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A method for identifying the needs of children, the elderly and the disabled people, and increasing their convenience, reducing the time and cost of accessing information and strategies to meet identified needs, using SDI and IoT

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ABSTRACT

Children, the elderly, and people with disabilities are vulnerable groups who are unable to identify and express their needs. Also, if the needs of this group of people are identified, their access to the most up-to-date information and solutions to meet identified needs will be difficult, time-consuming and costly. For this purpose, the Internet of Things (IoT) and selective dissemination of information (SDI) are used in this paper to automate steps from needs identification to providing up-to-date information and solutions to address identified needs. The proposed method has been tested on children with the subject of English language teaching. In this implementation, the children's education network graph created by Internet of Things was analysed. Children's educational needs were identified and after transforming the needs into keywords, they were sent to the selective dissemination of information system. Then, using the selective dissemination of information system, solutions based on the educational needs of each child were sent to their parents. The results showed the high efficiency of the proposed method.

KEYWORDS: Internet of Things, information systems, selective dissemination of information, vulnerable groups

1 INTRODUCTION

Information is data that has become a meaningful and useful element that can help meet the needs of individuals. Therefore, information consists of processed data [1]. Today, information is constantly changing. This indicates the need to collect, record, process and distribute information. The more up-to-date, complete, and accurate the information, the closer the decisions are to reality. It should also be easy to access information. The way to achieve these goals is to use information and communication technology (ICT) tools in information systems. ICT is the collection, organization, storage, and dissemination of information, including audio, video, or text, using computer and telecommunications tools [2]. ICT has undoubtedly been widespread in all social and economic spheres, and its impact on human societies is such that today's world is rapidly becoming an information society. In addition to the benefits of ICT, it also has some challenges. One of the challenges is the use of ICT for children, the elderly, and the disabled people to access up-to-date information to meet their needs. This group of people is also unable to identify and state their needs and interests. So, the main research questions are:

- RQ1: How can technology and ICT tools be used to identify the needs of children, the elderly and the disabled?
- RQ2: How can technology and ICT tools be used to facilitate access to up-to-date information for children, the elderly, and disabled?

This article presents a method for identifying the needs of this group of people, increasing their ease of access to information and obtaining the latest up-to-date information. The proposed approach uses Internet of Things (IoT) in selective dissemination of information (SDI). In the next section, related work is discussed. In the section 3, selective dissemination of information and Internet of Things are explained and then the proposed method is presented. In the section 4, the proposed method is tested on children.

2 RELATED WORKS

Kolodziejczak uses ICT tools to facilitate the access of disabled tourists to the information they need [3]. In his view, tourists need information at all stages of their journey. This information includes the routing of locations (including recreational places, restaurants, etc.), the status of roads, the weather, the laws and regulations at each location, alerts of impediments, and so on. He divides the disabled tourists into groups like blind, deaf or disabled people in moving (forced to use wheelchairs). For blind people, route guidance and alerts about impediments are notified by voice (by smartphone). For the deaf, vibration and display (e.g., displaying directions and alerts) are used on the smartphone. For people with disabilities using wheelchairs, routing is provided for routes that do not have obstacles such as stairs. He implemented his proposed method in Poland, which results in increased satisfaction of disabled tourists.

Blok et al, in a field research with N = 35 population, examined the role of technology and ICT tools in helping older people with cognitive impairments [4]. According to the results, ICT can help these people improve their social and emotional processes (using social networks) and access the information they need to control and do their daily work.

Mayordomo-Martínez et al, designed a mobile application to search for easily accessible stores to help people with disabilities [5]. The purpose of this application is to improve their living conditions through appropriate information. Evaluation of 357 businesses in Murcia (Spain) showed that only 25% of the access is good and 35% are inaccessible shops.

Hollier discusses the impact of Internet of Things on the education of students with disabilities [6]. A 6-month research project was launched at Cortin University to determine the importance of Internet of Things in education. The study included analysis of the literature on the subject, focus on Internet of Things and disability, and interviews to determine the Internet of Things perspective of five students with disabilities. Recent developments, including the availability of smartphones everywhere, improved user interaction with Internet of Things as well as ease of real-time data collection, provide significant opportunities for Internet of Things -based innovations and solutions. Students with disabilities can access and operate Internet of Things through their devices.

