Distance learning using video terminals—an empirical study

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Abstract

This paper reports on a further study of application of community-based information networks reported by Kodama (*International Journal of Information Management 19* (1999) 495). With respect to the distance learning using real-time model functions that is characteristic of community-based information networks, in this report, the results of services provided in the actual distance learning fields held in Japan over the past 4 years are analyzed and evaluated from various aspects including technology, study effectiveness and human aspects. This report clarifies that community-based information networks are an effective tool for distance learning and also contains perspectives on and issues for the future. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Distance learning; Videoconference; IT; Multimedia

1. Introduction

Video terminals[1] (Rosen, 1996; Trowt-Bayard & Wilcox, 1997) have long been hailed as an ideal transmission and technology development domain for use in a wide range of fields, from business to the family/individual, not merely for trustworthy visual information transmission. It is also expected that the technology will be used as a means of personal expression and in education, medical and welfare fields, as well as fusion with the arts.

Networks using video terminals (in this document, these are called community-based information, hereinafter referred to as Community-Net) are spreading widely across Japan and Europe. This technology is used in various forms, not only in the distance learning field but also in medical, welfare and business fields. Its value has been increasing as an effective communication strategy tool within companies, between companies and between companies and customers (Kodama, 1999, 2000). Additionally, in the field of e-commerce, this is expected to grow rapidly in the future; the advent of new business models based on human-to-human e-commerce sales and support through interactive video communications is expected (Collaborate.com, 2000). I believe

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[1] Video terminals are based on videoconferencing systems and/or video phones standardized by the ITU-T.

that Community-Net as a multimedia digital networking will be widespread regardless of the communication medium that is used, e.g. ISDN (Integrated Services Digital Network)[2] and the Internet. Nowadays, video terminals are used to communicate with individual households during airing of terrestrial broadcast programs. As the audience has got used to missing frames and installation and transmission/reception have become convenient, the use of video terminals has been increasing.[3]

In this report, the results of services provided in the actual distance learning fields using Community-Net are analyzed and evaluated from various aspects including technology, study effectiveness and human aspects to verify the effectiveness of distance learning using Community-Net.

2. Positioning of Community-Net in distance learning

2.1. Need for distance learning in Japan

2.1.2. Adult education in Japan

It is conceivable that there will be increased opportunities in the future for adults at the university and graduate school levels, in order that they might gain the most possible knowledge and to learn about technology while otherwise employed. However, due to time and geographical restrictions it is difficult for an adult to attend university full-time while also working. In the past, universities overcame these restrictions with special adult selection examinations, day and night classes, regional and suburban campuses with public lectures, etc. Specifically, the majority of graduate school lectures have been based on ''seminars'' where students actively argued among themselves in question and answer form, rather than traditional ''lectures'' given in one-way format by a lecturer. Confrontation and interactivity are therefore indispensable.

On the other hand, in the context of a strong national need by adults for a high-quality business education and the idea for communications graduate schools, several business schools in Japan have created an environment through the active use of multimedia technology in which people can receive cutting-edge business education while working, without the need to be physically present.

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[2]A digital network service (Integrated Services Digital Network) is established by the telecommunications standardization sector of the International Telecommunications Union (ITU-T). Additional information on ISDN is available at ⟨http://www.alumni.caltech.edu/∼dank/isdn⟩, and ITU-T recommendations are also available at ⟨http://www.itu.ch/itudoc/itu-t/tec/i.html⟩.

[3]The videophone which was released to the market in September 1997 by Nippon Telegraph and Telephone Corporation (hereafter to be referred to as NTT), Japan's largest telecommunications company, is an ISDN videophone featuring high picture quality and the world's lowest price. Approximately, 30,000 had been sold throughout Japan by the end of 1999. In July 1999, a new model videophone was developed and released to the market. This model achieved an ISDN transmission rate of approximately 64 kbps and a video image transmission frame rate of approximately 10 frames/s. At 128 kbps, the rate is 20 frames/s. This model has been growing as a signing support tool used by people with hearing handicaps in remote locations. (Reference: Normal television frame rate is approximately 30 frames/s). In addition, in the ''Sunday Sport'' professional baseball news program, Nippon Hoso Kyokai (NHK) provides both real-time terrestrial and satellite broadcasting and interactive communications such as interviews with manager and players via a videophone that connects the stadium or dorm and the company's Tokyo studios.

The universities are proceeding with studies designed to open the door to nationwide "remote classes" that overcome time and geographical restrictions.

The battles the universities faced in developing multimedia can be conceived of as having contributed both to the support and expansion of educational opportunities for adults as well as in contributing to advancing education in outlying regions. At home or in the office, it is possible for anyone to freely choose from among a number of areas of interest the class or lecture that best suits their needs and study preferences.

2.1.3. Life study in Japan

With the greying of society, it is conceivable that the needs of people with regard to life studies which comprise a reason to live and a sense of fulfillment will rise. Trends toward carrying out remotely the life study which Japanese national community organizations perform on networks are rising.

It is at this point that remote life study classes that utilize multimedia are able to respond accurately to the various study needs of the individual by increasing the opportunities for learning that transcends time and place restrictions. It is here that expectations are harbored for the dissolution of the "depopulation of education" and planning for an increase in the educational effect of life study.

Moreover, by merely setting up video terminals in people's homes, it is possible to open a virtual university at a national level. Through these multimedia methods, it is possible to realize a "university founded in society" (cyber college) that is capable of releasing the educational contents that a university possesses across a wide area. It is predicted that this system will spread out to national universities and community organizations.

