Trends in Teaching/Learning Research Through Analysis of Conference Presentation Articles

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Abstract Information Technology (IT) has been changing the procedural means/methods used in social activities, and this effect has influenced directly or indirectly the behaviors of human beings. Of course, in teaching/learning activities, this observation is nothing out of the ordinary. Currently, IT plays an important role in supporting the teaching and learning processes both effectively and effectually. In this paper, we investigate current research trends, examining various articles published in conferences so as to extract the features correlated with specific research interests and objectives. We discuss these research features on the basis of our "knowledge transfer scheme" learning principle.

Keywords Knowledge transfer scheme · Knowledge composition · Knowledge acquisition · Knowledge understanding · Information technology

1 Introduction

Information Technology (IT) has been changing the procedural means/methods used in social activities and is also influencing our daily lives, working styles, communication means, etc. Although in terms of historical development we can only consider the last 70 years since the appearance of the computer, the effects can be observed in a wide range of human activities, environments, social organizations, etc. In the realm of teaching/learning activities, IT has had a profound influence on the methods, means, processes, interactions, and environments used. IT has encouraged teachers/learners to free themselves from spatio-temporal constraints. The resultant ubiquitous environment has made it possible for everyone who wants to learn to do so anytime, anywhere.

In the IT-based evolution of teaching/learning activity, the starting point was to make the teaching procedure more powerful/effective by means of data processing

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(such as CAI), and the current viewpoint is now to intelligently support processes and environments for learning as well as for the conventional teaching procedure. This trend may be dependent on the concepts of personality and virtualization in a cyber society. The powerful expansion of the Internet is one of the major factors here, since the features of the Internet can provide IT-based functionality for individual learners ubiquitously.

In this paper, we focus on articles that have been presented at various international/domestic conferences and analyze the research points from the viewpoints of investigation style, research topic, practical/experimental effect, etc. In our view, the basic platform is a knowledge transfer scheme, proposed by us, as a framework for learning [1]. With this framework, our discussion clarifies the learner's role in an IT-based environment and unifies the architectural views for teaching and learning actions.

2 Knowledge Transfer Scheme

We have already defined learning as the transfer of knowledge from the outside of the learner, such as textbooks, teaching/learning contents, and authoring resources, to in the side of the learner, such as his/her brain and notes. Under this definition, we can consider our learning mechanism, namely, knowledge composition, knowledge acquisition, and knowledge understanding (or utilization), and illustrate the knowledge transfer scheme with simple/basic actions. Figure 1 gives a basic overview of our knowledge transfer scheme.

(1) Composition transforms knowledge from a scattered structure to an aggregated one.
(2) Acquisition moves the composed knowledge to the learner's brain or notes.
(3) Understanding refines the moved knowledge with already acquired knowledge.

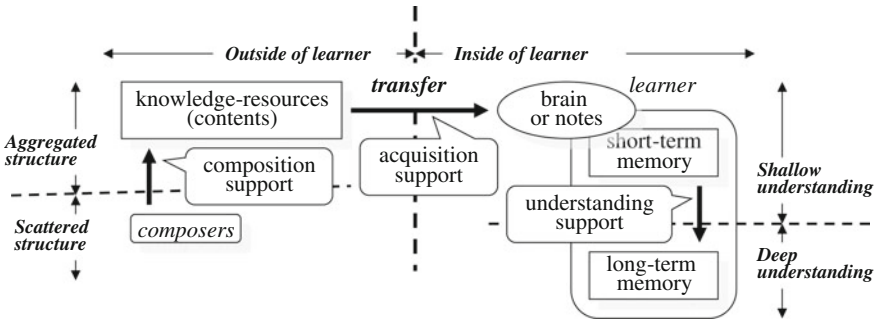

Fig. 1 Knowledge transfer scheme

These phases play important roles in making the learning procedures for each learner effectual and effective. If they can work successively, the learner will be successful in managing the knowledge in his/her learning process. Of course, the composition process is not the responsibility of the learner but rather of the teacher, the author of the textbook, etc. Functions and mechanisms that support smart learning need to be designed. Thus, the research topics we discuss in this paper concern these phases, and we also focus on the interaction/interdependency among these phases. Of course, the basic functionality will remain the domain of traditional teacher behaviors. Our concept is that we can look upon traditional teaching actions as a support means of knowledge transfer scheme. We regard these phases as keys in research topics during our discussion of the current trends of research issues.

