Organizational Models of Educational Technology in U.S. and Canadian Medical Schools

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Abstract

Purpose
To examine the organizational structure of educational technology units within U.S. and Canadian medical schools in order to (1) identify organization models that support educational technology, (2) describe key attributes of these models, and (3) discuss the strengths and challenges associated with these models.

Method
The authors distributed a survey to 88 schools that had previously provided information on their educational technology services and infrastructure. The authors developed the survey through a series of pilots and, then, from the data for each respondent school, created concept maps, which were used to identify organizational models. The authors conducted analyses to determine differences among models. The authors coded the comments about organizational models and identified themes.

Results
The authors received adequate data for analysis from 61 schools (69%). Four models for educational technology organizations emerged: (1) centralized units located in the school of medicine, (2) centralized units located at the health science center, (3) centralized units at the comprehensive university, and (4) no centralized unit (Dispersed Model). The majority (75%) of schools relied on some type of centralized organization. Whereas few organization attributes proved to be statistically significant, the centralized models have more resources devoted to educational technology and a closer alignment with the academic mission than the Dispersed Model.

Conclusions
Medical schools primarily use central models. The authors recommend that schools structuring their educational technology resources consider exploration of a central model because of its focused use of resources to improve teaching and learning.

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Learners increasingly anticipate that medical schools will offer educational technology services. As recognized by medical educators, educational technology is a growing area that provides learners and faculty with exciting and innovative ways to enhance teaching, learning, and assessment, such as interactive learning modules, virtual and simulated patients, and electronic portfolios.[1] The Liaison Committee on Medical Education expects schools to use educational technology in the delivery and management of their undergraduate education programs, yet there is no requirement for an organizational unit to support educational technology.[2] Medical schools have independently developed their educational technology services, often without a clear understanding of the relationship between educational technology and existing university informational technology (IT) organizations, the needs of the curriculum, or the effective implementation of these technologies.[3]

EDUCAUSE, a nonprofit organization for IT professionals in higher education, conducts an annual survey of member universities to capture core data about campus IT environments and practices for the purpose of peer comparisons and information sharing.[4] The survey covers IT organization, staffing, and planning; finance and management; faculty and student computing services; networking and security; and information systems. In 2002, the Association of American Medical Colleges (AAMC) Group on Information Resources (GIR) began an annual survey of AAMC member schools examining centralized IT expenditures, staffing, and technologies.[5] Both surveys provide benchmarks (e.g., IT expenditures, the newest innovations, and security services) to participating schools so that they can compare their IT practices and expenditures with those of others. Results are available only to participating schools. However, neither survey focuses specifically on the organizational aspects of IT that are applied to the science of teaching, otherwise known as educational technology. This is a missed opportunity to provide guidance for the growth and development in this area within a medical school.

Purpose

Existing studies of technology organizations in higher education do not provide an adequate understanding of the organizational models supporting educational technology in medical education. This understanding is an essential first step towards "making sense of our organizations."[6] Our purpose in

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this study was to identify organizational models that support educational technology, to describe key attributes of these models, and to discuss the strengths and challenges associated with each of these models.

Method

Design and sample

This was a descriptive study, the second in a planned series of studies to describe educational technology services currently in place in medical schools and the organizational models that provide these services. For the first study, we successfully contacted representatives from 137 of the 146 allopathic AAMC-member schools in the United States, Canada, and Puerto Rico and asked them to complete the survey.[7] The purpose of the first study was to describe the current educational technology infrastructure and services provided by North American allopathic medical schools in order to present information needed for institutional benchmarking. The second study, reported in this paper, was a follow-up study designed to look at how medical schools organize educational technology. In November 2004, we invited the individual at each school who responded to our original technology services survey (n = 88) to complete an additional survey regarding the organizational infrastructure that supports the educational technology efforts at his or her school. We identified these individuals according to, first, their affiliation with educational technology, and, second, their responsibility for the curriculum at their schools. We consulted with the AAMC Division of Medical Education and GIR to help identify these individuals. For this study, we defined an organizational unit dedicated to educational technology as having the following four attributes: (1) two or more staff members, one who serves as director or leader, (2) a clearly defined mission or purpose, (3) a core set of services, and (4) a dedicated budget. We defined educational technology as electronic and other forms of IT used to support teaching and learning. These include, but are not restricted to, computer-based learning programs, computerized mannequins, instructional Web sites, video/audio production, application development, and online course management. We assumed consent when the individuals clicked on the URL that took them to the Web-based survey instrument. The institutional review boards from each author's school approved this study, and no funding was provided for this study outside of the authors' departmental support.