Jones et al, have used technology and digital tools to care for the health of people with disabilities [7]. Used cases include remote care with the help of a smartphone. Brunner et al, discusses technology and its role in the rehabilitation of cognitive and communicative disabilities caused by brain injury [8]. in this research three major types of communication technologies (assistive technology, augmentative and alternative communication technology, and information communication technology) are being used. Results of using these technologies have been reported positively in 95 studies and have improved the rehabilitation of patients with cognitive and communication impairments caused by brain injury.

There are cases as a research gap in the use of technology and ICT tools for vulnerable groups such as children, the elderly, and people with disabilities. Some of these include:

1. Vulnerable groups such as children, the elderly and people with disabilities are incapable of expressing their needs. Therefore, one of the important issues is identifying the needs of this group of people. In this paper, Internet of Things and sensors are used for this purpose.
2. This group of people, especially their supervisors, should be informed about the identified needs and problems.
3. In informing, new and up-to-date solutions and information should be provided to address the needs and problems of this group of people. In this paper, information systems such as selective

dissemination of information are used to search and provide new and up-to-date solutions and information to meet identified needs.

To improving convenience, save time and cost, it needs to be automated from the need's identification stage to the presentation of solutions and information. For this purpose, the combination of Internet of Things and selective dissemination of information has been used.

3 MATERIALS AND METHODS

3.1 Selective dissemination of information

Selective dissemination of information is a way of presenting and transmitting information, individually, regularly and continuously, by searching and sending the information needed by each user. Users express their interests and new information related to each user's interests is sent separately. Selective dissemination of information is about providing, organizing, selecting and disseminating information to individuals and organizations according to their predetermined needs. Selective dissemination of information is one of the new methods of information services designed to adapt information to the needs and interests of users, to make better use of information resources. In fact, at selective dissemination of information, the information system automatically selects and sends information, once the need and interest of the user is reached [9]. Young, also describes selective dissemination of information as "a service provided by information institutions to inform their users periodically of new publications, reports, or other information sources of interest to them" [10].

The purpose of selective dissemination of information is to provide useful information on new content and developments in each user's domain, based on their predetermined needs and interests. A selective dissemination of information system enables each user to access more accurate information about their interests and needs at a lower cost and time [11]. O'Neill identifies two main reasons for engaging in information services [12]:

1. Increasing information: Information is growing and users are limited in time to search for their needs and interests. The information service solves this problem.
2. Increasing specialization in all branches of knowledge leads to information on a subject being available in multiple sources.

Selective dissemination of information sifts large number of documents. It therefore makes the information and items selected to fit exactly with the needs and interests of the people in question and displays a list that has the highest percentage of useful information that the user has not been aware of so far [13]. The flowchart of a selective dissemination of information system is shown in Figure 1.

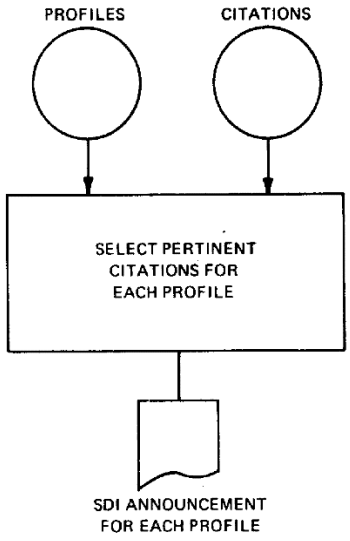

Figure 1: Flowchart of a selective dissemination of information system [14]

As shown in Fig. 1, the selective dissemination of information system compares keywords (which express user interests) and documents, and the appropriate listings for each user are sent weekly, biweekly, monthly, and so on.

3.2 Internet of Things

Internet of Things is one of the new technologies that can help in information gathering, status recognition and management. In Internet of Things, entities other than humans can connect to the Internet. Entities and objects will be able to automatically communicate with each other and exchange needed data [15]. With Internet of Things, all objects are interconnected that can be controlled and managed with the help of apps [16]. Figure 2 shows an example of communication between objects via the Internet. For example, when a person opens the door, there is a connection between the door and the lamps and the lamps are lit. As the lamps light up, a connection is made between the lamps and the tea maker and boiling water is prepared; in the same way, communications between other objects can be made available via the Internet.

Figure 2: Overview of communication between objects in the home by Internet of Things

In fact, Internet of Things is a new concept in the world of technology and communications that, as a modern technology, enables the transmission of data through communication networks for anything [17]. Internet of Things has many applications in various fields and sciences, including education, smart home, smart city, smart farming, transportation, health, energy, and more [18].

