異質數位學習內容整合

曾世邦
tsp@tajen.edu.tw

資訊工程與娛樂科技系，
大仁科技大學
Outline

1. Introduction

2. Related Works
   - Learning theories in e-learning
   - Personalization of learning

3. Proposed method
   - Integration by using Vector Space Model
   - Improved Integration by Weighted Content

4. Experimental Results

5. Applications
   - Test Sheet Assembling

6. Conclusion
Learning is the major human activity to accommodate the environment or the society better.

The learning efficiency becomes more important due to the rapid changing of modern society.

E-learning is proposed and developed to enhance the human learning efficiency.
Characteristics of the e-learning

- The interaction between teachers and learners are enhanced by the Internet technology.
- The learning activities can be independent from the constrains of time and space.
- There is the higher individuality of learning to the learner.
- The teachers and learners can receive more and faster feedbacks of the learning activities.
Importance of assessment

For the personalization, it is necessary to gather information about the learners by assessment process.

**assessment**

- **Learner**: change the learning behavior.
- **Teacher**: understand the effectiveness of the learning activities to different learners.
- **School**: understand the performance of the educational program.
Relationship between e-assessment and feedback

- Learning
- E-assessment
- Feedback to Learner
  - Information rich to support revision
- Revision
- Feedback to Learner
  - Information rich to support to learn next unit
- Successful
- Unsuccessful
- Learning next unit

S.P. Tseng
Itembank integration
E-assessment

**paper-pencil test (PPT)**
- Higher cost
- Less performance

**Computer-based test (CBT), e-assessment**
- Lower cost
- Higher performance
- Greener
Effectiveness of E-assessment

Test sheet assembling
- selecting the candidate items from the itembank to generate the test sheet

Quality of itembank
- well-organized structure
- content-richness
Introduction

Related Works

Proposed method

Experimental Results

Applications

Conclusion

heterogeneous itembanks

One course/textbook taught/edited by many instructors/editors

- The instructors/editors of the same course may have different background

One course using several reference books

- The instructors base their teaching material on several reference books
- Learners find related information from other books or articles.
Example: Heterogeneous Itembanks

國小四上社會康軒版

生活的場所
- 家鄉的環境
- 三合院
- 老街
- 廟宇
- 家鄉的歷史

生活的變遷
- 池塘與水圳
- 碎礫與耕耘
- 堆肥與化肥
- 謝籃與塑料袋
- 家鄉是大家的

生活的安排
- 家鄉的傳統生活
- 現代的生活
- 傳統節慶
- 現代的節日
- 家鄉的新風貌
Example: Heterogeneous Itembanks

家鄉的地名與位置
- 家鄉的名字
- 地圖上的家鄉

家鄉的自然環境與生活
- 家鄉的地形與生活
- 家鄉的氣候與生活
- 家鄉的水資源與生活

家鄉的開發
- 家鄉開發的故事
- 鄉民生活的轉變

家鄉的節慶與民俗活動
- 家鄉的傳統節慶
- 家鄉的民俗活動

家鄉的名勝古蹟與特產
- 家鄉的名勝古蹟
- 家鄉的特產

家鄉的走透透
- 家鄉的交通
- 家鄉一日遊

S.P. Tseng Itembank integration
Learning theories in e-learning

- Behaviorism
- Cognitivism
- Constructivism
Behaviorism

- Behaviorism is a learning theory that focuses on the study of the relationship between stimuli and responses.
- It is based on the classic model of stimulus (S) - response (R) - behavior (B) interaction.
- Instructors present stimuli to learners, who then respond, leading to behavior.
- The goal is to predict and control behavior through the application of principles such as reinforcement and punishment.

Reference behavior

- Itembank integration
Cognitivism

- Knowledge Input
- Sensory Memory
  - Forgotten
- Attention
- Short-term Memory
  - Forgotten
- Coding
- Long-term Memory

Learning theories in e-learning
- Personalization of learning

- Sensory Memory
- Short-term Memory
- Long-term Memory

S.P. Tseng
Itembank integration
Cognitivism

Unit N

Unit 4

Unit 3

Unit 2

Unit 1
Which unit is the first?