Survey development

The study grew out of a 2002 project developed by the Computer Resources in Medical Education (CRIME) special interest group of the Western Group on Educational Affairs (WGEA), which aimed to understand how AAMC medical schools organize and support educational technology. CRIME found that member schools' organizational charts did not provide useful information for understanding how the organization of educational technology at their schools worked. This corresponds to reported findings of Bolman and Deal[6] that organizational charts in higher education are becoming outmoded because organizations manage through processes rather than structures. According to Bolman and Deal, organizational charts represent only the attributes of the "structural frame" of an organization. Researchers should also consider attributes from three additional frames—"political," "human resources," and "symbolic"—when examining an organization.[6] To accomplish necessary work, processes are often independent of the formal structure of the organization.[8] We were interested in how medical schools supported or failed to support the processes necessary for educational technology services. Therefore, for this paper, we use the key attributes of an organization as presented by the Bolman and Deal frames. The structural frame focuses on the structures and processes necessary to create an effective organization (i.e., funding). The political frame contains attributes involving power, authority, and responsibility, as well as the ability to manage change and continuous improvement (i.e., key leadership). The human resource frame focuses on how organizations manage people (i.e., staff development). The symbolic frame focuses on events and processes that reflect the culture of the organization (i.e., strategic vision).[6]

In 2003, two of us (K.S. and C.K.) facilitated group discussions on Bolman and Deal's four frames with CRIME members at a special session during the annual WGEA meeting.[9] To maximize the information solicited, two subgroups worked with facilitators to provide input characterizing all of the individual institutions relative to each of the four frames. The groups switched facilitators to add to what the other group had identified. We repeated the process until participants had provided input on all four frames. Twenty-three individuals representing 13 medical schools participated.

From these group discussions, we developed a survey with, first, two closed-ended questions that sorted respondents into one of three categories, and then a maximum of 25 possible open-ended questions tailored to each category:

1. schools with no educational technology initiatives, whose respondents answered two structural questions;
2. schools with educational technology initiatives but without a centralized unit to support these initiatives, whose respondents answered nine structural, four political, one human resources, and two symbolic questions; and
3. schools with a centralized educational technology unit, whose respondents answered 16 structural, five political, two human resources, and two symbolic questions.

Interested readers may contact the lead author for access to the survey questions.

Concurrent with this effort, we were aware of the EDUCAUSE Core Data Survey[4] and the AAMC GIR survey,[5] which both began in 2002. Where possible, we correlated the organizational items identified in these surveys with our organizational survey; for example, the ranks and titles of educational technology leaders and whom they report to within the organization. The EDUCAUSE survey and the GIR survey focus broadly on IT in, respectively, higher education and medical education, and neither focuses specifically on educational technology.

Analysis

We used a mixed-methods approach to analyze the survey results. Using MindManager Pro software, we qualitatively developed one-page concept maps organizing school-level attributes into Bolman and Deal frames. At the 2005 AAMC Annual Meeting, the authors presented preliminary results from 18

schools in a small-group discussion session in which 25 participants provided feedback on interpretability and usability of these maps.[10] The participants commented that additional models might exist and could be revealed if the maps displayed more data. See Figure 1 for an example of the finalized map.

For statistical analysis, we tabulated the quantitative responses from the survey, using SPSS. We calculated descriptive statistics including counts, percentages, means, and standard deviations. We conducted one-way analysis of variance tests as well as chi-square analyses to determine differences among models in responses and in infrastructure and services scores obtained from the initial survey.[7] Because the educational technology scores were interrelated, we set the level of significance at 0.02 for each test. One of us (C.K.) reviewed the survey respondents' comments on the strengths and weaknesses of their organizations using open coding methodology, which is a repetitive process of conceptualizing, reducing, and grouping data. The rest of our research team reviewed the resulting themes in light of the comments to reach consensus on the themes.

