creation of quality professional development programs as they have on creating e-content. The JEI involvement should extend beyond coordinating international support to provide professional development programs for Jordan, to include working closely with the Training Directorate at the MoE to ensure the quality and alignment of the professional development programs by providing formative evaluation and monitoring of the programs while they are in the development and pilot phases.

The JEI should consider investing as much energy on the creation of quality professional development programs as they have on creating e-content.

There are a few key areas that warrant priority attention from the JEI:

1. *Support the development of more robust set of professional development offerings for teachers about ICT integration, new strategies for teaching and learning, student-centered learning:* This entails two components. First, all teachers need to have a high quality course on ICT as a pedagogical tool to support student-centered learning that is common. This is more important than an intense ICT skills only course. Second, Jordanian teachers need a variety of course options as a second phase of their professional development. Offering a selection of courses that focus on different aspects of ICT integration and teaching (i.e. project based learning, special education, ICT to teach English, etc) will allow teachers to pursue work in the areas they find most relevant to their students and their

[41] Webb, M., & Cox, M. (2004). A Review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education, 13*(3), 235-286.
[42] Cohen, D., Raudenbush, S., & Ball, D. (2000). *Resources, Instruction and Research* (CTP Working Paper No. W-00-2). Seattle: Center for the Study of Teaching and Policy.
[43] Lieberman, A. (1995). Practices that support teacher development. *Phi Delta Kappa, 76*(8), 591-596, Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis, 15*(2), 129-151, Olsen, B., & Kirstman, L. (2002). Teacher as mediator of school reform: An examination of teacher practice in 36 California restructuring schools. *Teachers College Record, 104*(2), 301-324.
[44] Carrigg, F., Honey, M., & Thorpe, R. (2003). Putting local schools behind the wheel of change: The challenge of moving from successful practice to effective policy, *Scaling up Success Conference*. Harvard University, Cambridge, MA, Cohen, D. K., & Hill, H. C. (2001). *Learning policy : when state education reform works*. New Haven: Yale University Press.

teaching. Teacher training in the use of ICT should be coordinated with training in corollary skills in other aspects of reform policy, such as pedagogical practice, assessment, curriculum implementation and school organization. UNESCO[45] provides a comprehensive set of standards which JEI might find as a useful base for developing their own training courses or identifying appropriate offerings from other training providers

Currently there are a number of offerings that could fulfill part of the professional development needs. There are three course options which are identified as a basic ICT and teaching course, a CADER (Change agent for Arab Development & Education Reform) course that is part of the Education Support Project (ESP), Intel Teach and World Links for Development, but relatively few teachers have been able to take these courses. These courses are all quite long at 160 hours and the content of these courses range from basic topics to more advanced topics. These courses could be divided into smaller units where some would be basic ICT and teaching, but others could be options for more advanced teachers. The MoE and JEI should consider whether these courses are effective as they are and develop strategies to reach a larger number of teachers in the Discovery Schools.

There are subject-specific training courses lasting only a few days that introduce e-content to the teachers, but these courses may be too short to be more than just a basic introduction to the resources. Teachers perceived these trainings to lack: (i) enough pedagogy on how to use the content in the classroom teaching, (ii) link with the ERfKE teaching strategies and (iii) seems not to have a good quality control mechanism. The JEI should consider ways to need to develop them further with hands on experience in teaching strategies and classroom practices; ensure synergy with ERfKE new curriculum and teaching strategies and maintain a quality control system to monitor and enhance the training.

2. *Create professional development programs for school leadership:* The school leadership plays an important role in ensuring that the school and classroom conditions allow teachers to experiment and innovate. Our research in the Discovery Schools strongly suggests that strong leadership from the principals is crucial to creating change. The JEI, in collaboration with the MoE, should develop a leadership training course from principals on how to support the use of ICT and reform.

The JEI should encourage informal opportunities for teachers and school principals to learn and share strategies. JEI should consider encouraging schools to create other types of learning opportunities for the teachers like study groups, teacher collaborative projects, or inter-school collaborations. Additionally, activities such as conferences and exhibits of teacher and student work can be another way to reach teachers and encourage sharing of best practices. An event like a Discovery School conference for teachers to share and showcase exemplary student-centered teaching techniques and habits can help teachers see and understand what can be done. Or, the JEI could create an online space for teachers to collaborate and share as well as an online and onsite mentoring system will further promote shared practices and help teachers to develop both their pedagogical and technical skills. Similar strategies could be developed for a principal network with conferences and an on-line space.