Entropy

Engine

S.P. Tseng

Itembank integration
Constructivism

Experience from a specific context → Constructing / Re-constructing ➔ Knowledge in a specific domain

- Constructivism
  - Experience
  - Constructing / Re-constructing
  - Knowledge in a specific domain
Constructivism

Learning theories in e-learning
Personalization of learning

Accessibility
Knowledge fragment

Learner

Itembank integration
Personalization of learning

Learning theories in e-learning

- Personalization of learning

Introduction
- Related Works
- Proposed method
- Experimental Results
- Applications
- Conclusion

S.P. Tseng
Itembank integration
Integration of Heterogeneous itembanks

- Integration by using Vector Space Model
- Improved Integration by Weighted Content
Introduction

Related Works

Proposed method

Experimental Results

Applications

Conclusion

**Heterogeneous Itembanks Integrator (HIBI)**

- Import Items
- Chinese Segmentation
- Clean-up
- Vectorization
- Integrating via VSM
- Result Analysis

**Integration by using Vector Space Model**

Improved Integration by Weighted Content
Data Cleanup

- Chinese segmentation
  - CKIP Chinese Word Segmentation System
    - http://ckipsvr.iis.sinica.edu.tw/
    - Accuracy: 95%-96%
  - Removing the stopwords
    - Noun
    - Verb
    - Adjective
Example of Data Cleanup

1 item:
通常人們會稱自己( )為了自己的家鄉[居住的縣市鄉鎮] [工作的地點] [結婚地點] [求學地]

2 segmentation:
通常(D) 人們(Na) 會(D) 稱(VG) 自己(Nh) 爲(P) 自己(Nh) 的(DE) 家鄉(Nc) 居住(VA) 的(DE) 縣市(Nc) 鄉鎮(Nc) 工作(Na) 的(DE) 地點(Na) 結婚(VA) 地點(Na) 求學(VA) 地(DE)

3 extraction:
人們(Na) 稱(VG) 自己(Nh) 自己(Nh) 家鄉(Nc) 居住(VA) 縣市(Nc) 鄉鎮(Nc) 工作(Na) 地點(Na) 結婚(VA) 地點(Na) 求學(VA)
Vector space model

- Documents are represented as vectors.
  \[ d_j = (w_{1,j}, w_{2,j}, \ldots, w_{t,j}) \]  

- Each dimension corresponds to a separate term.
- The term specific weights in the document vectors are products of term frequency (TF) and inverse document frequency (IDF).
  \[ w_{t,d} = \text{tf}_{t,d} \cdot \log \frac{|D|}{|t \in D|} \]  

- Document similarity is the cosine of the angle between the vectors.
  \[ \text{similarity} = \cos \theta = \frac{\vec{d}_1 \cdot \vec{q}}{|\vec{d}_1| |\vec{q}|} \]
Integration by using Vector Space Model

Improved Integration by Weighted Content

Vector space model

\[ \vec{q}, \vec{d}_1, \vec{d}_2 \]

\[ \theta_1, \theta_2 \]
Integrating via VSM

1: **for each** Item \( t \) in the source itembank **do**
2: \( \text{Depth} = 0 \)
3: \( \text{Current} = \text{root} \) of the destination itembank
4: **while** Node \( \text{Current} \) is not a leaf-node **do**
5: **for each** child \( c \) of the \( \text{Current} \) **do**
6: evaluate the similarity \( \text{Sim}(c, t) \)
7: **if** \( \text{Sim}(c, t) > \text{MaxSim} \) **then**
8: \( \text{MaxSim} = \text{Sim}(c, t) \)
9: \( \text{MaxSimNode} = c \)
10: **end if**
11: **end for**
12: \( \text{Current} = \text{MaxSimNode} \)
13: \( \text{Depth} = \text{Depth} + 1 \)
14: **end while**
15: Insert item \( t \) into the node \( \text{Current} \)
16: **end for**
17: Output the destination itembank as integrated itembank
Integrating via VSM