Results

Of the 88 schools contacted for this study, 69 (78%) responded to the survey request; however, we excluded eight schools from the final analysis because of incomplete data. Forty of the 61 (66%) respondents represented public schools, which reflects the 64% of accredited North American allopathic medical schools that are public. The return rate by AAMC region[11] was

- 10 (16%) from the western region (western schools are 12% of all AAMC schools);
- 17 (28%) from the central region (central schools are 23% of all AAMC schools);
- 21 (34%) from the southern region (southern schools are 32% of all AAMC schools); and
- 13 (21%) from the northeast region (northeast schools are 31% of all AAMC schools).

There was no association between the number of respondents by AAMC region and whether the school was public ($p > .05$). Thirty-seven of the 61 (61%) respondents had the title of director or manager. Twenty-four (39%) of the respondents identified themselves as deans, and the remaining respondents held various titles, including faculty member, coordinator, vice president, and developer.

The infrastructure and services scores attributed to individual schools in this study were derived from our first study, "Educational technology infrastructure and services to support the medical education continuum."[7] On average, the responding schools had implemented three (SD = 1.5) of the six infrastructure items covered in the survey and had offered 11.4 (SD = 4.1) of the 22 services covered in the survey.

Models

Each concept map (Figure 1) represented the technology issues relevant to one particular school on a single page. This allowed two of us (K.S., C.K.) to examine relationships and look for patterns that emerged among the four frames and among schools. We looked for density of information within an arm of the map and were able to quickly cluster schools that were visually alike. From there, we compared the details of each frame to refine the clustering and arrive at organizational models. After we completed the concept maps for all 61 schools, we reviewed the maps along with the feedback of the AAMC small group (described above in Method).

Four primary models for educational technology organizations emerged, named according to where they are located within the governance of the school: (1) centralized educational technology units located in the school of medicine (SOM Central Model), (2) centralized educational technology units located at the health science center (HSC Central Model), (3) centralized educational technology units at the comprehensive university (University Central Model), and (4) no centralized educational technology unit (Dispersed Model). Schools with an SOM Central Model have resources devoted to support educational technology directly in the school of medicine, and they have leadership in place to govern these services. Medical schools with an HSC Central Model provide support to the health science center (a freestanding

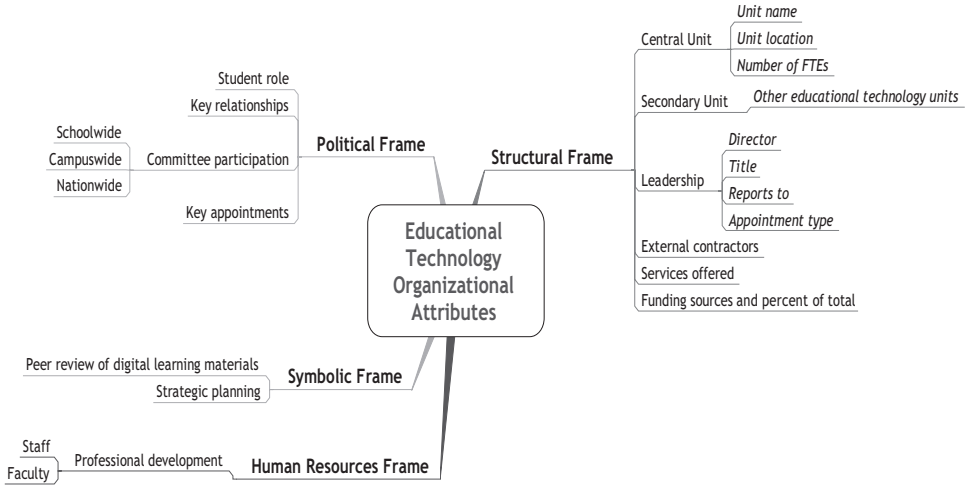

Figure 1 Concept map template used to map each respondent institution's (N = 61) educational technology organizational attributes in the Bolman and Deal[6] frames—structural, political, human resources, and symbolic—2005.

parent health sciences university, which also comprises other schools such as nursing, pharmacy, dentistry, and allied health), which, in turn, provides educational technology services to the medical school. The University Central Model is one in which medical schools provide financial support to a larger university campus unit to support their educational technology needs. Finally, the Dispersed Model refers to medical schools where no centralized governance provides support of educational technology infrastructure and services, yet the medical school is providing financial support to various groups to provide these services. Forty-six of the schools (75%) used one of the central models. There was no association between the distribution of public versus private schools across these four models. Table 1 provides a comparison of the models by key attributes. We found no statistical differences among the 61 schools across models, except for size as represented by FTEs devoted to the medical school with the SOM Central and HSC Central models having significantly larger FTEs than the other two models.