3 Conference Articles

In this paper, we examine three conference articles:

(1) Ed-Media (World Conference on Educational Media and Technology), managed by AACE (Association for the Advancement of Computing in Education) [2]
(2) E-Learn (World Conference on E-Learning), managed by AACE [3]
(3) Domestic Annual Conference of JSiSE (Japanese Society of Information Systems in Education) [4]

3.1 Ed-Media and E-Learn

First, let us consider Ed-Media. Table 1 lists the number of articles presented at this conference in various research categories. As shown, there were 853 articles in 2008, 497 in 2011, and 408 in 2014. These numbers have been decreasing year by year: for 6 years from 2008, the decreasing ratio is 43.3 % (47.8 % when poster articles etc. are included), and in 2015 it is 35.3 % (40.9 %). The cause of this decrease is uncertain, and we are unable to properly investigate this phenomenon even when IT-based promotions/managements play important roles. In Ed-Media, the significant points are that non-traditional presentation styles (best practices sessions, virtual sessions, etc.) are introduced in addition to conventional oral sessions with two categories (full (long) and brief (short) articles). Best practices sessions focus on the effects/results/plans of case studies and large-scale experiments. Virtual sessions make it possible for even presenters who cannot physically participate in a conference to join virtually through the Internet.

Category no. 3 in Table 1, “New Roles of the Instructor & Learner”, occupies the highest ratio for all articles through 2011, 2014, and 2015, and every year the ratio is over 50 % (except 36.8 % in 2008). Each category includes various

Table 1 Trends of articles in Ed-Media

Category	2015				2014				2011			2008		
	Full	Brief	Other	Total (%)	Full	Brief	Other	Total (%)	Full	Brief	Total (%)	Full	Brief	Total (%)
1: Infrastructure	18	10	18	46 (15.3)	15	23	9	47 (12.7)	35	51	86 (17.3)	41	35	76 (8.9)
2: Tools & Content-oriented Applications	16	5	7	28 (9.3)	15	20	10	45 (12.2)	22	22	44 (8.9)	80	117	197 (23.1)
3: New Roles of the Instructor & Learner	59	38	68	165 (54.8)	85	75	58	218 (59.1)	136	176	312 (62.8)	110	204	314 (36.8)
4: Human-Interaction (HCL/CHI)	6	2	2	10 (3.3)	5	4	5	14 (3.8)	9	4	13 (2.6)	39	50	89 (10.4)
5: Cases & Projects	18	10	7	35 (11.6)	17	15	5	37 (10.0)	17	20	37 (7.4)	54	76	130 (15.3)
6: Universal Web Accessibility (Special Strand)	4	1	3	8 (2.7)	2	1	5	8 (2.2)	0	2	2 (0.4)	21	18	39 (4.6)
7: Indigenous Peoples & Technology	1	2	2	5 (1.7)	0	0	0	0 (0.0)	1	2	3 (0.6)	3	5	8 (0.9)
Subtotal of above columns				296				369			497			853
0-1: ET	1	1		2 (0.7)										
0-2: Design	1			1 (0.3)										
0-3: LD		1	1	2 (0.7)										
Subtotal of above columns	124	70	107	301	139	138	92	369	220	277	497	348	505	853
Poster				34				38						
Others				14				1						
Total of all				349				408			497			853