2.1.4. Language study in Japan

In the real international era, the necessity and need for language education continues to increase. Needless to say, in principle, the most effective method for native speakers to provide language education is through face-to-face interaction. However, virtual lessons by native speakers anytime, anywhere are becoming more important for busy business people to obtain language skills. Not only the world "standard" English language, but also Chinese, Russian, etc. are also important nowadays for many companies in order for them to actively engage in international business. Therefore, this new business model using video terminals has high growth possibilities because a nationwide virtual language school can be created simply by installing video terminals in companies or homes.

2.2. Placing importance on real time and interactive features

It is an important issue to establish a network-type education environment in which adults can obtain the latest, most advanced information and knowledge possessed by universities or educational institutes at inexpensive cost, anywhere, anytime, throughout one's life. Studies of the cost and time efficiency of the distance learning environment as a social foundation indicate that a non-real-time (storage type) based system is ideal; however, storage-type systems are used to disseminate established information/knowledge that holders (educational organizations) hand down to non-holders (students).

On the other hand, when handling existing but not systemized information/knowledge or unknown subjects, an environmental system in which the position of learning and teaching can freely be dispersed is desired. A real-time, interactive discussion environment will be increasingly needed in the future for new information/knowledge formation to handle unknown subjects. In other words, circulation and creation of information/knowledge are the key points.

In this case, Community-Net,[4] which has real-time functionality, is appropriate. The leading fields in industrial and economic circles especially need this technology.

2.3. Market trends in sales of video terminals

The global market for video terminals such as video conferencing systems and videophones has been showing explosive growth over the past 6 years. Video conferencing is being increasingly introduced in a variety of fields not only by large corporations but also by small and medium-sized companies due to the appearance of so-called desktop video conferencing systems utilizing a PC and high-quality, low-cost standalone videophones. Recently, data conferencing and video conferencing in LAN environments and the Internet is becoming possible, and video conferencing is now transcending the conventional framework of a "conference" and expanding the possibilities as a new tool of communication (Kodama, 1999).

If we generally classify video terminals from the two viewpoints of quality (video quality × audio quality) and cost (terminal cost × communications network cost), the classification would fall into two applicable areas as shown in Fig. 1. The first area covers video terminals that use the Internet as their communications platform. These terminals mainly feature low cost and are mostly prevalent in the United States. The second area covers video terminals that use ISDN as their communications platform, and their main feature is quality. Their use is growing in countries such as Germany and Japan where ISDN has become widely available.[5] The ISDN-based video terminals are being used mainly for business purposes, while Internet-based video terminals are mostly being used in personal life.[6]

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[4]As a concept of Community-Net, Kodama (1999) reported on real-time and interactive real-time models that integrate multimedia information such as video, audio and data (text), and a storage model function that is non-real time but is instead a storage type. Of them, this report discusses an empirical study of distance learning using Community-Net, where importance is placed on the interactive features of the real-time model.

[5]Deutsche Telecom leads the ISDN diffusion rate among the various telecommunications operators spread across Europe. Deutsche Telecom is energetically strengthening its network base and pushing forward with advancement into foreign markets through the liberalization in 1998 of the European telecommunications market. In response to the growth of ISDN, Deutsche Telecom is proceeding with positive investment, such as the investment of 12 billion marks, with the aim of creating a digital network connecting 50 German cities. Currently, ISDN can be mutually connected between 41 countries, and a digital network platform that will make interactive visual communication internally possible with video terminals is already in place. In Japan, which has the second highest ISDN penetration rate, NTT, the largest telecommunications carrier, has positioned the promotion of ISDN as an important business strategy to promote the popularization of multimedia services, and has been vigorously developing the business since 1995. Specifically, it has increased the number of new ISDN subscribers by developing ISDN terminal applications through strategic partnerships with numerous companies in various industries, offering new network services and various content provision services, and offering services that are valuable and beneficial to the user (see Kodama (2000)).

[6]On the constant bit switch-based network whose quality is as stable as that of ISDN, video terminals are mainly used in business applications. The Internet (packed-based network, in other words, a type of common-use network), where quality is not stable, is mainly for private use.
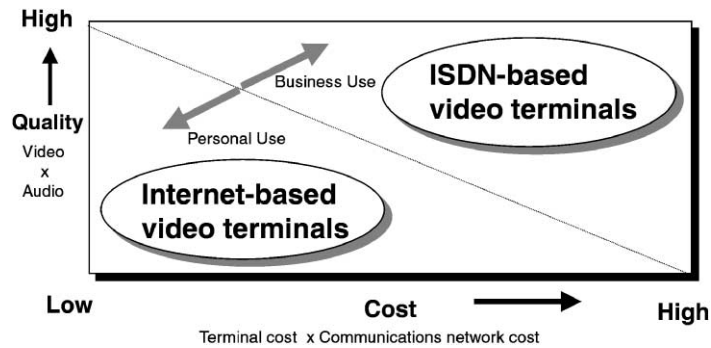
Fig. 1. Areas of video terminal application (quality and cost).