Key attributes

The descriptive data collected in this study provided additional details about key attributes from the structural, political, human resources, and symbolic frames that we did not quantify in Table 1. We describe these attributes by each frame and report much of the detail that we could not easily place in a table. We also provide descriptive comparisons of the models.

Structural frame. The structural frame focuses on the structure and processes needed to run the organization, including staffing, skills, and services.

FTE skills. Schools with a centralized unit to support educational technology described the types of skills provided by personnel in their units as follows: instructional design (27 schools, 59%), Web design (15 schools, 33%), application development (13 schools, 28%), multimedia expertise (8 schools, 17%), and network administration (8 schools, 17%). Schools with the Dispersed Model reported that staff primarily uploaded course materials and maintained Web sites.

Twenty-nine (63%) of the forty-six schools with a centralized unit reported that faculty hold one or more of their FTE positions, and 31 schools (67%) reported that their highest-ranking educational technology leader held a faculty appointment. Schools with the Dispersed Model reported that faculty held no FTE positions.

Key relationships. Key relationships facilitate access to skills and resources available in other units, as well as build political alliances within the school. All three centralized models reported that relationships with IT and academic computing units, libraries, offices of medical education, and individuals contribute to their success. Four schools with the Dispersed Model reported key relationships with IT organizations.

Student involvement. Across all models, medical schools reported using student participation in educational technology in a variety of ways. Thirteen of the schools (21%) seek student input; that is, the schools gather feedback through student representation on committees and focus groups or through student testing of new applications and services. Eight of the schools (13%) involve students in multimedia development; that is, the students provide expertise in programming, video editing, and creating animation. Six of the schools (10%) engage students in curriculum maintenance; that is, the students upload new content, tape lectures, and develop modules under faculty member supervision. Four of the schools (7%) invite students to contribute content development; that is, the students develop projects in their areas of interest to share with their peers, and they maintain and build student Web sites that include resources such as question banks. Schools with the Dispersed Model primarily used student input for the first purpose, feedback.

Contractor involvement. All three centralized models relied on external contractors to develop special projects, such as specialized video production work. However, schools with the Dispersed Model used external contractors for a wide variety of more routine tasks including hardware and software support, database development, and Web design.

Services provided. Across all models, schools most frequently reported that their educational technology units (centralized) or staff (dispersed) made the following services available: desktop support (26 schools, or 43%), Web design (25 schools, or 41%), instructional design and course-management-system support (24 schools, or 39%), video production (23 schools, or 38%), classroom technologies, such as audience response systems or tablet PCs (21 schools, or 34%), and content development and faculty development (15 schools, or 25%).

Budgeting. Across all models, 28 schools (46%) said they had flat student technology fees, either per semester, per year, or at admission. We asked participants how their schools made decisions to spend these student technology fees. Ten schools (16%) reported that committees, some with student representation, made these decisions. Seven schools (11%) stated that the dean made these decisions; four (7%) stated that the finance or business officer made these decisions or that the IT office made these decisions.

Political frame. The political frame focuses on the power and authority within an organization to manage change, facilitate relationships, and move the organization forward. All information gleaned about the political frame relates to each school's reporting structure, and Table 1 provides all the information provided by respondents. We acknowledge that the respondents provided limited information to the four questions in this frame.

Human resources frame. The human resources frame is focused on maximizing the potential of organizations' people. Across all models, 42 schools (69%) provided staff development in educational technology. Twenty-nine schools (48%) included professional conferences and training for staff in their annual budgets, and respondents from 10 schools (16%) said there were minimal funds available for professional development; the remaining reported support as being ad hoc. Faculty development opportunities included workshops (52 schools, or 85%), one-on-one training (27 schools, or 44%), project-development support (5 schools, or 8%), online training (4 schools, or 7%), and preparation for internal grants (4 schools, or 7%). We acknowledge that the respondents provided limited information in response to the two questions in this frame.