Table 2 Categorical keywords in Ed-Media

1: Infrastructure	4: Human-computer Interaction (CHI/HCI)
1.1: Architectures for Educational Technology Systems	4.1: Computer-Mediated Communication
1.2: Design of Distance Learning Systems	4.2: Design Principles
1.3:Distributed Learning Environments	4.3: Usability/User Studies
1.4: Methodologies for System Design	4.4: User Interface Design
1.5: Multimedia/Hypermedia Systems	5: Cases & Projects
1.6: WWW-based Course-Support Systems	5.1: Corporate
2: Tools & Content-oriented Application	5.2: Country-Specific Developments
2.1: Agents	5.3: Exemplary Projects
2.2: Authoring Tools	5.4: Institution-Specific Cases
2.3: Evaluation of Impact	5.5: Virtual Universities
2.4: Groupware & WWW-based Tools	6: Universal Web Accessibility (Special Strand)
2.5: Interactive Learning Environments	6.1: Emerging technologies & Accessibility
2.6: Multimedia/Hypermedia Applications	6.2: Infrastructure, Technology & Techniques
2.7: Research Perspectives	6.3: International Challenges
2.8: Virtual Reality	6.4: New Roles for Teachers/Learners
2.9: WWW-based Course Sites & Learning Resources	6.5: Other: Research, Library Issues, etc.
3: New Roles of the Instructor & Learner	6.6: Policy and Law
3.1: Constructivist Perspectives	6.7: Site Management Considerations
3.2: Cooperative/Collaborative Learning	7: Indigenous Peoples & Technology
3.3: Implementation Experiences	7.1: Indigenous Peoples & Technology Issues/Applications
3.4: Improving Classroom Teaching	
3.5: Instructor Networking	
3.6: Instructor Training and Support	
3.7: Pedagogical Issues	
3.8: Teaching/Learning Strategies	

individual keywords, as shown in Table 2. This conference (Ed-Media) focuses mainly on topics related to education, as reflected by the "educational media and technology" in the conference name, and the media, tools/systems, methods, and practical studies/performances for teaching and teachers are investigated. The idea is to show how the functionality and mechanisms in IT-based tools/systems help support teaching activities and teachers' pedagogical means/methods.

E-Learn, which was also organized by AACE, focuses on the learning and learner. Table 3 shows the categorical features of these topics. When we compare the categories in Table 3 with those in Table 2, the difference is clearly recognizable. E-Learn focuses on practical/functional problems in the learning process, learning efficiency, and learning support. Table 4 shows the number of articles in

Table 3 Categories in E-Learn

No	Code	Topics	No	Code	SIG Topics
1	CD	Content Development	1	ELEARN-DEV	E-Learning in Developing Countries (Opportunities, Trends, Challenges, and
2	EVAL	Evaluation			
3	IMPL	Implementation Examples & Issues			Success Stories
4	INDE	Instructional Design	2	ELEARN-TREND	Innovations (Social Learning, Mobile, Augmented etc.)
5	PI	Policy Issues			
6	RES	Research	3	ELEARN-DESIGN	Designing, Developing, and Assessing E-Learning
7	SOC	Social & Cultural Issues			
8	STD	Standards & Interoperability			
9	TOOL	Tools & Systems			
10	OTH	Other			

Table 4 Number of articles in E-Learn 2015

	Virtual	Full	Brief	Roundtable	Other	Total	Ratio
CD	5	20	59	4	1	89	22.3
EVAL	4	13	18	1		36	9.0
IMPL	9	23	69	14	4	119	29.8
INDE	9	6	24	7		46	11.5
PI		2	2			4	1.0
RES	4	8	18	1	2	33	8.3
SOC	1	1	5	2		9	2.3
STD		1				1	0.3
TOOL	1	3	7	2		13	3.3
OTH	8	2	10	2		22	5.5
Subtotal	41	79	212	33	7	372	
ELEARN-DEV	1	2	1			4	1.0
ELEARN-TREND		1	6	1		8	2.0
ELEARN-DESIGN		6	7	2		15	3.8
Total	42	88	226	36	7	399	

(Note) Number of poster presentations: 19

each category, with the highest ratio occupied by Implementation Examples and Issues (IMPL). There are more articles in E-Learn2015 than in Ed-Media2015. The focus of E-Learn is learning while that of Ed-Media is education (or teaching), and as such, the categories in E-Learn concentrate on industrial criteria while those in Ed-Media relate to supporting-based functionality or system-oriented mechanisms. It is safe to say that the topics in E-Learn are dependent on the system-oriented feature and those in Ed-Media relate to human activities.