However, it is highly possible in the future that the speed increases on the Internet accomplished through the introduction of fiberoptics and high-speed access lines such as asymmetric digital subscriber line (ADSL) and CATV will elevate the quality of Internet-based video terminals to a high level and implement comfortable interactive video communications over the Internet and expand the use of Community-Net.[7]

2.4. The spread of high-quality, low-priced video terminals

Video terminals are classified into three types: room, desktop and videophone. These three types have seen wide-ranging price drops worldwide, thanks to the technological revolution and the entry of many system vendors into a competitive marketplace. Specifically, video terminals have expanded remarkably in the past few years in comparison with the rise in demand for ISDN in the Japanese market, and an aggregate spread of 400,000 units was predicted for the year 2000 (Fuji Chimera Research Institute, 1998).[8]

The first type, room type, is a traditional videoconferencing system and appeared around the world in mid-80 s, aimed towards corporate users. It spread due to a worldwide boom in new media at that time and was introduced centrally to large corporations. Within the global communications equipment market, it was predicted that worldwide ISDN network construction after 1990 would serve as an engine of growth, and these developments also led to certain expectations with regard to the room system.

On the other hand, accompanying a broad range of post-1990 developments in picture encoding technology, a second teleconferencing method appeared, dubbed desktop teleconferencing system (DTC). This desktop computer-based system enjoyed wide success due to its low cost compared with the room system, and the ability to share data in a collaborative environment. The technology quickly spread from large corporations to small and medium-sized firms.

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[7]Community-Net (real-time model and storage model) that operates using Internet protocols (TCP/IP) and can be used with ADSL or CATV communication systems have already been made practical; however, it is expected that because of high speed future networks the real-time model function for real time and interactive communications in particular will be significantly improved over the current quality available through Internet technology.

[8]Interviews with the senior managers of NTT and Picture Tel on future directions in the video market.

Targeted at average households, a third category, a low-cost, high-functionality videophone, made its debut in the latter half of 1990. Currently, products that can be used with ISDN and the cost close to $6,00 are spreading throughout the Japanese markets. Low-cost, high-quality video terminals can be used in education, health care, welfare and business fields in the ways mentioned above, as a common worldwide system platform.

2.5. Introduction of a low-cost, stable, reliable, standardized system

Currently, the reception/distribution systems of distance learning includes satellite communications systems, the Internet, video terminals, etc. and various combinations. However, taking into consideration, its use in individual homes only video terminals are currently available to implement sufficient interactive features between senders and receivers at low initial and operating cost for real-time distance learning.

On the other hand, the Internet is low cost but there is no guarantee that it can provide real-time video, audio, and stable real-time interactive features. Feasibility from a business viewpoint is essential as the biggest issue in the establishment of distance learning systems. In order to provide a system that is feasible from a business standpoint, the system must be low cost, stable/reliable, and standardized or there should be a possibility that the system will become a standard so that dissemination can be ensured.

In the work reported here, we connected a multiple number of inexpensive video terminals at the sender and receiver and verified the effectiveness of distance learning via Community-Net using a multipoint connection network[9] running over ISDN and employed an advanced Community-Net system that efficiently integrates data (text) with video and audio.

3. Modeling of Community-Net for distance learning effectiveness verification

In order to verify the effectiveness of Community-Net as an efficient tool for distance learning, we distributed a questionnaire to many instructors and students and conducted opinion surveys in various distance learning fields in Japan from 1995 to 1999. The surveys focused primarily on technology, learning effectiveness and human aspects. The technology aspect was verified in terms of efficient interactive distribution of multimedia information (video, audio and data). From a learning effectiveness aspect, distance learning effectiveness using Community-Net was analyzed. For human aspects, usability by instructors and students, and organization and structure to operate distance learning were studied.

Specifically, we configured three patterns of Community-Net as shown in Fig. 2, and set up distribution of various education contents and distance learning via interactive communication between instructors and students.

Pattern 1
Pattern 1 in Fig. 2 shows a virtual form of Expo (Nihon Keizai Shimbun 1998a, b; Nihon Kogyo Shimbun, 1998a), Seminar (Nihon Keizai Shimbun, 1998c, d), lifelong learning

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[9] A network service that connects, over ISDN, multiple videoconferencing systems and/or videophones differing from those standardized by the ITU-T.
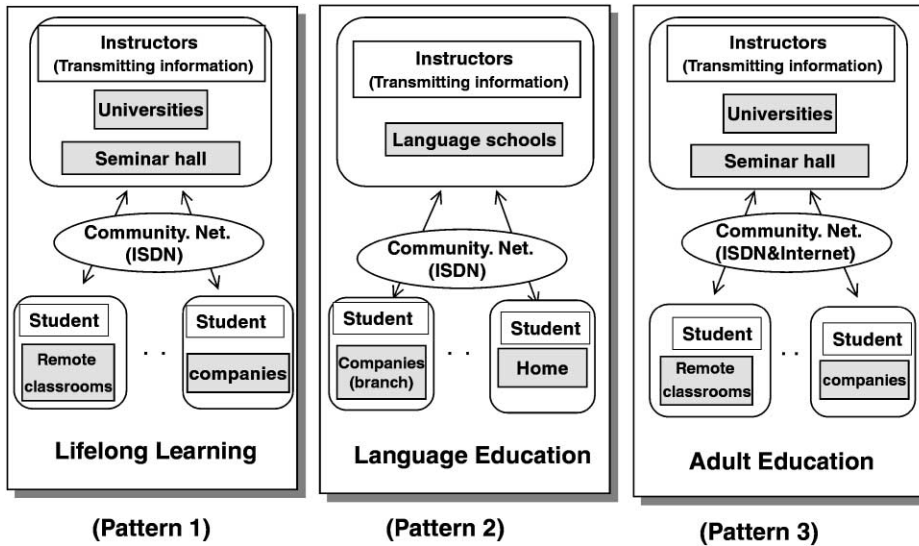
Fig. 2. Community-Net in each pattern.