3.3 Proposed Method

In this section, we propose a two-phase method for identifying needs and provide up-to-date information and solutions to meet needs. The proposed method as a system consists of three parts: input, processing and output. The proposed method is presented on the basis of each of these sections.

3.3.1 Input Phase

In this section, the types of inputs based on Internet of Things inputs and selective dissemination of information inputs are discussed.

3.3.1.1 Internet of Things Related Inputs

First, should be determined a variety of possible scenarios for the needs of children, the elderly or disabled, depending on the subject under consideration. For example, if the subject under consideration is related to the health of the elderly, the different types of needs may include: 1- Elderly people whose blood

pressure should be considered 2- Elderly people whose cardiovascular disease should be considered 3- Elderly people who need attention for diabetes 4- And so on.

Next, the types of sensors needed to cover the defined needs should be considered. For example, for the health of the elderly, sensors such as blood pressure sensor, heart rate sensor, body temperature sensor, etc. should be considered. Then a database should be provided to determine the type of need using the data values collected by the sensors. For example, if for the elderly *i*, the data collected by the blood pressure sensor were higher than the value of a and the data collected through the heart rate sensor was higher than the value of b, elderly *i* has *x* disease and needs up-to-date information and guidelines on this type of disease to be provided to this elderly person and their caregivers.

3.3.1.2 Selective dissemination of information Related Inputs

Selective dissemination of information system settings must be specified:

1. Recipient of information (self, supervisor or both).
2. How to get information (email, social network, SMS, etc.).
3. Number of notifications over a period of time (daily, weekly, monthly, etc.).
4. Content of notifications (abstract, abstract and titles, first 10 pages of document).
5. Other items are added as needed.

3.3.2 Processing Phase

In this section, the data collected through the sensors are matched with the information in the database to identify needs. Once the type of need for person *i* has been identified, keywords for that need should be created. For example, if an elderly person *i* was diagnosed with heart disease, keywords such as foods needed for heart patients, exercises needed for heart patients, and so on should be created. After the need type has been identified and converted into keywords, the selective dissemination of information system searches for the most up-to-date information, articles, books, and more about the keywords assigned.

3.3.3 Output Phase

After the information about the set keywords is searched and selected, a notification is made to the user. Notification content, notification method, etc. are based on user settings in the input phase. If the user is interested in the notification, he can request the entire document content.

3.3.4 Flowchart and Pseudo-Code of Proposed Method

Figure 3 shows a flowchart of the use of Internet of Things in the selective dissemination of information system to identify the needs of children, the elderly and the disabled, and provide up-to-date information and strategies to address identified needs.