3.2 JSiSE

Next, we refer to the domestic annual conference JSiSE in Japan. Here, we discuss the features of each article in addition to the trends for interest points. Table 5 shows the categories of articles in the JSiSE2015 conference. These categories completely separate the development of IT-based functionality/mechanisms from the teaching/learning performance. The annual JSiSE conference combines the features of Ed-Media, which focuses mainly on teaching/learning performance, with those of E-Learn, which are based globally on IT-based functionality/mechanisms, with respect to the characteristics of "support" and "technology".

(a) ***Presentation category***

Table 6 shows the affiliation of the first author for 212 articles in 2013 and 235 in 2014. The ratio by which authors belong to universities is 89.2 % in 2013 and 89.8 % in 2014. The highest ratio is one of features attended inherently with this academic association in the teaching/learning domains. Table 7 shows to which field the articles are related. Here, we define three domains:

(1) Information engineering, which is the viewpoint focused on the advanced development or effective management of IT-based tools/functions with respect to teaching/learning.
(2) Cognition, which is the viewpoint concentrated on thinking/recognition processes or the ability related to such processes.
(3) Education, which is the viewpoint dependent on the behaviors of teachers/learners with respect to performance, observation, evaluation, investigation, etc.

There are more articles in the education domain than in the information engineering domain. Specifically, the ratio of the information engineering domain is 44.1 % and that of the education domain is 52.1 %. Of course, the same speaker may present two or more articles.

(b) ***Article research view***

Table 8 shows the total number of technical key terms used in each article. Of course, one article may contain several terms at once, while another may not include even one term. These terms are extracted from the title, abstract, keywords,

Table 5 Categories in JSiSE

	Category	Clue terms
Support	Design	Teaching design, Instructional design
		Learning environment design
	Teaching/Learning methods	Distance of learning
		Blended learning
		Cooperative teaching
		Collaborative learning
		Active learning
	Evaluation	Analysis of learner's features and behavior
		Learning evaluation, Assessment
	Special support teaching	HRD, Life learning
		University
		Elementary/Middie/High school
		FD
	Course-oriented teaching	Programming
		Language
		Information
		Special support
		Skill
		Medical, Nurse, and Hospital
		Information literacy
Technology	ICT utilization	Multi-media utilization
		Social-media utilization
		Device utilization
	Development/Management	Platform
		Infrastructure
		Authoring-support
	Advanced learning support technology	Intelligent learning support system
		Analysis
		Modelling
		Interface

and article body. Terminals such as mobile devices (tablets, smartphones, etc.) are currently popular learning media, and the Japanese government is promoting their use in primary/middle school classrooms as part of a pedagogical policy to establish an IT-based environment. The composition issue of learning contents is also considered an important project and is strongly supported by the Japanese government. Other key terms include Learning Management System (LMS) and portfolio; these terms indicate that the teaching/learning management plays a basic and effective role in managing/maintaining the learning progress of each learner successively,

Table 6 Affiliation of first author

	2013	2014	Total
University	181	209	390
College of technology in Japan	11	6	17
Junior college	8	11	19
Industry	2	2	4
High school		2	2
Middle school		1	1
Special school		1	1
Other	10	3	13
Total	212	235	447

Table 7 Research domain

		2013	2014	Total
1	Information engineering	96	101	197
2	Cognition	4	13	17
3	Education	112	121	233
	Total	212	235	447

Table 8 Key terms in articles

		2013	2014	Total
1	Terminal (Smartphone, Tablet, etc.)	27	26	53
2	Contents	24	16	40
3	LMS	16	15	31
4	Collaborative learning	14	12	26
5	Skill	9	14	23
5	Portfolio	13	10	23
7	Problem composition	4	13	17
7	Evaluation (Peer evaluation, Self evaluation)	8	9	17
7	Game	9	8	17
7	VR/AR	11	6	17
11	Presentation	6	10	16
12	Cooperation	4	9	13
13	Instructional design	3	8	11
13	PBL	8	3	11
15	Carrier	6	3	9
16	Distance	3	5	8
17	Mining	3	3	6
18	Flip teaching	2	3	5
18	Rubric	2	3	5

ultimately providing a successful teaching/learning strategy suitable for individual learners.

