電子閱讀測試：PISA處理國際之間
閱讀理解比較的取向

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摘 要

本文旨在記敘「澳門PISA中心」如何為澳門十五歲中學生籌備電子閱讀測試。首先闡述資訊新世代終身學習所衍生的閱讀素養概念；其次陳述閱讀素養評核架構，這架構突顯了在課室環境中培養的閱讀素養，當中涉及與資訊通訊科技密切相關的關鍵能力，並特別回應OECD「DeSeCo」計劃（即「關鍵能力的定義和選擇」計劃）。最後，本文演示如何設計電子閱讀素養測試題目，繼而將這些題目組合成評核任務，再發展為個別化電子測試平台。

關鍵詞：電子評核、閱讀素養、終身學習
Abstract

This paper seeks to document how Macau-PISA Center prepares for electronic assessment of reading literacy for the 15-year-old students in secondary schools in Macao. First, emerging concepts of reading literacy with regard to life-long learning for our next generation in the digital age is elucidated. Second, the Reading Literacy Assessment Framework, a response to the OECD "DeSeCo Project" (i.e. Definition and Selection of Key Competences) to include the ICT (Information and Communication Technology) components as key competences, is presented so as to highlight the constructs assessed and nourished in the classrooms. Third, the paper demonstrates how test items and assessment tasks for electronic assessment of reading literacy can be designed, and subsequently developed into an individualized computerized testing platform.

Keywords: e-assessment, reading literacy, life-long learning
DELINEATION OF KEY COMPETENCIES FOR LIFE-LONG LEARNING

In past decades, OECD collaborated with a wide range of scholars, experts and institutions to identify a small set of competencies that help individuals and whole societies to meet life-long learning goals. There are three broad categories identified in the Definition and Selection of Key Competencies (DeSeCo) Project: (1) Use tools interactively, i.e. deploying both physical tools such as information technology and socio-cultural tools such as language to interact with their environment; (2) Interact in heterogeneous groups, i.e. engaging with others from a range of backgrounds in an increasingly interdependent world; and (3) act autonomously, i.e. taking responsibility for managing one’s own lives in relation to a broader social context (OECD, 2003). The first category demands extension of the concept of linguistic literacy from print texts to electronic media. The second category addresses web-based learning technologies encouraging students to participate and interact in virtual environments, and these interactions may involve homogeneous (e.g. intranet communications within schools) or heterogeneous groupings (e.g. BLOG or discussion groups on the web). The third category reiterates that learning through ICT autonomously is a valuable educational goal, and a cook-book approach to the design of learning tasks is to be banished. The proposed electronic reading literacy assessment framework elucidated in this paper is anchored on the realization of the three key competencies for 15-year-olds in Macao and worldwide (OECD, 2006).

PISA DEFINITION OF PRINT-BASED READING LITERACY

Central to the PISA approach in the assessment of reading comprehension is the definition of reading literacy. Coiro (2003), amongst others, has urged for a broader model of reading comprehension with more comprehensive understanding of texts, reading activities, readers, and the social contexts. According to PISA, reading literacy is an individual’s capacity to understand, use and reflect on written texts, in order to achieve one’s goals, to develop one’s knowledge and potential and to participate in society (OECD, 2006). Reading literacy is assessed in relation to: (1) text format (i.e. continuous versus non-continuous texts of one of the following five types: description, narration, exposition, argumentation and instruction); (2) situations (i.e. reading for...
work, for education, for private and public use); and (3) aspects of the reading processes (i.e. retrieving information, forming a broad general understanding, developing an interpretation, reflecting on the contents and formal qualities of a text; see Figure 1 for the five inter-related aspects of print-based reading literacy). This definition goes beyond the basic skills of word recognition, phonemic awareness, decoding and comprehension, and it requires the reader to be an active and reflective user of texts so as to expand one’s knowledge and potentials. In a nutshell, one has to understand, apply, integrate and synthesize texts to fulfill one’s life-long learning goals.