Table 1

Key Attributes of the Four Organizational Models of Educational Technology Units (ETU) in U.S. and Canadian Medical Schools, 2005

Frame	Attribute	Central ETU in school of medicine—SOM Central Model (20)	Central ETU in health science center—HSC Central Model (13)	Central ETU at university level—University Central Model (13)	No central ETU—Dispersed Model (15)	*p* value
Structural	No. of FTEs devoted to educational technology at the SOM	6.3 (±3.0)*	6.0 (±4.6)*	1.8 (±2.3)†	0.77 (±1.2)†	<.001‡
	Reported titles of educational technology leaders (no. of schools)	N = 19 Director (15) Associate dean (4)	N = 12 Director (11) Coordinator (1)	N = 7 Associate dean (2) Chief information officer (CIO) (1) Coordinator (1)	N = 7 Director (5) CIO (1) Coordinator (1)	NC
	No. (%) schools reporting key relationships between ETU and other units	10 (50)	4 (31)	8 (62)	6 (40)	0.42
	No. (%) schools reporting student involvement in educational technology	13/20 (65)	7/12 (59)	7/13 (54)	5/14 (36)	0.31
	No. (%) schools reporting hiring outside contractors to provide educational technology services	3/19 (16)	3/12 (25)	5/13 (38)	8/14 (57)	NC
	Infrastructure score (mean) by model§	3.4 (±1.4)	3.5 (±1.5)	2.8 (±1.4)	2.9 (±1.6)	0.43
	Service score (mean) by model‖	13.4 (±3.5)	11.1 (±4.0)	11.7 (±4.1)	10.2 (±4.8)	0.53
	No. of schools reporting education technology funding and combined proportion (mean %) of funding ± SD from specified sources	N = 17 Dean SOM (72% ± 0.31%) Tech fee (9% ± 0.14%) Grants (5% ± 0.09%) Alumni (4% ± 0.13%) Corporate (3% ± 0.1%) Other (6% ± 0.24%)	N = 11 Dean SOM (53% ± 0.43%) Chancellor (17% ± 0.37%) Grants (15% ± 0.2%) Tech fee (12% ± 0.21%) Recharge (1% ± 0.01%) Other (3% ± 0.0%)	N = 10 Dean SOM (61% ± 0.44%) Campus (22% ± 0.41%) Tech fee (15% ± 0.31%) Corporate (1% ± 0.05%)	N = 7 Dean SOM (58% ± 0.49%) Tech fee (20% ± 0.37%) Grants (14% ± 0.38%) Other (7% ± 0.19%)	NC
Political	Number of schools reporting the person to whom their key education technology leader reports	N = 19 Associate/vice dean (12) Dean (3) Chancellor/provost (2) CIO (1) Other (1)	N = 13 Associate/vice dean (7) Chancellor/provost (3) Dean (2) CIO (1)	N = 6 Dean (2) Associate/vice dean (2) Chancellor (2)	N = 4 Associate/vice dean (3) Director (1)	NC
Human resources	No. (%) schools reporting availability of faculty/staff development in educational technology	15/20 (75)	10/13 (77)	6/13 (46)	9/15 (60)	0.21
Symbolic	No. (%) schools with a strategic plan for educational technology	10/20 (50)	6/13 (46)	5/13 (38)	5/15 (33)	0.77
	No. (%) schools that recognize digital scholarship for tenure and promotions	12/20 (60)	3/13 (23)	5/13 (38)	5/15 (33)	0.16

* For the FTE attribute, these two models are not statistically significantly different from each other; however, they are statistically significantly different from the University Central and Dispersed Models.
† For the FTE attribute, these two models are not statistically significantly different from each other; however, they are statistically significantly different from the SOM Central and HSC Central Models.
‡ Because of the lack of variance *p* for FTE, value was calculated from nonparametric, Kruskal-Wallis test.
§ Infrastructure score was derived for each school by determining the number of infrastructure components reported by respondents out of a possible total of six.[7]
‖ Services score was derived for each school by determining the number of service components reported by respondents out of a possible total of 22.[7]
NC, not calculated; SOM, school of medicine; HSC, health science center.

Symbolic frame. The symbolic frame focuses on the actions and processes that reflect the culture of the organization.

Strategic planning initiatives. Across all models, 17 schools (28%) reported having strategic plans primarily for educational technology initiatives. Fifteen schools (25%) reported that educational technology is part of an overall *school* plan. Ten schools (16%) reported that educational technology is part of an overall *IT strategic* plan.