Integration by using Vector Space Model
Improved Integration by Weighted Content

Destination Itembank

Source Itembank

Destination Itembank

Source Itembank

Destination Itembank

Source Itembank

Destination Itembank

Source Itembank

S.P. Tseng

Itembank integration
Improved Integration by Weighted Content

- Weighted Content
  - based on the type and structure of the items
  - different parts of the item with different weight

- Post-process of Chinese segmentation
Improved Integration by Weighted Content

Import Items

Chinese segmentation

Post-processing of Segmentation

Clean-up

Vectorization

Weighted-Content Process

Integrating via VSM

Integrated Itembank

Result Analysis

Source Itembanks

Destination Itembank

S.P. Tseng

Itembank integration
Chinese segmentation post-processing

Example of compound noun

”人口分布” ➞ ”人口”，”分布”

- **Rule 1:** if one adjective directly followed by one noun, the adjective and the noun would be composed into a compound noun.

- **Rule 2:** if one noun directly followed by one noun, the two nouns would be composed into a compound noun.
True/false items

**True-type:** all the item are with normal weights because the stem contains no irrelevant terms.

**False-type:** Because the answer is false, it means that there are some irrelevant or error terms in the stem. The detail of answer would be involved into the classifying process and with double weight relative to the stem.
Multiple choice items

- **Stem**: double weight.
- **Options**:
  - **Positive-type**:
    - **Key**: since this option is true/correct, the terms in the key are with double weight.
    - **Distractors**: since this option can contain some error or irrelevant terms, the terms in the distractors are with normal weight.
  - **Negative-type**: identified by ”錯”(wrong), ”非”(false), ”不”(not), ”誤”(error), ”無”(no), ”沒”(no), and ”否”(not).
    - **Key**: since this option can contain some really error or irrelevant terms, the terms in the key are with normal weight.
    - **Distractors**: since these options are really true/correct, the terms in the key option are with double weight.
## Itembanks

<table>
<thead>
<tr>
<th></th>
<th>Society</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st semester</td>
<td>2nd semester</td>
</tr>
<tr>
<td>Nani</td>
<td>NA</td>
<td>1529</td>
</tr>
<tr>
<td>Han Lin</td>
<td>697</td>
<td>950</td>
</tr>
<tr>
<td>Kang Hsuan</td>
<td>464</td>
<td>1106</td>
</tr>
</tbody>
</table>
Itembank manager of HGLS
Itembank manager of HGLS

S.P. Tseng  Itembank integration
Distinguishability
Measure of integration performance

\[ \delta = \frac{|\text{sim}(t, a) - \text{sim}(t, b)|}{\max(\text{sim}(t, a), \text{sim}(t, b))} \] (4)

where the two nodes \( a \) and \( b \) in the meta-itembank are most similar to the item \( t \). If \( \delta < 0.2 \), the item \( \tau \) is assumed to be indistinguishable. Otherwise, it is distinguishable.

**Distinguishable Ratio**

\[ DR = \frac{N_d}{N_d + N_i} \times 100\% \] (5)
A example of distinguishable item

\[ \delta = \frac{|0.8 - 0.5|}{\max(0.8, 0.5)} = \frac{0.3}{0.8} = 0.375 > 0.2 \]
The Distinguishable ratio of integrating different heterogeneous itembanks