(Fukushima Minpo Shimbun, 1997; Mainichi Shimbun, 1997) and corporate training[10] using Community-Net. We distributed various education contents from the main facilities (university, seminar hall or training center) to training rooms at companies, temporary satellite rooms and public halls, etc. in an effort to conduct interactive communications based on questions and answers between instructors and many students. The advantages of distance learning for students are that they can take the latest business trend courses, advanced technical seminars and general education courses at their own office or a nearby hall without going to a distant main hall, needlessly spending time and money, and also it is possible to directly ask questions and get answers real-time to/from instructors who are specialists. It is also possible to conduct a virtual collective lecture by setting up a temporary satellite hall especially in local areas (Osaka, Kyushu, Shikoku, Hokkaido, etc.) rather than metropolitan Tokyo, Japan's capital, and gather local students at these halls. In Pattern 1, an extremely low fee was set for a distance learning course (including communications costs) compared to the total fee incurred when actually taking the course (course fee + transportation).

For a network-type and information transmission method, Pattern 1 used ISDN-compatible (128 Kbps/s) video terminals for video, audio, and document distribution. For documentation distribution, presentation materials such as Word and PowerPoint data were converted into video signals using camera and videocam converter and sent to the video terminals.

There were a total of 784 students and 64 instructors in Pattern 1.

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[10] Multimedia training was conducted inside NTT from 1996 to 1998. Training rooms in Tokyo, Nagoya and Osaka were connected with Community-Net and distance learning was performed.

Pattern 2

Pattern 2 in Fig. 2 shows a virtual form of home language study (Nikkei Sangyo Shimbun, 1997) and corporate language training[11] using Community-Net. We had the instructor distribute various language education contents (English, Chinese, etc.) from the language school to the students' homes or offices at companies to conduct interactive language lessons between instructors and students (one instructor for each student, or one instructor for three to four students, forming a virtual classroom). Unlike Pattern 1, this virtual class consisted of several students and an instructor and the students attended the class from his/her home or office on an individual basis. The reason for this is that language education is more effective if you study in a small classroom rather than a large one with many students. The greatest advantage of virtual language schools for students is that busy businessmen can take lessons at preferred time without actually having to physically attend a language school. Additionally, in Pattern 2, an extremely low fee was set for the distance learning course (including communication cost), as compared to the total fee incurred when actually taking the course (course fee + transportation).

The network type and information transmission method in Pattern 2 is the same as Pattern 1 for video, audio and document distribution.

There were a total of 293 students and 21 instructors in Pattern 2.

Pattern 3

Community-Net in Pattern 3 is an advanced version of Patterns 1 and 2. ISDN having stable network line quality is used for (video/audio) information for which the importance is on real-time and interactivity features. Furthermore, the document distribution technology (Nikkei Sangyo Shimbun, 2000; Nihon Kogyo Shimbun, 2000; Nikkan Kogyo Shimbun, 2000)[12] using Internet distributes documents together with video and audio to multiple student locations (in this report, it is called a hybrid-type Community-Net: a detailed network configuration diagram is shown in Fig. 3).

A hybrid-type Community-Net was tried based on the results of opinion surveys of many students and instructors who were interested in remote lectures using a multipoint connection network by sharing figures and references created on PCs. The concept of the class is that while students are listening to the lecture via video terminals at many locations, they can share reference materials on the Web, which can be accessed via the Internet.

For this hybrid-type Community-Net, video terminals and PCs are connected to ISDN (128 Kbps). One channel (64 Kbps) is for video terminals connected to the multipoint connection network. Another channel (64 Kbps) is for PCs to connect to the data conference server via the Internet. In this way, students take distance learning courses by sharing references on the browser on their PCs and at the same time sharing video and audio. This is an advanced distance learning method that makes good use of the advantages of ISDN, which allows for dual

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[11] The English conversation trainings conducted inside NTT from 1996 to 1997. Various locations throughout Japan were connected with Community-Net, and distance learning was performed for employees at sales offices nationwide.

[12] This is what is called a data conferencing system. Many software vendors primarily in the US commercialized products that can be used with this kind of system.
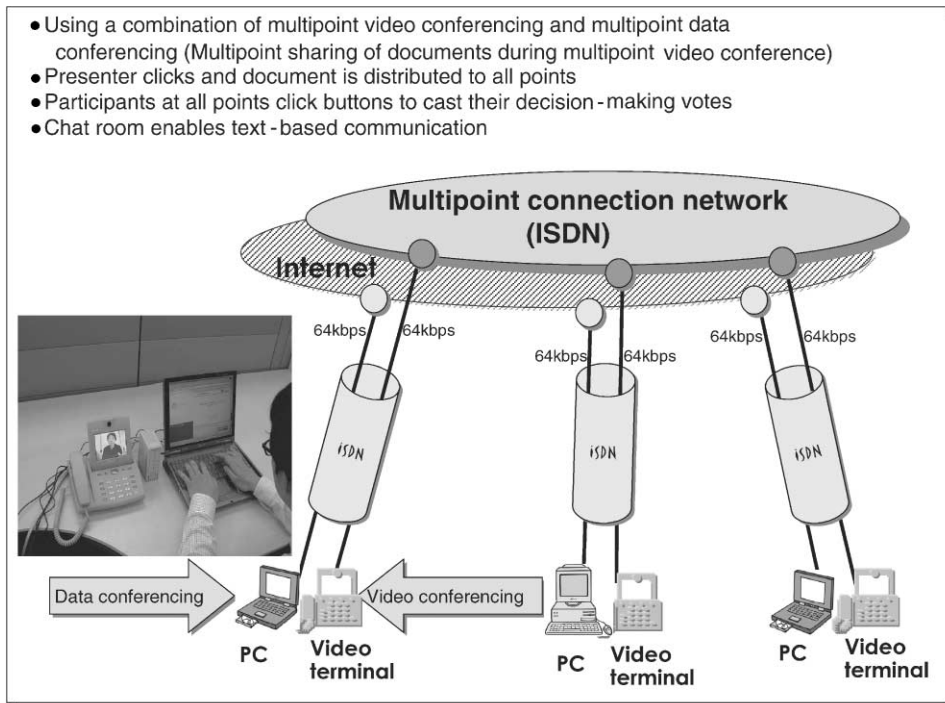
Fig. 3. Hybrid-type Community-Net.

communication at the same time. One ISDN line (128 Kbps/s) is used to mix video/audio with references.