Recognition of digital scholarship. Across all models, 15 respondents (25%) stated that their schools' promotion and tenure

committees recognized digital scholarship, which includes enduring educational materials in electronic format. Seventeen schools (28%) explicitly reported that their schools do not recognize digital scholarship. Another 20 (33%) said that whereas their schools recognized digital scholarship for promotion and tenure, there were no clear criteria, and many faculty felt a great deal of uncertainty about whether it was truly valued.

Strengths and challenges. In analyzing the responses regarding strengths and challenges in educational technology support, the authors set a threshold of 20% occurrence within any one model for inclusion in Tables 2 and 3. Under *strengths*, the authors identified six themes (Table 2). Under *challenges*, the authors identified four themes (Table 3). The units' structures were the most prevalent strengths, and a lack of resources was the most frequently mentioned challenge. Respondents also frequently listed structure as a challenge, because of misaligned resources and reporting structures as well as a loss of flexibility.

Conclusions

Our findings provide a snapshot of the current organizational structures supporting educational technology in medical schools, including structural, political, human resources, and symbolic attributes. We identified four organizational models, three of which consisted of some form of centralized support used by 46 (75%) of the schools studied, and one which entailed dispersed support. Regardless of model, the dean's office provides the greatest portion of the budget. There are distinctive attributes, strengths, and challenges for each model, and these are particularly informative when considering the resources required. However, the authors see few statistical differences, measured across models, among many of the attributes, including the importance of relationships with other units, the amount of infrastructure in place to support educational technology, the number of services provided, the ability to offer faculty development, or the tendency to engage in strategic planning. The statistical analysis may be underpowered for attributes where differences seem to exist; in future work, we need to identify more schools within each model.

Some authors suggest that well-financed institutions have greater access to IT funding than smaller colleges with fewer resources, creating a digital divide.[12] Candler and colleagues[13] raise the same concern for medical schools. A concern our data raised is that schools with the Dispersed Model are ones that do not currently have the same depth of technological capacity as those with the central models. However, as is seen in Table 1, there are no significant or practical differences among models or in the infrastructures they employ and the services they provide. Therefore, the Dispersed Model probably exists as a result of reasons other than lack of technology sophistication.

We believe that we have captured the range of models for educational technology support in medical schools. A pattern favoring more depth of activities emerged with the centralized models. Among the three centralized models, the strengths and challenges were related to the types of institutions in which the schools were set. For example, leadership at some HSC Central Models report to administrative deans—rather than education deans—which reflects a poor understanding of educational technology's role in supporting teaching and learning. An additional example is found in the University Central Model where medical schools report they must compete with other colleges and programs within their institution for priority and resources. The Dispersed Model, in turn, benefited from flexibility, but it was hindered in its effectiveness because of a lack of protected funding, accountability, and visibility.

The evidence suggests that the centralized models have a number of advantages that align the educational technology unit more closely to the curriculum, which is a key success factor. According to Bolman and Deal,[6] the leader, as viewed through the structural frame, must align the structure (the educational technology organization) to the task (the curriculum). It is clear that this would be a challenge for a leader in the Dispersed Model. This study found that, structurally, when educational leaders in a centralized model are aligned with the educational leadership—rather than the IT or financial leadership—they are able to create more effective environments to meet educational technology expectations. Politically, those leaders in the centralized models were in better positions to put their agendas into place. Few of the respondents (four) in the Dispersed Model described to whom the leader reports. This is an indication that leaders in the Dispersed Model are handicapped in carrying out agendas requiring institutional support. From the symbolic frame perspective, leaders in centralized models are in the position to better acknowledge the accomplishments of the faculty and staff, but it seems as if this is an area for development even within some of the central models.

The four organizational frames described by Bolman and Deal[6] were useful for providing us with a method for examining these models of educational technology organization. Fincher and colleagues[14] previously applied this methodology in medical education to analyze the infrastructures through which medical schools support faculty as educators. The implementation of the Bolman and Deal framework seems to have both successes and limitations when applied to understanding the growth and development of educational technology units in a medical school. First, the frames did help organize attributes that described the schools, but they did not provide sufficient information to truly distinguish one model from another except in the case of FTEs. This could be a function of the small numbers of units in some of the models. A larger sample might lead to better clarity, particularly for an attribute such as digital scholarship.