(c) ***Article description point***

Table 9 shows the description position of each article with nine types of classification. As shown, the categorical position of an article is not always consistent with the externalized representation of the authors. For example, even if the authors describe an article as addressing the experimental results, we may look upon the article as an "enforcement" if it describes only the experimental process without any detail analyses or considerations. The classification "enforcement" accounts for 20.6 % of all articles in Table 9 and refers to articles that report the results and situation of projects, experiences, and trials. The classification "implementation" occupies 19.3 %. The articles in the education domain are mainly composed on the basis of views for "enforcement", "consideration", and "survey" while those in the information engineering domain discuss "implementation", "proposal", and "management" with a view to making the functionality.

Table 9 was chiefly arranged on the basis of description phrases from the title, abstract, and introduction in the article body. Additionally, we analyzed the features of these articles by ourselves (i.e., without input from the authors), with the results shown in Table 10. Table 11 explains classification features in Table 10. In Table 10, the classifications are divided into more detailed fields than in Table 9. Table 10 is organized with domain-specific terms while Table 9 is arranged basically with description phrases of the authors from the title, abstract, and introduction. Table 10 is arranged in accordance with our own judgment, target objects, and description objectives gleaned from phrases in the article body.

Table 9 Description points of authors

		2013	2014	Total	Note
1	Enforcement	47	45	92	Perform plans in practice
2	Implementation	40	47	87	Develop IT-based functions/tools/systems
3	Consideration	44	26	70	Estimate next direction after evaluation or with new fact
4	Proposal	11	49	60	Propose new trial/plan
5	Survey	21	32	53	Investigate results, collected by questionnaire, interview, etc.
6	Experiment	18	15	33	Perform plan for verification, discovery, refinement, etc.
7	Management	14	8	22	Manage systems/works for teaching/learning
8	Composition	10	8	18	Compose teaching/learning contents resources
9	Analysis	7	5	12	Analyze existing/newly acquired information
		212	235	447	

Table 10 Classification features of articles

		2013				2014				Total
		inf.	cog.	edu.		inf.	cog.	edu.		
1	Function development	38		4	42	25		9	34	76
2	Enforcement report	10		34	44	7		24	31	75
3	Method proposal	12	1	6	19	6	10	5	21	40
4	Contents composition	6		15	21	4	1	14	19	40
5	Analysis report	6	1	18	25	5		8	13	38
6	Survey report		1	12	13			25	25	38
7	Teaching method	2		10	12	2	1	15	18	30
8	Skill training	5			5	15			15	20
9	Processing technology	2		1	3	13		2	15	18
10	Teaching support	7		3	10	6		1	7	17
11	Learning management	1		2	3	6		3	9	12
12	Terminal utilization			1	1			9	9	10
13	Learning environment	3			3	4		3	7	10
14	Experiment result	3	1	2	6				0	6
15	Learning functionality	1			1	4		1	5	6
16	Interaction support			2	2		3		3	5
17	Learning support	1			1	1			1	2
18	Learning method				0	1			1	1
19	Industry-university cooperation				0			1	1	1
				1	1			1	1	2
	Total	97	4	111	212	99	15	121	235	447

Table 11 Explanation of classification features in Table 10

	Classification feature	Note
1	Function development	Develop functions, tools and systems
2	Enforcement report	Describe performed plans
3	Method proposal	Propose new plans/ideas
4	Contents composition	Compose teaching/learning-contents resources
5	Analysis report	Analyze phenomenon from experiments and investigation
6	Survey report	Describe results, collected by questionnaire, interview, etc.
7	Teaching method	Propose teaching means, methods, and procedures
8	Skill training	Acquire special skill
9	Processing technology	Design and develop IT-based functions and mechanisms

(continued)

Table 11 (continued)

	Classification feature	Note
10	Teaching support	Support teaching process
11	Learning management	Manage and maintain learning process
12	Terminal utilization	Utilize newly developed devices and tools
13	Learning environment	Develop effective learning environment
14	Experiment result	Describe results, performed and arranged in experiment
15	Learning functionality	Research learning functions and mechanisms
16	Interaction support	Develop interface between human beings and systems
17	Learning support	Support learning process
18	Learning method	Propose learning means, methods and procedures
19	Industry-university cooperation	Cooperate and interact between industries and universities

