Research on Smart Learning Ecosystem Structure Based on Ubiquitous Internet of Things

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Abstract. The paper studies a kind of smart learning ecosystem based on the analysis of the germination, connotation, information model and seamless integration of the digital learning ecosystem. The survey from state owned energy enterprise shows that smart environment and atmosphere can significantly affect the effectiveness of smart ecosystem intelligence. The result can be served as a helpful guideline for smart learning ecosystem based on cyber-physical-system design and application.

1. Introduction

With a deepening transition to clean and low-carbon energy, it appears inevitable for energy Internet to achieve the integrated development of the ubiquitous power Internet of things. Things like smart grids and other smarter planet solutions are referred to as “cyber physical systems,” where we link the cyber world the IT world with the physical world. So, constructing a smarter environment to promote learning for sustainable development is the demand of the times. Up to now, most researches focus on intelligent learning, key technologies, architecture model, learning resources and construction of intelligent learning environment. Taking state owned energy enterprise of China as an example, this paper attempts to study elements of ecological learning and further to reveal the impacts of smart environment and atmosphere can significantly affect the effectiveness of smart ecosystem intelligence, and then to find out the way to improve effectiveness of smart ecosystem intelligence [1-2].

2. Literature Review and Statement of Hypothesis

The research on smart ecosystem abroad mainly focuses on United States, Greece and other countries.

The idea of a “smart earth” was first proposed by the President of IBM Chief executive [3]. Since then, more and more proposals have been put forward on intelligent elements.

At present, smart system mainly focuses on the construction and application, most of which focus on the intelligent application of physical environment [4]. According to Chin, smart learning environment should base on the application of information and communication technology, and also meet the following characteristics, which meet learner different style and learning ability, support learners lifelong learning and support the development of learners [5]. Benkiran et al. believed that intelligent learning environment should adhere to learner-centred characteristics, including independence, communicability, adaptability and cooperation [6].

Smart learning ecosystem, similar to that of ecosystem, includes environmental factors and main parts: environmental factors (natural environment, social environment), normative environment and smart learning space. It allows learners to access any form of access on any device to receive continuous
services to obtain the opportunity to learn anytime, anywhere and on demand. It can also perceive learning situations location and social relations, through deep study and analysis of record history data thus help learners to make decision right, promote learners’ behaviour ability to create wisdom potential. Smart learning ecological environment construction, based on Internet of things technology, includes “sense”, “transmission”, “knowledge” and “control” corresponding to the perception layer, network layer, service layer and lying of the Internet of things.

So, we assume:

H1: Smart Learning Ecosystem has three centers: People-centric centre/circle Terminal centre/circle “Net” centre /circle, including intellectual participants, smart methods, smart resources, interactive environment, integrated resources and a big data interactive center, and ubiquitous internet of things, shown as Figure 1.

![Figure 1. key centers of Smart Learning Ecosystem](image)

From the background of "Internet +" education, "Internet +" education, wisdom learning, wisdom learning environment, ecological system and education ecological system were reviewed in detail, which clarified the situation and trend of the development of education. The establishment of a dynamic balance of the wisdom ecological environment system can achieve the sustainable development of wisdom education and improve the learner’s wisdom.

On macro level, values of Smart Learning Ecosystem are consistent with values of concepts in specific cultures, and follows concepts of service-centred, student-centred and experience-centred, which is also appeal of humanistic concept of smart education. Therefore, the intelligent learning ecology believes that this kind of thinking and ability needs to be acquired in the real experience (the unprecedented challenge). Based on literature review, its specific expression can be summarized as follows.

H2: People-centric centre/circle has positive effects on effectiveness of Smart Learning Ecosystem.

H3: Terminal centre/circle has positive effects on effectiveness of Smart Learning Ecosystem.

H4: “Net” centre /circle has positive effects on effectiveness of Smart Learning Ecosystem.

The core idea of cloud computing is a unified management and scheduling of a large number of connected computing resources. Constitute a computing resource pool that satisfies the user's on-
demand service. Cloud computing is divided into cloud software, cloud management and cloud platform. So, we assume:

H5: Interaction of “data+” centre/circle and People-centric centre/circle on effectiveness of Smart Learning Ecosystem.