We acknowledge that we did not have equal depth of questioning in all frames. In a future study, researchers would need to expand the questions in these areas. The structural frame seems to have been fairly comprehensive, but, in the political frame, there could be additional questions about committee membership, an individual's or committee's political impact, and identifiable outcomes of influences. In the human resources frame, there could be additional questions about mentoring and the provision of leadership opportunities for unit members. Questions about awards given to faculty and students for educational technology would further strengthen the human resources section. Questions about strategic planning cover much of the symbolic frame, which, like

Table 2

Reported Strengths of the Four Organizational Models of Educational Technology Units (ETU) at U.S. and Canadian Medical Schools, 2005

	Central ETU in school of medicine—SOM Central Model (N = 20)		Central ETU in health science center—HSC Central Model (N = 13)		Central ETU at university level—University Central Model (N = 13)		No central ETU—Dispersed Model (N = 15)	
Strengths	**No.***	**Representative quotation**	**No.***	**Representative quotation**	**No.***	**Representative quotation**	**No.***	**Representative quotation**
Structure	9	"an ability to mobilize resources between projects or to create dynamic ad hoc teams comprised of staff with different talents."	6	"The educational technology support is provided through a medical center wide group that serves medicine, nursing and allied health. Advantages include being able to share innovations, successes and challenges across the three schools."			5	"High decentralization permits individual initiative."
Top-down support	7	"Strong support for educational technology throughout the dean's office."			4	"There is recognition of the importance of educational technology."		
Vision, planning, and integration	6	"The e-learning manager and IT director sit on the implementation team for the curriculum. That constant interaction and feedback facilitates both the smooth running of the program as well as identifying emerging issues and opportunities."						
Faculty	4	"Faculty are an integral part of the process and [are] taking strong advocacy and leadership roles in the development and implementation of new technologies."					3	"There are faculty in the school that have received grant funding and created some wonderful innovations free of any restrictions (or support) from the school."
Dedicated staff							4	"Talent pool extends across many departments and allows for both effective and efficient educational design."
Relationships with other units					6	"Process is very flexible and this enables better cooperation between various units within the college."		

* Reports number of schools within each category reporting strengths within each attribute.
SOM, school of medicine; HSC, health science center; IT, information technology.

Table 3

Reported Challenges of the Four Organizational Models of Educational Technology Units (ETU) at U.S. and Canadian Medical Schools, 2005

	Central ETU in school of medicine—SOM Central Model (N = 20)		Central ETU in health science center—HSC Central Model (N = 13)		Central ETU at university level—University Central Model (N = 13)		No central ETU—Dispersed Model (N = 15)	
Attributes	No.*	Representative quotation	No.*	Representative quotation	No.*	Representative quotation	No.*	Representative quotation
FTE or funding	13	"The number of personnel is grossly insufficient to meet the demand for services."	6	"Basic weaknesses in our organizational structure for educational technology are related to the relatively thin staffing level overall and the fact that our major leadership positions are part-time."	5	"Insufficient funds to easily roll out new technology."	7	"[There is] no funding specifically allocated to promote the use of technology throughout all programs—leading to haves and have-nots."
Structure	3	"Decentralized structure for innovation makes universal implementation difficult. Some faculty develop new technology-dependent teaching instruments that are not [widely adopted and] this creates difficulties in supporting everything."	8	"Reporting structure [is to] financial [leadership] and not educational decision makers."	9	"The weakness is that we do not have any group dedicated specifically to the medical school, thus we compete with other biological science divisional groups for priority and resources."	8	"No clear lines of accountability given distributed system . . . resulting in some lack of vision/planning."
Vision, planning, and integration	3	"Occasional dissention between [medical education leaders] in their view of the best technologies to support particular aspects of the curriculum."			3	"Lack of clarity of mission and responsibilities, and lack of dedicated funding or funding for new initiatives."		
Lack of support for teachers and learners							6	"Faculty and students have nowhere to go [if they want] help for teaching with technology. They either do it on their own, purchase outside help with grant or departmental funds or do without. Therefore, there are no common interfaces, even for course Web sites, and students and faculty have to be persistent to find resources that are available."

* Reports number of schools within each category reporting challenges within each attribute.
SOM, school of medicine; HSC, health science center.

the structural frame section, seems to have been comprehensive. We included strategic planning in the symbolic frame on the basis of observations made by Mintzberg,[15] who found that strategic planning rarely achieves its rational objectives. Reflecting on Mintzberg's observations, Bolman and Deal[6] point out that plans are "symbols . . . games . . .

excuses for interaction . . . [and] advertisements," therefore meeting their criteria for the symbolic frame.