The basic functions of the hybrid-type Community-Net are as follows.

- Video/audio interactive communication functions between multiple points.
- Distribution and sharing of lecture reference materials. Lecture reference materials created by a PC can be used as they are and pages specified by the instructor can be distributed to each student.
- Displays a student connection status list. Instructor can monitor student connection status.
- Students express their desire to speak and are allowed to speak. Students can ask to speak and the instructor can allow them to do so.
- Chat function. Text communication (chatting) can be performed between students.

This hybrid-type Community-Net makes it possible to implement a compound communication environment consisting of a videoconference (64 Kbps) + data conference (64 Kbps), which makes good use of the advantages of ISDN and via which it is possible to conduct effective distance learning at homes, etc.

Pattern 3 opened the management special class (Nihon Keizai Shimbun, 1998e) or medical information class intended for post graduates or adult students who are the targets of advance study content. 118 students and 25 instructors participated.

4. Results and discussion

4.1. Evaluation of multimedia information distribution

Fig. 4 shows organized subjective evaluation results by students and instructors on video/audio/data multimedia information transmission for each pattern in Fig. 2.

With respect to interactive video communications, satisfactory results could be obtained for all patterns. For the three patterns, 84% (1096) of the total number of students and instructors said that instructors and students could communicate well with each other using questions and answers and also the majority of people could feel the atmosphere of the class (vigor of instructors, attitude of students, and the look of office or home of students) experience the togetherness in the virtual class. In addition, 94% (1224) of all students and instructors in all patterns said that about 15 frames/s (for ISDN 128 Kbps transmission) to 7 frames/s (for ISDN 64 Kbps transmission) is sufficient for distance learning, where movement of an instructor and students may not be so important. As a noteworthy opinion, many students (23%, 274 of the total number students) said that even though 1–2 frames/s (equivalent to video transmission via current Internet technology or an analog line) is almost a still image transmission, it is acceptable for distance learning. However, for the remote language lessons in Pattern 2, where the movement of the mouth for Chinese or English pronunciation is important, most instructors and students (98%: 307 of the total number of students and instructors participating in Pattern 2) said that about 15 frames/s video transmission quality is necessary.

On the other hand, satisfactory results could be obtained with respect to the interactive audio communication in all patterns (97%: 1263 of the total number of students and instructors in all

	Pattern 1	Pattern 2	Pattern 3	Comment by instructor/participant
Video	Fully satisfied (84%: 1096 people)			.15 frames/sec. (128 kbps/s) to 7 frames/sec. (64 kbps/s) quality is ok with D.L for which movement of instructors and students is not important (94%: 1224 people)
Audio	Fully satisfied (97%: 1263 people)			·There are no hard to hear problems at all such as "intermittence" or "muffling" of voice that are frequently problems with Internet-based TV conference systems (82%: 1068 people)
Data (text)	Almost satisfied (18%: 209 people) Not so satisfied (54%: 627 people Not satisfied (28%: 325 people)	Fully satisfied (100%: 143 people)		·Hybrid type Community-Net with which data conference is integrated is a effective tool for D.L. (91%: 130 people)

Pattern 1   Students: 784   Instructors: Data was collected from 64 people
Pattern 2   Students: 293   Instructors: Data was collected from 21 people
Pattern 3   Students: 118   Instructors: Data was collected from 25 people

Fig. 4. Subjective evaluation (instructor/student) on multimedia information (video/audio/data).

patterns). There were no hard-to-hear problems at all such as "intermittence" or "muffling" that are often a problem in real-time distance learning via current Internet technology. Additionally, the majority of people (82%: 1068 of the total number of students and instructors in all patterns) said audio was more important than video in distance learning.

Finally, students did not highly rate Patterns 1 and 2 in terms of efficient data transmission for document distribution. When "reference video" is handled in Patterns 1 and 2, typically, documents printed beforehand are filmed with a camera or PC output and converted into video signals using a scan converter (one significant advantage is that this method is easy for instructors to operate). However, in addition to unclear distributed video with both methods, it is problematic that the image of reference materials and the instructor cannot be viewed at the same time (instructors must consider the size of characters and figures of the original reference when creating them). Therefore, in Patterns 1 and 2, documents are needed to be distributed to the students beforehand and the students needed to use this pre-distributed document during the class. As a result, many students requested that they wanted to take distance learning class by sharing more convenient and clear reference materials. On the other hand, since Pattern 3 used the Internet to distribute documents, figures and texts were clear, which satisfied 100% of the students.

According to the above results, we could confirm that distance learning Pattern 3 is the most effective method from an all-around viewpoint of efficient distribution method of multimedia information.

4.2. Study effectiveness of each pattern compared to face-to-face class

We analyzed the results of a questionnaire under conditions where the same education contents were given to the same 48 students for each distance learning pattern (see Fig. 5).