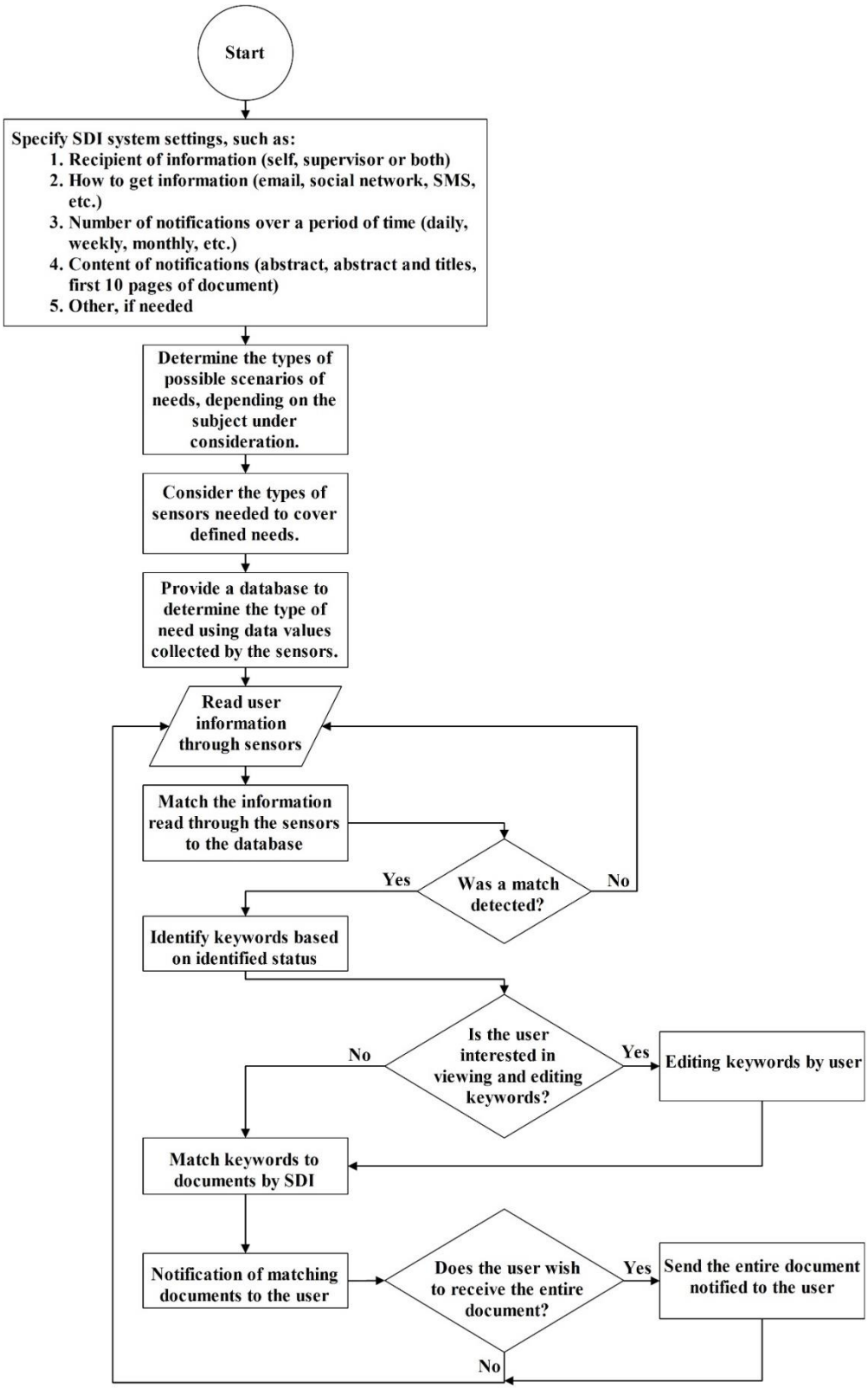

Figure 3: Flowchart of using Internet of Things in selective dissemination of information to identify needs and provide the most up-to-date solutions

The pseudo-code of the proposed method is also presented.

Algorithm 1

Function: using IoT in SDI

// **SDI system settings**

1. Determine the recipient of information (self, supervisor, or both)
2. Determine the method of receiving information (email, social network, SMS, etc.)
3. Set the number of notifications over a period of time (daily, weekly, monthly, etc.)
4. Determine the content of notifications (abstract, abstract and list of topics, first 10 pages of document**)**

//

Determine the types of possible states of "needs", depending on the subject under consideration.

Consider the types of sensors needed to collect data based on the types of needs states defined.

Provide a database to determine the type of need using data values collected by the sensors.

While enter exit **do**

Input: Get user information through sensors

Match the information read through the sensors to the information in the database

If a match is detected **do**

Specify the keywords based on the matching mode

If the user wishes to view and edit keywords **do**

Editing keywords by the user

End if

Match keywords to documents by SDI system

Notify the user of the matching documents

If the user wishes to receive the entire document declared **do**

Send the whole document to the user

End if

End if

End while

End function

As seen in Figure 3 and described in the pseudo-code, selective dissemination of information with Internet of Things can automate the identification of needs and announcements of the most up-to-date information and solutions to meet identified needs without the least effort, cost and time.

4 IMPLEMENTATION OF THE PROPOSED METHOD ON CHILD-TO-CHILD EDUCATION

In this section, the proposed method is tested on child-to-child education. The process of education is a child-to-child education that children teach each other. Educational games have been used to enhance the appeal of the educational process for children. In this game, each child has two types of cards (Intro Card and English Vocabulary Card). Every child should refer to other children and teach them his vocabulary card. Children receive points based on the number of words they have successfully trained or learned. Cards are NFC-enabled. When child i goes to child j for education, child j scans child *i*'s intro card through the NFC reader (smart bracelet or smartphone). Then, child *i* teaches his vocabulary card to child

j. If the learning process succeeds, child *j* scans the child's vocabulary card *i*. After a certain time, the game ends. Then, to check the accuracy of the vocabulary learned, the vocabulary that each child claims to have learned successfully is examined. Based on the scanning of intro cards and vocabulary cards, two communication and education networks are formed. Thus, if child *i* refers to child *j*, the directed link from node *i* to node *j* is formed in the communication network. Also, if child *i* was able to successfully teach child *j*, the directed link from node *i* to node *j* is formed in the education network. According to the proposed method, the types of possible scenarios of needs are considered as follows:

1. Children who are poor instructor.
2. Children who are poor learners.
3. Children with low communication (for education and learning).