H6: Interaction of “data+” centre/circle and Terminal centre/circle on effectiveness of Smart Learning Ecosystem.

3. Questionnaire Design and Data Collection
To ensure reliability and validity of research tools, this study adopts scale as used in the existing literature, and carries through appropriate modification in aim of present study.

Effectiveness of Smart Learning Ecosystem is comprised 5 dimensions: Stability development sharing controllable resources sharing and wisdom. Smart learning aims to cultivate intelligent talents with good value orientation, strong action ability, good thinking quality and deep creative potential.

These talents are good at learning, collaboration, communication, judgment, creation and solving complex problems. Ecosystem was first clearly defined by Tansley as a biological community or cluster in a specific space and its related physical environment. Although the definition does not specify the mechanism of interaction between living and nonliving components, Tansley alludes to this by referring to the term "systems" in physics. Therefore, the biomorphic system can be regarded as a system formed by the interaction between organisms and non-biological components in the environment in a certain space. The paper adopted above measurement instrument. The Cronbach’s α is 0.892, 0.79,0.84, all above 0.7 [6-8].

3.1. Reliability and Validity
The standardized coefficients of each observed variable are more than 0.70, the AVE value of each variable is than 0.5, and the square root of AVE variables are greater than the correlation coefficient of the variable with other variables, which indicates the variables have good introverted validity and discriminate validity.

3.2. Hypothesis Testing
The paper uses the LISREL 8.70 software for data analysis. We can read the results in table 1 and table 2.

| Variable                          | 1    | 2    | 3    | 4    |
|----------------------------------|------|------|------|------|
| Smart Learning Ecosystem construction | 0.80 |      |      |      |
| People-centric centre/circle     | 0.22 | 0.885|      |      |
| “Net+”center/circle              | 0.31 | 0.26 | 0.80 |      |
| Terminal centre/circle           | 0.19 | 0.36 | 0.16 | 0.87 |
| Cronch(α)                        | 0.86 | 0.88 | 0.92 | 0.90 |
Table 2. The results of assumptions

| Variable | Assumption | Standard value | T value | Results |
|----------|------------|----------------|---------|---------|
| H2       | Effective of Smart Learning Ecosystem ← People-centric centre/circle | 0.78 | 0.86 | yes |
| H3       | Effective of Smart Learning Ecosystem ← Terminal centre/circle | 0.67 | 1.82 | yes |
| H4       | Effective of Smart Learning Ecosystem ← “Net+” centre /circle | 0.71 | 1.19 | yes |
| H5       | “Net+” centre /circle culture* People-centric centre/circle | 0.83 | 2.78 | yes |
| H6       | “Net+” centre /circle culture* Terminal centre/circle | 0.45 | 6.12 | no |

Cronch(α) 0.89 0.96 0.91 0.38
Chi-Square=132.45, df=81, RMSEA=0.052, NFI = 0.92, NNFI = 0.97, CFI = 0.96, IFI = 0.96, GFI = 0.90, AGFI = 0.85

4. Conclusion and Discussion

From the perspective of ecology, construction and analysis of smart learning ecosystem help to solve learning problems caused by the change of subjective factors, so as to improve learning efficiency, enhance the wisdom of learners, and finally realize the sustainable development of education. Different from traditional learning environment, smart learning ecosystem embodies more wisdom. Any learning activity will restrict its learning results due to the change of some factors (restriction factors).

Further, the dynamic balance of smart learning ecosystem can reduce the function of restriction factors. The material flow, energy flow and information flow among People-centric centre/circle, Terminal centre/circle and “Net” centre /circle maintain a stable, dynamic and balanced state, and interact and regulate each other. The paper pointed interaction of “data+” centre /circle and people-centric centre/circle on effectiveness of smart learning ecosystem.

Smart Learning Ecosystem with its intelligence, advanced, strong interaction, personalized, humanized, ecological features help learners increase their ability to adapt to the environment, and enhance their willpower and resistance to pressure, and achieve learning wisdom. The paper can provide the basis for constructing smart ecological system and realizing sustainable development of wisdom education.

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