In Patterns 1 and 2, lecture reference materials were distributed to the students beforehand and then a survey was conducted on how much the students understood. The results showed that even

Pattern 1 and Pattern 2 (total no. of students: 48)

Almost same level as collective training (6%: 3 people)	A little less effective than face to face collective training but preparation makes it possible to be the same level (75%: 36 people)	Cannot say that study is effective (19 %: 9 people)

Pattern 3 (Total no. of students: 48)

Almost same level as collective training (71%: 34 people)	A little less effective than face to face collective training but preparation makes it possible to be the same level (26%: 13 people)	Cannot say that study is effective (3%: 1 person)

Fig. 5. Study effectiveness in each pattern.

though 6% (three students) was at the same low level as that of collective training, because study reference materials were distributed beforehand and the students could fully prepare for the class we found that it was possible to obtain almost the equivalent level of effectiveness as with face-to-face classes (75% : 36 students). On the other hand, 19% or nine students said "it is hard to say the class was effective". Most of the expressed opinions were that the quality of the video and audio clarity was significantly different from real face-to-face classes; the class seemed to lack reality and there were many problems with document-oriented lectures. Some mentioned IT literacy issues, saying that difficulty in operation of devices might decrease the degree of understanding of study. This issue has a psychological aspect for students and must be studied in the future.

We conducted a survey on the study effectiveness of Pattern 3, in which lecture references are distributed to students beforehand. In Pattern 3, where the issue of the distribution of text such as a document is solved, including preparation effectiveness, 97% (47) of students showed the equivalent level of effectiveness as with face-to-face class. It seems that the effective use of a hybrid-type of Community-Net that enables video, audio and document distribution at the same time increases the study effectiveness in distance learning compared to Patterns 1 and 2. The one student who said there was no study effectiveness encountered problems operating the video terminal and PC.

4.3. Needs of distance learning specialists

Many instructors (94%: 103 instructors) provided us with important requests and opinions as follows that arose while providing services to the students. One is the need for a key man on the education organization side who is in charge of distance learning operations that transmit many education contents on the network and also smoothly carry out interactive distance learning. The key man needs to be involved with all processes in the workflow, from planning to carrying out the program with respect to the operation of distance learning. The key man needs to be a coordinator between instructors who have the education contents, education organization side secretariat and the responsible persons at education organization side facility. At the same time, he/she takes a general role to smoothly fuse and integrate lecture contents and Community-Net. The work role of the key man is roughly divided into two categories (see Fig. 6). One is coordinating work that practically plans and promotes virtual education businesses called distance learning in an educational organization. The other work is teaching assistance that provides overall support for individual classes and seminars in terms of technology and operation so that interactive distance learning can be carried out smoothly between instructors and students. It was mentioned that bringing the key man up to a speed is a very important issue. There is also a need to create documents such as a distance learning operating guide, a video terminal operation guide, troubleshooting operation manuals, etc. that are collections of know-how, and to train the education organization side staff based on the manuals.

From the result of opinion surveys and questionnaires given to the educational organizations, it was felt that the system shown in Fig. 7 is necessary at the educational organizations. That is, the coordinator is in charge of planning and organizing the entire distance learning program, while instructing and cooperating with the teaching assistant, while the teaching assistant supports instructors and students with regard to operation and technology when operating each distance learning program. In accordance with this information, for this report we actually tried a distance

Coordinator

· Promotes overall operation of distance learning.
· Keeps well-versed in distance learning methods, and takes a leadership role in horizontal expansion of distance learning within the school.
· Has the expertise to actually develop the objectives of classes of instructors and lecturers, including external lecturers.
· In charge of the education of teaching assistants.

Teaching Assistant

· Obtains human resources needed for each curriculum (seminar students and trainees can also be trained to become teaching assistants).
· Performs a variety of support duties for classes to heighten the educational effectiveness of classes that link remote locations, based on consideration for the instructors and students attending lectures.
· Maintains an optimal hardware environment for camerawork, voice level checks, and lighting.
· Provides instructor support with respect to human and operational aspects to avoid a sense of alienation on the part of remotely located students (including such considerations as question response times).
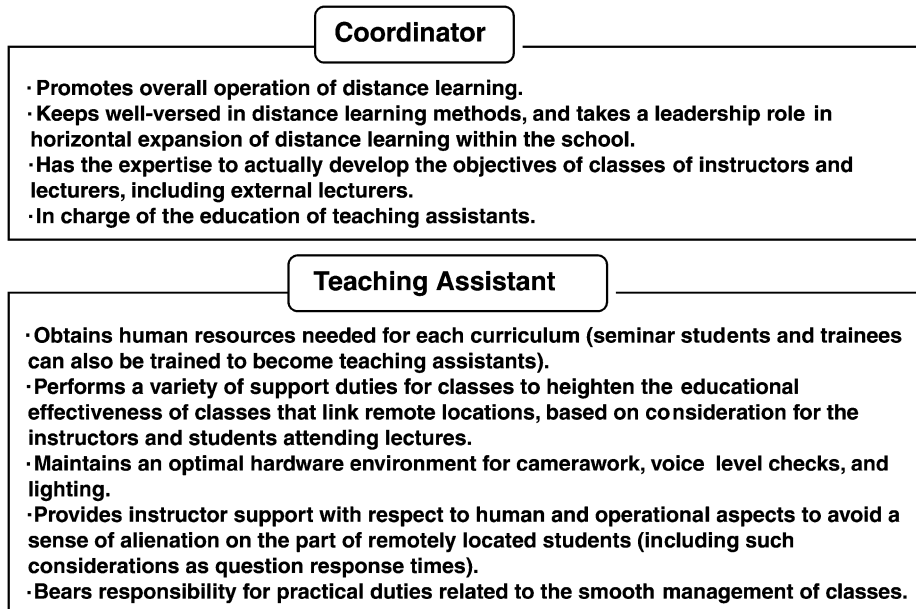· Bears responsibility for practical duties related to the smooth management of classes.