An additional limitation is that we did not validate from a second source the responses given to the survey, but, given the titles that our respondents hold, we feel they are likely to be knowledgeable about the information required to complete the survey. Also, the data we collected failed to cover the evolution of the organization, and, thus, we lost the chance to identify how models change, if at all, as part of an evolutionary process.

The information provided in this study is useful to institutional leaders when they are formulating a clear argument for, and seeking to understand the consequences of, change as they plan to make adjustments in their educational technology organizational model. They should examine these models to determine what is best for their institution. For instance, if they are considering combining dispersed personnel to form a central office, they must weigh the flexibility represented by their current model with the greater political power and resources that come from a central model. A driving argument is the central models' ability to align educational technology more closely with the curriculum.

According to these findings, the key success factors for centrally supporting medical education with educational technology include adequate staffing, key leadership closely aligned with the education team, cultivation of key relationships throughout the institution, involvement of students, decreased reliance on external contractors, the ability to support a technical infrastructure and provide educational technology services, and consolidation of funding. Overall, this study suggests that different models do exist and that the Dispersed Model, by its very nature, will be limited in reaching full capacity as described by Bolman and Deal's frames.

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References

1 Association of American Medical Colleges Institute for Improving Medical Education. Effective Use of Educational Technology in Medical Education. Colloquium on Medical Technology: Recommendations and Guidelines for Medical Educators. Available at: (https://services.aamc.org/Publications/showfile.cfm?file=version80.pdf&prd_id=184&prv_id=224&pdf_id=80). Accessed March 13, 2008.

2 Liaison Committee on Medical Education. Accreditation standards. Available at: (http://www.lcme.org/standard.htm). Accessed March 13, 2008.

3 Ward JP, Gordon J, Field MJ, Lehmann HP. Communication and information technology in medical education. Lancet. 2001;357:792–796.

4 EDUCAUSE Core Data Service Web site. Available at: (http://www.educause.edu/coredata). Accessed March 13, 2008.

5 Association of American Medical Colleges Group on Information Resources Survey Committee. Information Technology Survey of Medical Schools. Available at: (https://services.aamc.org/privatesite/index.cfm?path=/members/gir/private). Accessed July 1, 2004.

6 Bolman LG, Deal TE. Reframing Organizations: Artistry, Choice, and Leadership. 3rd ed. San Francisco, Calif: Jossey-Bass; 2003.

7 Kamin C, Souza KH, Heestand D, Moses A, O'Sullivan P. Educational technology infrastructure and services in North American medical schools. Acad Med. 2006;81:632–637.

8 Ernst DJ, Katz RN, Sack JR. Organizational and Technological Strategies for Higher Education in the Information Age. Available at: (http://www.educause.edu/ir/library/pdf/PUB3013.pdf). Accessed March 13, 2008.

9 Souza KH, Kamin C. Computer Resources in Medical Education (CRIME) Spring Meeting. University of Nevada School of Medicine. Reno, Nevada. Friday, March 28, 2003 [meeting agenda]. Available at: (http://missinglink.ucsf.edu/crime/meetings/2003_03_28.pdf). Accessed March 27, 2008.

10 Kamin C, Souza KH, Moses A. Educational technology: Services and organizational models. In: AAMC 2005 Annual Meeting: Final Program. Washington, DC: Association of American Medical Colleges; 2005:1:27. Available at: (http://www.aamc.org/meetings/annual/2005). Accessed September 2007.

11 Association of American Medical Colleges. Group on Educational Affairs. GEA regions. Available at: (http://www.aamc.org/members/gea). Accessed March 27, 2008.

12 Phipps RA, Wellman JV. Funding the "InfoStructure": A Guide to Financing Technology Infrastructure in Higher Education. Available at: (http://www.luminafoundation.org/publications/infostructure.pdf). Accessed March 13, 2008.

13 Candler CS, Uijtdehaage SH, Dennis SE. Introducing HEAL: The health education assets library. Acad Med. 2003;78:249–253.

14 Fincher RM, Simpson DE, Mennin SP, et al. Scholarship in teaching: An imperative for the 21st century. Acad Med. 2000;75:887–894.

15 Mintzberg H. The Rise and Fall of Strategic Planning : Reconceiving Roles for Planning, Plans, Planners. New York, NY: Free Press; 1994.