The projects that have been financially supported by official organizations are arranged owing to the classification in Table 10. "Function development", "method proposal", "skill training", "teaching support", and "processing technology" are accepted as the most appreciated projects in the information engineering domain, while "survey report", "teaching method", and "contents composition" received official funds in the education domain. Table 12 shows the ratio of fund-supported

Table 12 Financially supported articles

		2013				2014				Total
		inf.	cog.	edu.		inf.	cog.	edu.		
1	Function development	14		3	17	11		4	15	32
2	Method proposal	8	1	2	11	5	2	2	9	20
3	Enforcement report	2		4	6	3		3	6	12
4	Survey report			4	4			7	7	11
5	Analysis report	1		7	8	2			2	10
6	Teaching method			6	6	1		3	4	10
7	Contents composition			4	4			5	5	9
8	Skill training	2			2	5			5	7
9	Teaching support	4			4	2			2	6
10	Learning environment	2			2	1		2	3	5
11	Processing technology	1			1	3			3	4
12	Experiment result	2	1	1	3				0	3
13	Terminal utilization				0			3	3	3
14	Learning management	1			1				0	1
15	Interaction support			1	1				0	1
16	Learning functionality	1			1				0	1
		38	2	31	71	33	2	29	64	135

Table 13 Ratio of funded articles

		Ratio (%)	Note
1	Method proposal	50	= 20/40
1	Learning environment	50	= 5/10
1	Experiment result	50	= 3/6
4	Function development	42	= 32/76
5	Skill training	35	= 7/20
5	Teaching support	35	= 6/17
7	Teaching methods	33	= 10/30
8	Terminal utilization	30	= 3/10
9	Survey report	29	= 11/38
10	Analysis report	26	= 10/38
11	Contents composition	23	= 9/40
12	Processing technology	22	= 4/18
13	Interaction support	20	= 1/5
14	Learning functionality	17	= 1/6
15	Enforcement report	16	= 12/75
16	Learning management	8	= 1/12
17	Learning support	0	= 0/2
17	Learning method	0	= 0/1
17	Industry-university collaboration	0	= 0/1
	Other	0	= 0/2

projects for all articles in descending order. The highest supported research areas are "method proposal", "learning environment", and "experiment result", while "enforcement report", "learning management", and "learning support" tend not to be supported. Table 13 shows the ratio of funded articles in ascending order.

4 Consideration

Our knowledge transfer scheme not only represents the movement of knowledge from the outside of the learner to the inside but also indicates that learners should to make use of acquired knowledge in applicable cases. However, this requirement is not always satisfied in many trials. Key terms such as "problem composition" and "evaluation" may indicate topics that can lead to knowledge understanding. The teaching/learning activity feature is not enough in itself for one trial; "cooperation", "continuousness", "sustainability", and others must also be established. For this viewpoint, the management and maintenance approach, which has links to several situations, becomes increasingly important. We arrange the current research issues from such viewpoint:

(1) unified management of various learning situations (e.g., LMS, portfolio);
(2) integration/systemization of contents (e.g., CMS);

(3) cooperation among universities (e.g., communization of system management, development and sharing of open resources, etc.); and
(4) cooperation/coordination among industries and universities (e.g., practical usability, refinement of functions and contents, etc.).

We feel it is necessary to support and use the environment in addition to developing systems (functions, tools, contents, etc.) and using tools.

5 Conclusion

We extracted the features from articles presented at two international conferences (Ed-Media and E-Learn) and one domestic conference (JSiSE) and investigated the current trends. Of course, this paper is limited in some sense because the behavior of human beings is a vast factor that would take several articles to discuss. Moreover, it is not easy to estimate and evaluate phenomena from behavior.

As future work, we intend to discuss how to extend the successive scenario for design, implementation, and utilization, or how they can be extended. To this end, it is crucial to present a paradigm for understanding and using acquired knowledge. The year 2045 is being predicted as the year of technological singularity. Really, will we observe the evolution of teaching/learning performance in just this time? What insights can we gain from our learning strategy? How can we best facilitate this process? We will address these questions in our future work.

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