For the definition of sensors, NFC is used for intro and vocabulary cards that are scanned through an NFC reader (smart bracelet or smartphone). The database is defined as if the number of child output links in the education network was less than half the maximum number of output links, that child would be identified as a poor instructor. If the number of child input links in the education network was less than half the maximum number of input links possible, that child would be identified as a poor learner. If the total number of child input and output links in the communication network was less than half of the total of maximum possible of input and output links, that child would be identified as low communication for education and learning.

The proposed method was tested on three children in an English language school. The number of experiments was twice. The first experiment was to diagnose the condition of children and provide the most up-to-date guidelines and information, and the second experiment was to evaluate the improvement made by the proposed method. Figure 4 shows the intro cards and vocabulary cards. The subject of vocabulary in the first experiment was fruits and the subject of vocabulary in the second experiment was the planets. Figure 5 also shows part of the implementation of an educational game for children.

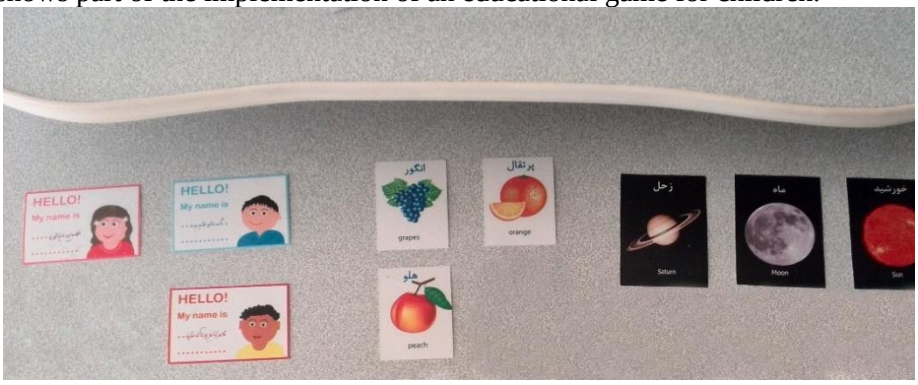

Figure 4: Intro cards and vocabulary cards in the experiment

Figure 5: Part of the educational play between children

After the first experiment, communication and education networks were formed. Figure 6 (a) shows the communication network from the first experiment and Figure 6 (b) shows the education network from the first experiment.

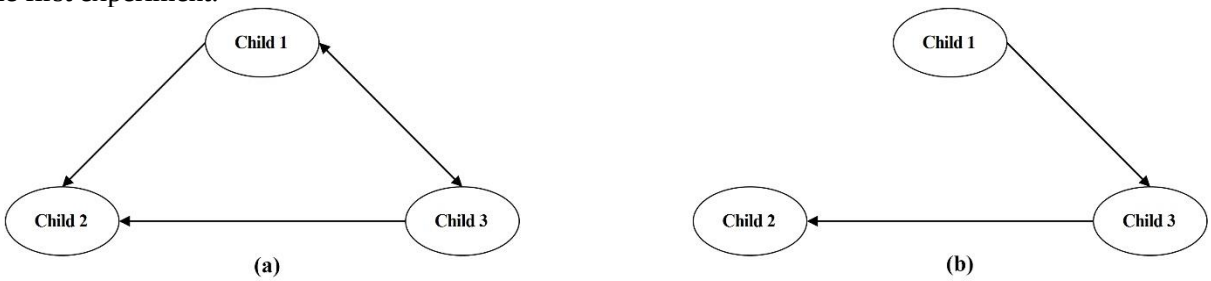

Figure 6: (a): Communication network from experiment 1 (b): Education network from experiment 1

Since the number of network nodes is 3, each node can have at most 2 input links and 2 output links. According to the proposed method, nodes with less than half the total of maximum possible number of input and output links in the communications network are designated as low-communication children for education and learning. According to Figure 6 (a), a child with low communication was not identified. In the education network, nodes with less than half the maximum number of possible input links are identified as poor learners. According to Figure 6 (b), child 1 is identified as a poor learner (because of less than 1 input link). Also, in the education network, nodes with less than half the maximum possible number of output links are designated as poor instructor. According to Figure 6 (b), child 2 is identified as a poor instructor (due to less than 1 output link).