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Source</th>
<th>Destination</th>
<th>$\text{HIBI}_{\text{flat}}$</th>
<th>$\text{HIBI}_{\text{tree}}$</th>
<th>$\text{IIWC}_{\text{flat}}$</th>
<th>$\text{IIWC}_{\text{tree}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Society</td>
<td>Kang Hsuan</td>
<td>Han Lin</td>
<td>79.10</td>
<td>93.53</td>
<td>96.12</td>
<td>96.34</td>
</tr>
<tr>
<td>1</td>
<td>Society</td>
<td>Han Lin</td>
<td>Kang Hsuan</td>
<td>78.80</td>
<td>87.37</td>
<td>91.39</td>
<td>90.96</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Kang Hsuan</td>
<td>Han Lin</td>
<td>72.60</td>
<td>89.33</td>
<td>92.50</td>
<td>93.22</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Nani</td>
<td>Han Lin</td>
<td>75.93</td>
<td>89.99</td>
<td>92.61</td>
<td>92.94</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Han Lin</td>
<td>Kang Hsuan</td>
<td>72.21</td>
<td>85.16</td>
<td>89.89</td>
<td>89.89</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Nani</td>
<td>Kang Hsuan</td>
<td>72.99</td>
<td>83.52</td>
<td>86.52</td>
<td>86.07</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Han Lin</td>
<td>Nani</td>
<td>71.52</td>
<td>89.96</td>
<td>91.23</td>
<td>91.23</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Kang Hsuan</td>
<td>Nani</td>
<td>76.11</td>
<td>88.74</td>
<td>92.11</td>
<td>91.16</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Kang Hsuan</td>
<td>Han Lin</td>
<td>76.36</td>
<td>89.37</td>
<td>90.89</td>
<td>90.67</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Nani</td>
<td>Han Lin</td>
<td>77.78</td>
<td>90.00</td>
<td>92.59</td>
<td>92.59</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Han Lin</td>
<td>Kang Hsuan</td>
<td>71.53</td>
<td>82.55</td>
<td>85.98</td>
<td>85.98</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Nani</td>
<td>Kang Hsuan</td>
<td>74.81</td>
<td>83.33</td>
<td>86.30</td>
<td>84.07</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Han Lin</td>
<td>Nani</td>
<td>78.97</td>
<td>83.69</td>
<td>86.27</td>
<td>87.70</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Kang Hsuan</td>
<td>Nani</td>
<td>78.09</td>
<td>84.82</td>
<td>89.80</td>
<td>89.15</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td>75.49</td>
<td>87.24</td>
<td>90.30</td>
<td>90.14</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2.86</td>
<td>3.37</td>
<td>3.05</td>
<td>3.31</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The evaluation of accuracy only takes the distinguishable items into account.

For the integrating different itembanks, it must be done by the professional expert to verify the integrating result of each items. In the experiments, the destination and source itembank is the same. Therefore it is easy to verify whether the item is inserted into the correct (original) leaf-node.

Accuracy

Accuracy - Measure of integration performance

\[ AC = \frac{N_{dc}}{N_d} \times 100\% \] (6)

S.P. Tseng
Itembank integration
### Accuracy of integration

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Source/Destination</th>
<th>HIBI_{flat}</th>
<th>HIBI_{tree}</th>
<th>IIWC_{flat}</th>
<th>IIWC_{tree}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Society</td>
<td>Han Lin</td>
<td>97.40</td>
<td>98.09</td>
<td>99.14</td>
<td>99.73</td>
</tr>
<tr>
<td>1</td>
<td>Society</td>
<td>Kang Hsuan</td>
<td>97.60</td>
<td>97.33</td>
<td>97.60</td>
<td>97.62</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Han Lin</td>
<td>97.39</td>
<td>94.46</td>
<td>97.55</td>
<td>98.08</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Kang Hsuan</td>
<td>94.99</td>
<td>94.71</td>
<td>96.20</td>
<td>96.48</td>
</tr>
<tr>
<td>2</td>
<td>Society</td>
<td>Nani</td>
<td>96.06</td>
<td>94.91</td>
<td>96.13</td>
<td>96.60</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Han Lin</td>
<td>98.48</td>
<td>99.57</td>
<td>99.71</td>
<td>99.71</td>
</tr>
<tr>
<td>2</td>
<td>Nature</td>
<td>Kang Hsuan</td>
<td>94.06</td>
<td>98.19</td>
<td>97.07</td>
<td>97.29</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td><strong>96.95</strong></td>
<td><strong>97.16</strong></td>
<td><strong>97.83</strong></td>
<td><strong>98.09</strong></td>
</tr>
<tr>
<td><strong>Standard deviation</strong></td>
<td></td>
<td></td>
<td><strong>1.82</strong></td>
<td><strong>2.21</strong></td>
<td><strong>1.39</strong></td>
<td><strong>1.33</strong></td>
</tr>
</tbody>
</table>

S.P. Tseng  
Itembank integration
Test Sheet Assembling

Itembank integration
Test Sheet Assembling for Integrated Itembank

Redundancy of itembank

If the itembank aggregates a large amount of items from different sources, the itembank will be with high redundancy.

