SYSTEMATIZATION OF THE STROKE ORDER OF CHINESE CHARACTERS FOR FOREIGN STUDENTS

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In what stroke order do you write this character?

覧 = ↓B(→B(↓B(→B(↓B(→B(↓T(→T(→T(→T(→T)))))))))))

Background

Increase of the foreign students in Japan

KANJI = CHINESE CHARACTER
IS A BIGGEST BARRIER

• for their daily life: (about) 1000 char.
  Reading: it can be learn by books
  Writing: (the study of movement/order)

CAI SOFTWARE

Development of an Internet Kanji learning system
QUESTIONS for CAI SYSTEMS

- Does the stroke order have any effectiveness?
  - "HITUJUN SHIDO NO TEBIKI" (Guidebook of Stroke Order Education, published by the Ministry of Education)
    - Ease of writing
    - Legibility
    - Ease of learning
    - Traditions
  - already published (in Japan)

- Is there a meaning in learning all of 1000 character simply?
  - the order of AIUEO?
    - like ABC)
  - the order of stroke counts?
  - necessity of efficient method to learn

OUTLINE OF THIS STUDY

PURPOSE: SYSTEMATIZATION of stroke order
of Chinese character (for making a LEARNING COURSE)

METHOD: By making a NOTATION SYSTEM of the stroke order
(various purpose, using computer)

RESULTS: Some analytical DATA
of writing MOVEMENT and the ORDER
Decrease of learning quantity: 80% (predicted value)

CHARACTERISTICS:
- The notational system for multi-purpose
- Analytical data for the Chinese writing movements
Sample of the notation
(a character ‘E (hui, picture)’)

Level 6: \( \text{絵} = \rightarrow \text{E} (糸, 会) \)
Level 3: \( \text{絵} = \rightarrow \text{E} (糸, 会) \)
Level 2: \( \text{絵} = \rightarrow \text{E} (↓ \text{E} (幺, 小), 会) \)
Level 1: \( \text{絵} = \rightarrow \text{E} (↓ \text{E} (幺, \leftrightarrow (├, ハ)), \)
          \( ↓ \text{E} (人, 二, み)) \)
Level 0: \( \text{絵} = \rightarrow \text{E} (↓ \text{P} (く, く, く), \leftarrow (├, \rightarrow \text{P} (く, く)), ↓ \text{E} (H \rightarrow (く, く), \)
          \( ↓ \text{P} (←, ←) \rightarrow \text{T} (く, く))) \)

• The notations are unraveled automatically
• We can analyze by general tools such as SED

Sample of constructive factors
for the notation

(a) stroke patterns (15)

(b) elements (582)
• (character) 二口木日
• (radicals) し け み
• (original) く り ね く 主

(c) direction marks (14)
\( \downarrow \text{P} \): top to bottom (strokes.)
\( \rightarrow \text{E} \): left to right (elements)
\( \leftrightarrow \): outside to inside
\( \leftarrow \rightarrow \): inside to outside
\( \ ??? \): others
Analytical Results (1) **DIRECTION:** outermost direction marks

絵 = → E (↓ E (幺,小), 会)  

Analytical Results (1) **DIRECTION:** directions used in each level

- Many kinds of direction marks are used at L0-1.
- [left to right(e)]+[top to bottom(e)] are over 80% at L4-6.
- [left to right(e)] and [top to bottom(e)] are reversed between L3-4.
- Elements increase, parts decrease about [top to bottom] between L2-3.

Thus, if a student studies elements from Level0-2 and knows that the orders over level3 are usually [left to right] and [top to bottom], then this knowledge is adaptable to nearly any character.
Analytical Results (1) **DIRECTION:**
directions used in each level

**example:** 「朗」

**Level 0:** 朗 = \( \rightarrow \text{E (丶, 々 (丷, 临, 临, 临, 临))} \)

**Level 4:** 朗 = \( \rightarrow \text{E (良, 月)} \)

**Level 0:** 二 = \( \downarrow \text{P (丷, 临)} \)

**Level 1:** 月 = \( \rightarrow \leftarrow (丷, 二) \)

**Level 2:** 良 = \( \downarrow \text{E (丶, 良)} \)

**Level 3:** 良 = \( \downarrow \text{E (丶, 良)} \)

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Analytical Results (2) **MOVEMENT:**
combinations of stroke patterns

<table>
<thead>
<tr>
<th>Number of stroke patterns</th>
<th>2932</th>
<th>2941</th>
<th>1317</th>
<th>934</th>
<th>861</th>
<th>629</th>
<th>238</th>
<th>154</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement combinations</td>
<td>93</td>
<td>74</td>
<td>62</td>
<td>34</td>
<td>27</td>
<td>23</td>
<td>14</td>
<td>7892</td>
</tr>
</tbody>
</table>

*counts (total: 7892)*
Analytical Results (2)  MOVEMENT: Z type and + type

Analytical Results (2)  MOVEMENT: A hypothesis from Z type movement

We have not yet verified this enough.
Procedure of learning course

Priority: frequency in use of elements
- low level to high level
  - priority: same elements
  - priority: same rule(direction)

Learning quantity (predicted value)

<table>
<thead>
<tr>
<th>systematic</th>
<th>overlap</th>
<th>Learning quantity</th>
<th>decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>removing</td>
<td>Character</td>
<td>Elements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Counts</td>
<td>bytes</td>
</tr>
<tr>
<td>non-systematic</td>
<td>non</td>
<td>1,006</td>
<td>79,870</td>
</tr>
<tr>
<td></td>
<td>Existed</td>
<td>1,006</td>
<td>27,927</td>
</tr>
<tr>
<td></td>
<td>Existed</td>
<td>1,006</td>
<td>56,810</td>
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<tr>
<td></td>
<td>Original</td>
<td>1,006</td>
<td>48,543</td>
</tr>
<tr>
<td>systematic</td>
<td>all</td>
<td>1,006</td>
<td>9,976</td>
</tr>
</tbody>
</table>

why this is predicted value:
- Learners acquire the same rule by learning it repeatedly.
- Learners has an ability to arrange the knowledge which he or she has already learned and also an ability to apply it to other characters.
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