The keywords "teaching reinforcement" and "learning reinforcement" were designated as inputs to the selective dissemination of information system. The most up-to-date articles, books and information were searched and selected to enhance learning. The criteria of learning reinforcement were shown in Figure 7.

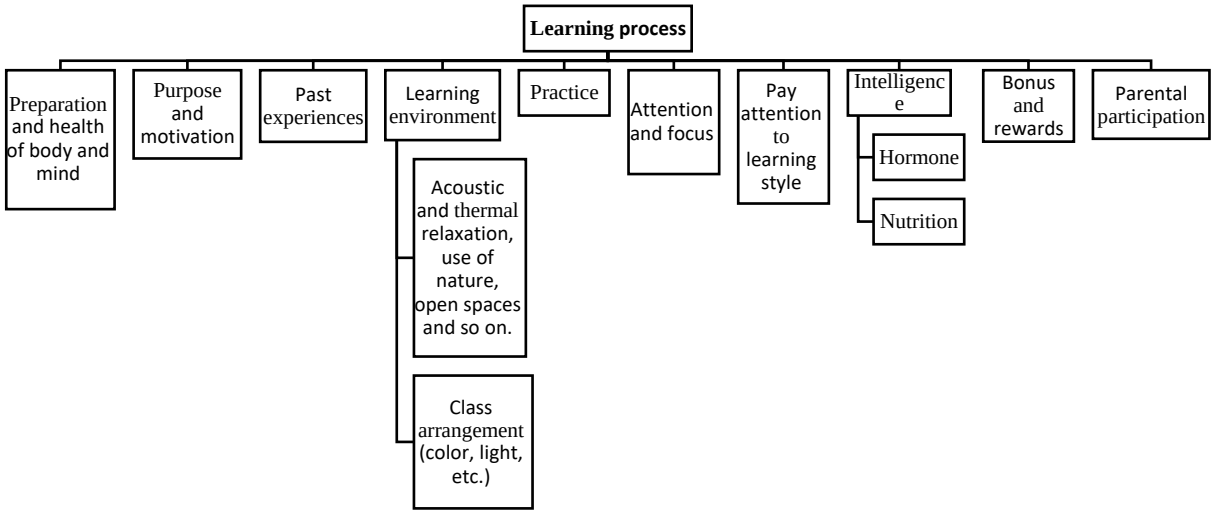

Figure 7: Effective criteria to enhance learning

In order to prioritize each criterion in enhancing learning, AHP technique was used to weight the criteria. Figure 8 shows the weight and priority of the criteria.