- The intelligent test sheet assembling is necessary to avoid the redundant items for the integrated itembank.
System architecture of test sheet assembling

- Integrated Itembank
- Word Segmentation
- Data Cleanup
- Maximum Concept Genetic Algorithm
- Test Sheet

S.P. Tseng
Itembank integration
Maximum Concepts Genetic Algorithm (MCGA)

1. Randomly initiate the population
2. **while** The terminate condition is not met **do**
3. Selection()
4. Crossover()
5. Mutation()
6. **end while**
7. Output the result
The example of crossover in MCGA

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>1 1 0 0 0 1 1 0 1 0</td>
<td>1 1 1 1 0 1 1 0 1 0</td>
</tr>
<tr>
<td>P2</td>
<td>1 0 0 1 1 0 1 0 1 0</td>
<td>1 0 1 1 0 1 0 1 0 0</td>
</tr>
<tr>
<td>O1</td>
<td>1 1 1 0 1 1 0 1 0 1</td>
<td>1 1 0 1 1 0 1 0 1 0</td>
</tr>
<tr>
<td>O2</td>
<td>1 0 0 0 0 1 1 0 1 0</td>
<td>1 0 0 0 0 1 1 0 1 0</td>
</tr>
</tbody>
</table>

S.P. Tseng  Itembank integration
Mutation

Types of mutation
- increment mutation
- decrement mutation

Flip-bit choosing strategy
- Random choosing
- Heuristic choosing
  - increment mutation: increase the maximum fitness value
  - decrement mutation: decrease the minimum fitness value
The example of mutation in MCGA

<p>| | | | | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Itembanks

<table>
<thead>
<tr>
<th></th>
<th>Item#</th>
<th>Keyword#</th>
<th>Identical keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1</td>
<td>697</td>
<td>7268</td>
<td>1874</td>
</tr>
<tr>
<td>DS2</td>
<td>464</td>
<td>3908</td>
<td>1255</td>
</tr>
<tr>
<td>DS3</td>
<td>340</td>
<td>3395</td>
<td>1058</td>
</tr>
<tr>
<td>DS4</td>
<td>123</td>
<td>1230</td>
<td>443</td>
</tr>
<tr>
<td>DS5</td>
<td>357</td>
<td>3873</td>
<td>1144</td>
</tr>
<tr>
<td>DS6</td>
<td>157</td>
<td>1707</td>
<td>611</td>
</tr>
<tr>
<td>DS7</td>
<td>551</td>
<td>5137</td>
<td>1481</td>
</tr>
<tr>
<td>DS8</td>
<td>182</td>
<td>1702</td>
<td>616</td>
</tr>
<tr>
<td>DS9</td>
<td>516</td>
<td>5248</td>
<td>1525</td>
</tr>
<tr>
<td>DS10</td>
<td>254</td>
<td>2555</td>
<td>887</td>
</tr>
</tbody>
</table>
We assume that the concepts in one item can be represented by its keywords. And all identical keywords of the itembank can be as the domain of the itembank. The coverage means that the ratio of the itembank’s domain is covered by the test sheet.

\[
Coverage = \frac{\text{The identical keywords in the test sheet}}{\text{The identical keywords in the itembank}} \quad (7)
\]
## Experimental result of MCGA, size = 50