A challenge “traditional” teachers face when trying to move towards student-centered practice is that they do not have an image of what a student-centered classroom looks like.

One of the challenges “traditional” teachers face when trying to move towards student-centered practice is that they may not know what a student-centered classroom looks like and therefore may not have a vivid image of where they are trying to get to. Although the general use of ICT may not be aligned with the end vision of the JEI,

[45] UNESCO (2008). ICT competency standards for teachers: Policy framework. http://portal.unesco.org/ci/en/ev.php-URL_ID=25733&URL_DO=DO_TOPIC&URL_SECTION=201.html. UNESCO (2008). ICT competency standards for teachers: Competency standards modules. http://portal.unesco.org/ci/en/ev.php-URL_ID=25731&URL_DO=DO_TOPIC&URL_SECTION=201.html.

in our visits we did meet teachers who were doing innovative activities and experimenting with new approaches (like role plays, cooperative groups or student research) and new tools (from the e-content to PowerPoint presentations and email collaborations). The JEI may want to consider developing strategies to share these teachers' experiences, either with workshops and trainings led by these teachers, written material about innovative teachers or creating simple video case studies.

9.3 Provide for updates to e-resources

9.3.1 The JEI should help develop strategies for the on-going improvement of the e-content and other e-resources

The ability to maintain, update and modify the e-content was a concern expressed by the content-developers and by MoE officials. There are numerous reasons why educational resources need to be updated and improved upon, but there are currently no provisions for updating or modifying the e-resources provided by the JEI. The MoE does not have trained personnel to alter the e-content, nor are their any contractual provisions for the developers to update or change the content once it is finalized. Digital resources should go beyond text and multimedia "content" and support student-based learning by providing the content in the context of a pedagogically-rich set of classroom practices, such as teacher-supervised, student-led projects, research studies, investigations, and case studies that draw on subject disciplines to explore timely topics of student interest. These materials can include computer simulations and models and incorporate data collection, analysis, and presentation tools. Such materials, along with teacher training in their use, can support the increased use of student-centered pedagogical practices.

9.4 Provide opportunities for students and the community

9.4.1 The JEI and the MoE can leverage infrastructure investments to create community outreach and after school activities to provide students and the community more access to the technology.

Many of the students and teachers we spoke to, especially in the poorer neighborhoods, reported that the schools were the only point of access to technology for their students. There are various strategies that these resources could be more fully utilized to create opportunities for students and parents.

1. *After school programs:* There are existing after-school programs that could be established in the Discovery schools. Some programs, like Intel Learn, are already working in the region. These programs can be effective ways to help student learn more technology skills and engage them in innovative learning opportunities.

2. *Community outreach programs:* School computer centers can be valuable resources for their communities and there are ways in which they can support life-long learning activities for the parents and the broader community. Schools in the US have established "parent universities" that offer ICT training or educational activities for parents. As en example, the Syria Trust for Development and the Syrian Ministry of Education has established a program in Syria called *ICT literacy for citizens* where students train community members on ICT using the school labs.

9.4.2 The JEI can create opportunities for students to acquire technical knowledge and experience in schools by establishing student tech support programs.

The lab technicians are vital and effective part of the Discovery Schools and they do provide sufficient tech support. However, create student tech teams can be an effective way to give students an active role in their schools, to give students practical skills and experience as well as create a quicker and more responsive tech support structure. Involving students allows fewer lab

technicians to support more computers. Additionally, as the Discovery Schools distribute more computers throughout the building with teacher laptops, student tech support for simple troubleshooting relieves a lot of the pressure on the lab technicians and on the teachers. There are many models available at the Student Tech Support Initiative of the Consortium for School Networking (CoSN) (http://www.studenttechsupport.org/). Some examples include:

- Generation YES program entitled Generation TECH Student Technology Support teams (www.genyes.com);
- C.R.E.A.T.E. for Mississippi (http://www.create4ms.org/stt/index.html) ;
- MOUSE Squad (http://www.mouse.org/).

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