Fig. 6. Key individuals responsible for the operation of distance learning.
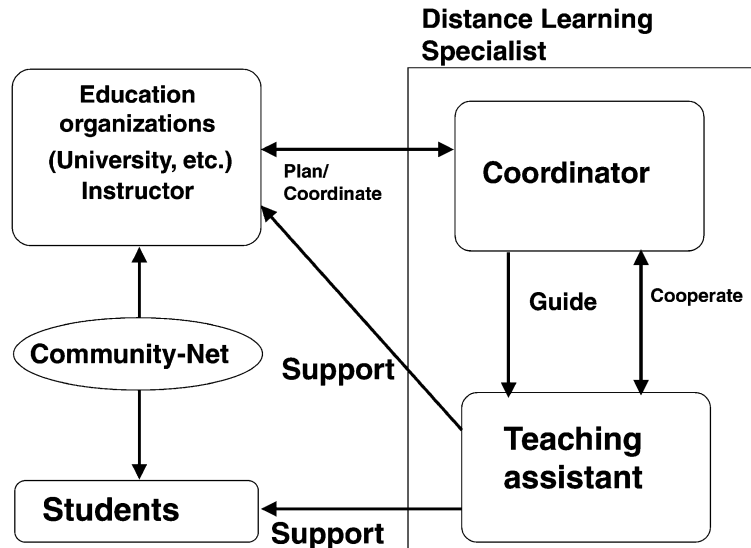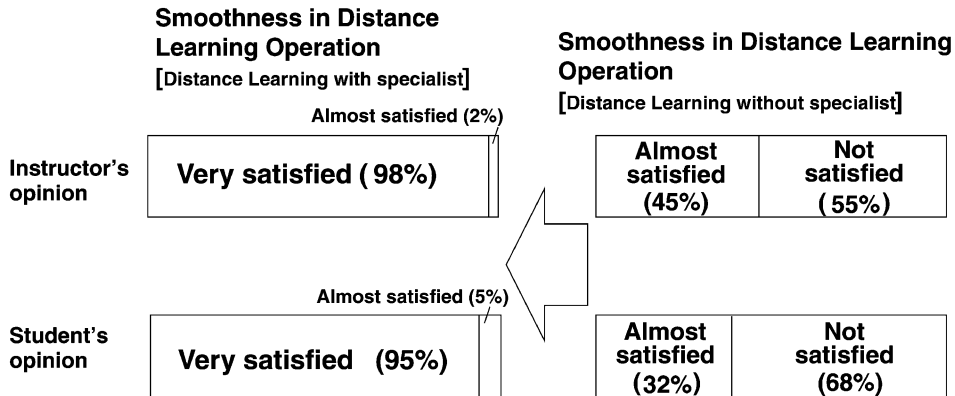

Fig. 7. Distance learning operation formation.

learning program that has a distance learning specialist, and one that does not have the specialist using Pattern 1, and analyzed the results. Specifically, according to Fig. 8, the results of a satisfaction survey of instructor and students regarding smooth operation of distance learning, the smoothness of distance learning was greatly improved when a specialist was assigned. 98% of the instructors and 95% of the students said they were satisfied.

Smoothness in Distance Learning Operation
[Distance Learning with specialist]

Smoothness in Distance Learning Operation
[Distance Learning without specialist]

Almost satisfied (2%)

| Instructor's opinion | Very satisfied (98%) | Almost satisfied (45%) | Not satisfied (55%) |

Almost satisfied (5%)

| Student's opinion | Very satisfied   (95%) | Almost satisfied (32%) | Not satisfied (68%) |

Data was collected from 67 students and 3 instructors.

Fig. 8. Satisfaction survey results for instructors and students regarding smooth operation of distance learning.

5. Future perspective and issues

Today the number of infants and school-aged children is decreasing. Also, most people hope for a high academic career throughout the world. In order to respond to these current societal needs, the content of education and educational methods are under pressure to change. The present circumstances in society will thus require improvement in these areas.

The new method of education called distance learning is rapidly replacing the conventional correspondence education in the US and Europe. Thus distance learning has the possibility to destroy the traditional education system and create a new global educational system. Information and communication technology (ICT), including the internet-based systems, satellite communication systems, CATV, high-speed digital lines and video terminals can give us all the information and knowledge we need (For example, Harry, 1999; Farrell, 1999). By using ICT, we can instantly communicate with one another. Through ICT we can change educational systems. When we establish distance learning education as a regular part of our education, we can achieve various types of education. These types of education cannot be achieved by being bound to only one school, or one classroom by traditional means. With distance learning education we can get all types of education efficiently through ICT, any place, any time.

Video terminals such as videoconferencing systems and video phones discussed in the paper are one of the tools in ICT. In this section, we would like to summarize the result of this empirical study and mention the future perspectives and issues of distance learning using video terminals.