<table>
<thead>
<tr>
<th></th>
<th>Random</th>
<th>MCGA&lt;sub&gt;R&lt;/sub&gt;</th>
<th>MCGA&lt;sub&gt;H&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coverage</td>
<td>Coverage</td>
<td>Time</td>
</tr>
<tr>
<td>DS1</td>
<td>0.19</td>
<td>0.36</td>
<td>0.78</td>
</tr>
<tr>
<td>DS2</td>
<td>0.23</td>
<td>0.37</td>
<td>0.50</td>
</tr>
<tr>
<td>DS3</td>
<td>0.30</td>
<td>0.54</td>
<td>0.42</td>
</tr>
<tr>
<td>DS4</td>
<td>0.58</td>
<td>0.86</td>
<td>0.16</td>
</tr>
<tr>
<td>DS5</td>
<td>0.31</td>
<td>0.51</td>
<td>0.46</td>
</tr>
<tr>
<td>DS6</td>
<td>0.50</td>
<td>0.76</td>
<td>0.23</td>
</tr>
<tr>
<td>DS7</td>
<td>0.22</td>
<td>0.39</td>
<td>0.62</td>
</tr>
<tr>
<td>DS8</td>
<td>0.44</td>
<td>0.70</td>
<td>0.23</td>
</tr>
<tr>
<td>DS9</td>
<td>0.23</td>
<td>0.38</td>
<td>0.63</td>
</tr>
<tr>
<td>DS10</td>
<td>0.34</td>
<td>0.56</td>
<td>0.34</td>
</tr>
</tbody>
</table>
### Experimental result of MCGA, size = 100

<table>
<thead>
<tr>
<th></th>
<th>Random</th>
<th>MCGA&lt;sub&gt;R&lt;/sub&gt;</th>
<th>MCGA&lt;sub&gt;H&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coverage</td>
<td>Coverage</td>
<td>Time</td>
</tr>
<tr>
<td>DS1</td>
<td>0.33</td>
<td>0.54</td>
<td>1.56</td>
</tr>
<tr>
<td>DS2</td>
<td>0.38</td>
<td>0.58</td>
<td>0.97</td>
</tr>
<tr>
<td>DS3</td>
<td>0.50</td>
<td>0.76</td>
<td>0.80</td>
</tr>
<tr>
<td>DS4</td>
<td>0.89</td>
<td>1.00</td>
<td>0.30</td>
</tr>
<tr>
<td>DS5</td>
<td>0.50</td>
<td>0.74</td>
<td>0.87</td>
</tr>
<tr>
<td>DS6</td>
<td>0.77</td>
<td>0.96</td>
<td>0.42</td>
</tr>
<tr>
<td>DS7</td>
<td>0.36</td>
<td>0.58</td>
<td>1.20</td>
</tr>
<tr>
<td>DS8</td>
<td>0.70</td>
<td>0.93</td>
<td>0.43</td>
</tr>
<tr>
<td>DS9</td>
<td>0.37</td>
<td>0.58</td>
<td>1.24</td>
</tr>
<tr>
<td>DS10</td>
<td>0.57</td>
<td>0.80</td>
<td>0.65</td>
</tr>
</tbody>
</table>
Converging process of MCGA, size = 50

S.P. Tseng
Itembank integration
Converging process of MCGA, size = 100
Conclusion

- This thesis focuses on how to integrate the heterogeneous itembanks into an integrated itembank with higher content richness for the e-assessment in the e-learning environment.

- The integrating method is based on the vector space model and improved by the weighted-content strategy and latent semantic indexing.

- The distinguishable ratio is from 75% to 90% in the integration of heterogeneous itembanks.

- In the accuracy tests, the accuracies of distinguishable items are very high, about 97% to 98% on average.
Conclusion

For the redundancy of the integrated itembank, we developed an effective GA-based test sheet assembling method, called MCGA.

For more information richness of the assessment feedback, we extended the itembank integrator to the content/item integrator with the ability of integrating the content from Internet, such as wikis and blogs.

The works are restricted in the descriptive courses, like ”Society” and ”Nature”.

S.P. Tseng
Itembank integration
A novel and independent schema should be automatically generated to integrate the contents of the collected itembanks.

The sequence in the textbook schema should be considered for the different applications.

We try to use the multi-objective optimization to assemble the test sheet for more different test requirements.