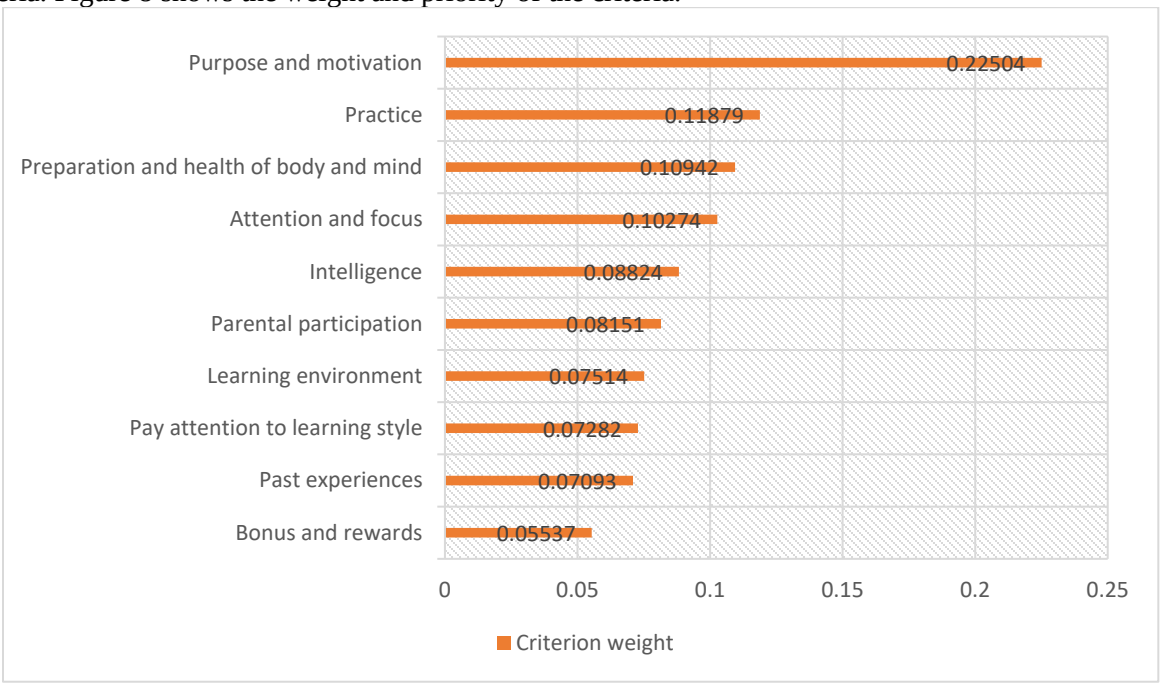

Figure 8: Weight chart and priority of effective criteria extracted in child learning process based on AHP technique

The criteria, their weight, and their priority, along with the most up-to-date articles and books on each criterion, were sent to child caregivers 1 who was identified as poor learner, through the social network. The most up-to-date articles, books and information were searched and selected to enhance teaching. The criteria of reinforcement of teaching were as shown in Figure 9.

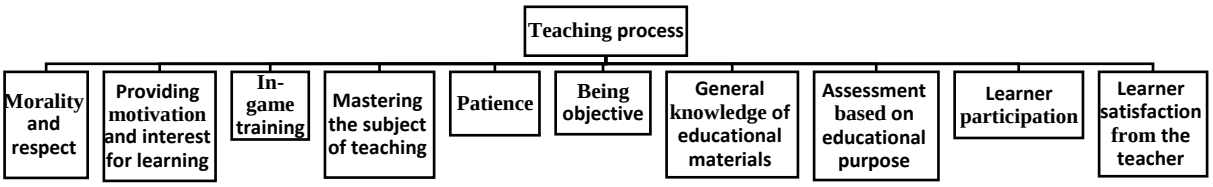

Figure 9: Effective criteria for reinforcing teaching

In order to prioritize each criterion in teaching reinforcement, AHP technique was used to weight the criteria. Figure 10 shows the weight and priority of the criteria.

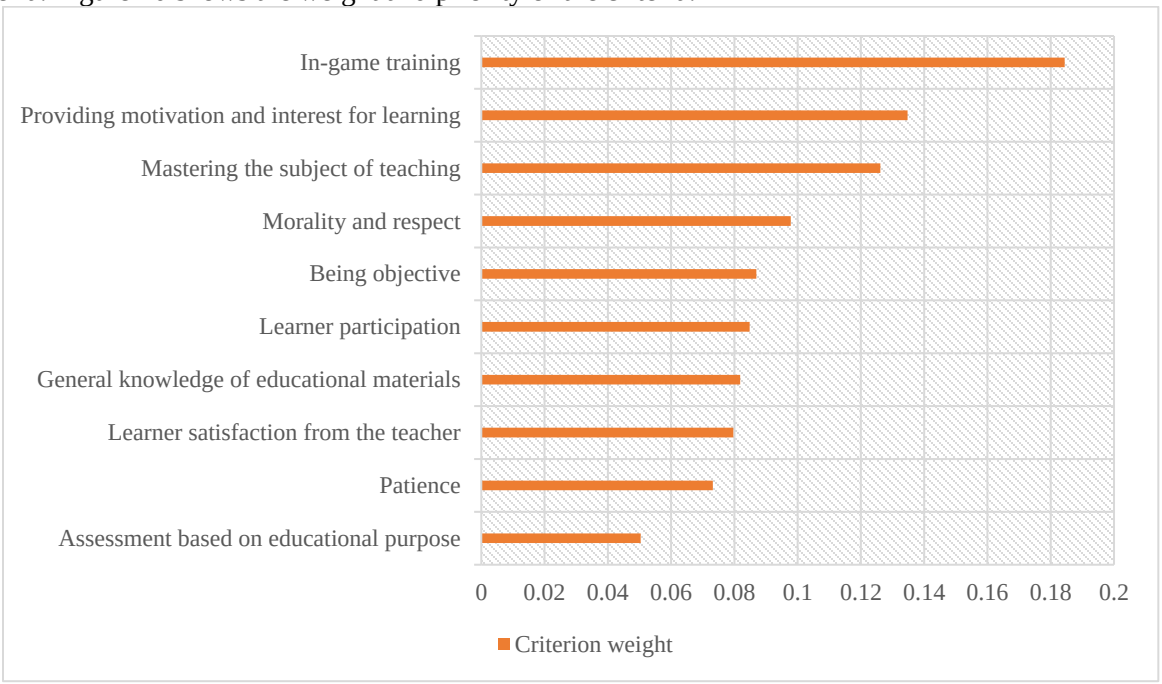

Figure 10: Weight chart and priority of effective criteria extracted in child teaching process based on AHP technique