According to the total evaluation of the demonstrative experience of distance learning in each pattern from the viewpoint of transmission of multimedia information and learning effectiveness, it was clarified that the hybrid-type Community-Net in Pattern 3 is currently the most appropriate environment for distance learning. The hybrid-type Community-Net is characterized by use of both a switch-based ISDN network and packet-based Internet transmission. The switch-based ISDN network guarantees high-quality interactive features for video and audio transmissions, which is an advantage, but the comparatively high communication fee is a disadvantage. For

example, in Japan, a local call is ¥10 for 3 min and the communication fee for a 1-h distance learning class is ¥200. On the contrary, fixed expenses for the Internet are ¥4000 to ¥6000 per month for a leased line, which is relatively inexpensive if it is only used for data transmission.[13]

These days, in many countries high-quality packet-based network services are being provided by many Internet service providers (ISPs) as a part of an effort to conduct a future next generation broadband Internet. I believe that an environment that provides high-quality interactive video communications will be prepared in the future. This means interactive video communications integrated with data transmission of text information, etc., and multimedia information (video + audio + data) over the Internet will be implemented in a comfortable environment. It is quite possible that higher quality and more economical distance learning will be implemented in the future. Furthermore, since the next generation mobile communication system (IMT-2000)[14] is to go into service in the fall of 2001 all over the world, we may be able to enjoy distance learning that is location-independent. Such a network infrastructure is called an integrated-type distance learning platform in this report and a conceptual diagram is shown in Fig. 9.

With the integrated type distance learning platform, high-speed Internet connections, ISDN and IMT-2000 mobile communications network are seamlessly connected so that users can do multimedia communications (real-time model functions such as videophone and storage-model functions such as video mail and video-on-demand) anytime, anywhere and with anyone without regard for the specific network being used. In addition, this platform can provide many users (businessmen, senior citizens, housewives, children, etc.) with distance learning in many forms. As a future study theme of this integrated-type distance learning platform, we will target distance learning using high-speed Internet connections, ISDN and IMT-2000, and conduct empirical studies of real-time and storage model distance learning running on various network environments (including mutually connected environment that combine high-speed Internet connections and IMT-2000). We will report the results of our study as they become available.

6. Conclusion

We verified the effectiveness of Community-Net from the technology, study effectiveness and human aspects using several Community-Net patterns that have real-time functions. Based on our study, it appears that the hybrid-type Community-Net is currently the most appropriate because it effectively distributes multimedia information such as video, audio and data (text) that increase study effectiveness and facilitates real-time interactive communications between instructors and students. It was further pointed out that there needs to be a distance learning specialist who serves in a coordination role, including planning, execution and technical-related

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[13] Currently, in Japan, various telecommunication carriers provide Internet leased line services and provide ISDN, ADSL or CATV network connections. The ISDN leased lines are currently available at ¥4500/month and ISDN has spread widely because it can be used as a switch-based network telephone.

[14] Current mobile phones and portable terminals are capable of high-speed transmission, but these are next-generation mobile; portable video terminals can transmit video, but not just voice and text, interactively. W-CDMA and cdma2000 are next generation mobile telephone systems proposed by the Swedish company Ericsson and the US company Qualcomm, respectively.
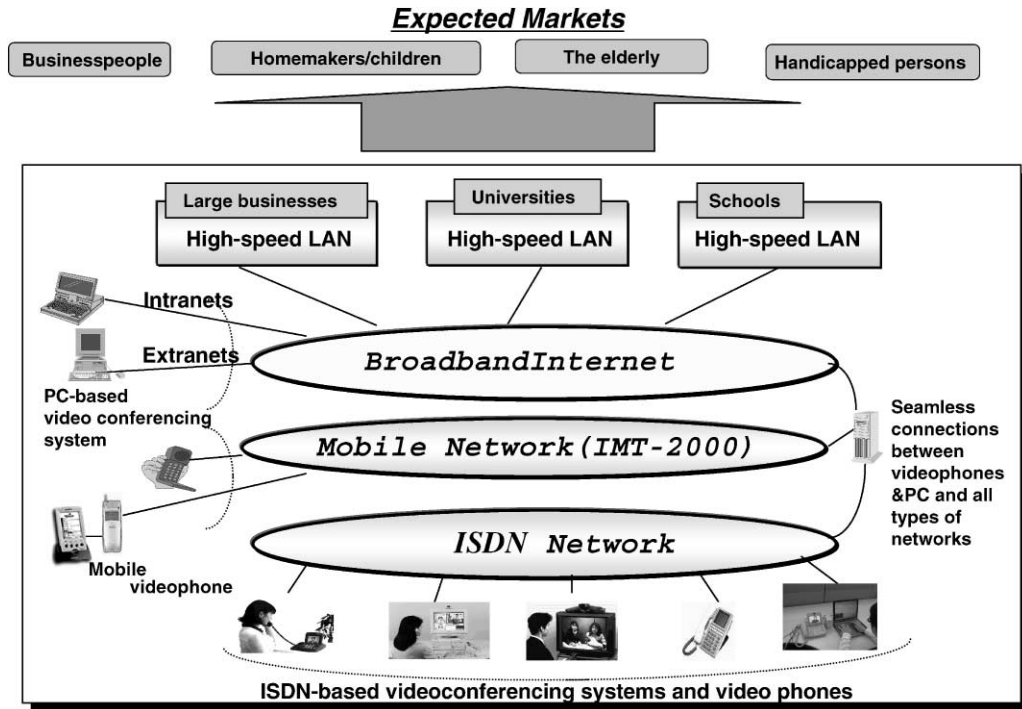
Fig. 9. Integrated distance learning platform.

work, and in this way smoothes the operation of distance learning by supporting instructors and students from various aspects.

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