Then the criteria, their weight and priority, along with the most up-to-date articles and books on each criterion were sent to child caregivers 2 who was identified as poor instructor, via the social network. After practicing children with the guidelines and information provided, a second experiment was conducted to evaluate the usefulness of the proposed method. Vocabulary topics in the second experiment were planets. Figure 11 (a) shows the communication network from the second experiment and Figure 11 (b) shows the education network from the second experiment.

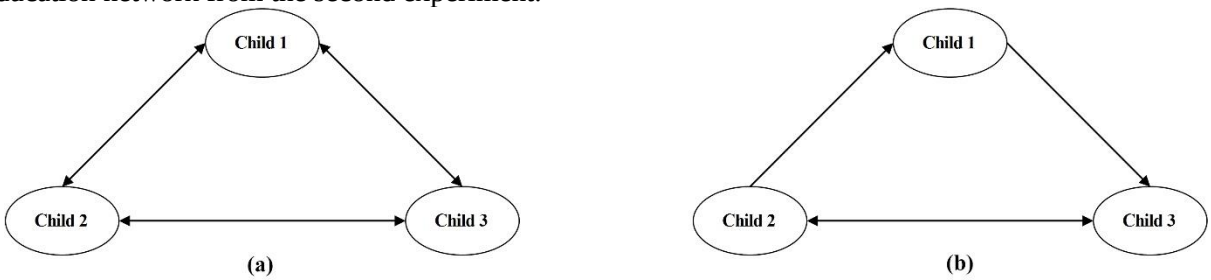

Figure 11: (a): Communication network from experiment 2 (b): Education network from experiment 2

Figure 12 shows the child performance diagrams in the education network from the first and second experiments.

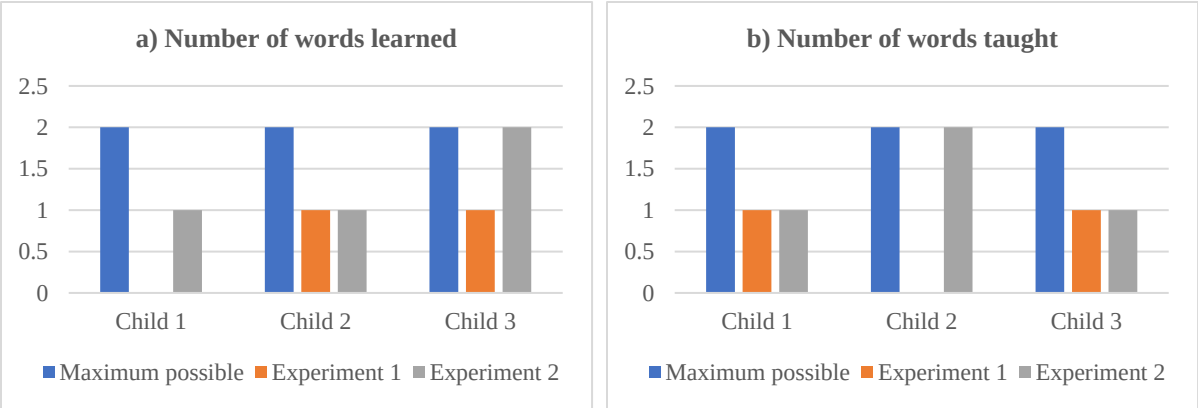

Figure 12: Child performance diagrams in the education network from experiments 1 and 2

As can be seen in Fig. 12, child learning rate 1 and child teaching rate 2 increased in the second experiment compared to the first experiment.

5 CONCLUSION

This paper presents a method for identifying the needs of vulnerable groups such as children, the elderly and the disabled who are unable to express their needs. In the proposed method, the selective dissemination of information system was used to provide up-to-date information and solutions to meet the identified needs. To increase ease, reduce time and cost, we automated the steps from identifying needs to presenting up-to-date information and solutions using Internet of Things and selective dissemination of information. The proposed method was tested on child-to-child education with subject of English-language teaching. The results showed increased ease in identifying needs, reducing the time and cost of accessing up-to-date information and strategies to address identified needs and improve children's performance.

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