**FIGURE 1**
The five aspects of print-based reading literacy

<table>
<thead>
<tr>
<th>Reading Literacy</th>
<th>Use information primarily from within the text</th>
<th>Draw upon outside knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on independent parts of the text</td>
<td>Focus on relationships within the text</td>
<td>Focus on content</td>
</tr>
<tr>
<td>Whole text</td>
<td>Relationships among parts of text</td>
<td>Focus on structure</td>
</tr>
<tr>
<td>Retrieve information</td>
<td>Form a broad understanding</td>
<td>Reflect on and evaluate content of text</td>
</tr>
<tr>
<td></td>
<td>Develop an interpretation</td>
<td>Reflect on and evaluate form of text</td>
</tr>
</tbody>
</table>

**PRINT VERSUS ELECTRONIC MEDIUM FOR READING LITERACY ASSESSMENT**

Electronic reading literacy is increasingly prevalent in nowadays knowledge society. As early as in the late 1990s, Labbo (1999) has demonstrated a viable approach for the formative assessment of reading comprehension by computer. At the turn of the century, PISA recognizes this trend and has integrated the reading of electronic texts into the PISA 2009 Reading Assessment Framework (OECD, 2007). The Electronic Reading Assessment (ERA) is thus an innovative project aiming at assessing the reading literacy of 15-year-olds using electronic texts. Specifically, ERA is planned as a 45-minute test.
using existing school ICT infrastructure. For the purposes of PISA 2009, the reading literacy assessment framework confines the definition of electronic texts to hypertexts in a computer-based environment. Hypertexts are texts with access structures that necessitate non-linear reading and text searching using search engines. The five aspects of print-based reading literacy need to be adjusted to reflect the fundamental difference between print-based and electronic media reading literacy. Figure 2 and 3 show the differing relationship between task, text and aspects in the print and electronic medium respectively.

In the print medium, the reading tasks are fixed texts with clearly defined boundaries, and what students do during reading are of three main aspects: (1) access and retrieve information; (2) integrate and interpret texts; and (3) reflect and evaluate (see Figure 2). In the electronic medium, while the three aspects remain the same, the reading tasks generally necessitate students to identify important questions, locate information which match the access structure of the reading tasks, analyze the usefulness of the information retrieved, integrate information retrieved from multiple texts to answer questions, and then communicate replies through electronic means. As such, the electronic texts come across by the students are dynamic with blurred boundaries (see Figure 3).

**FIGURE 2**

Relationship between task, text and aspects in the print medium
In the PISA 2009 Field Trial, electronic reading was incorporated into the reading assessment framework alongside print reading. Relationships between electronic text processing and navigation skills are needed to be examined before one can decide appropriate methods of constructing and analysing electronic reading tasks (see Cheung, et al., 2007 for the preparation of Macao’s ERA Field Trial; see Omar, Higgins, & Harrison, 2005 for a distinction of off-line and on-line reading comprehension; see also Gyöngyvér & Csapó, 2008 for a comparison of online adaptive versus paper-pencil testing).
ERA FIELD TRIAL ADAPTATION, TRANSLATION AND VERIFICATION

In the PISA 2009 ERA Field Trial, item units were released and bundled for online review by participating countries. McQueen & Mendelovits (2003) have written on how cultural and linguistic equivalence can be ensured in this reviewing process. The criteria for electronic item review include: (1) relevance for 15-year-olds; (2) sensitivity or bias problems; (3) translation problems; (4) comments on coding guides; (5) priority for inclusion; and (6) appropriate level of ICT demand. Unlike the print-based assessment, the source version of the test units was in English only (i.e. there is no French version). In this field trial, a total of 13 test units have been prepared, and these need to be translated into Chinese for use by 15-year-olds in Macao.

All ERA materials (i.e. the field trial test units, the two practice units and the Effort Thermometer survey) are required to be adapted and/or translated into the language of instruction for the reading domain in the participating countries/economies (see Figure 4 for the ERA adaptation, translation and verification process). This is consistent with the print-based PISA assessment practice and with the goal to assess reading literacy in the language of instruction. As text segments in a test unit that are repeated from earlier ones are automatically recognized by the translation editor, the total file translation load (stimulus and tasks) is considerably less. Adaptations to the English source version of test units are recorded in the ERA Adaptation Spreadsheet (EAS). Any additional adaptations that the participating countries/economies wish to make are recorded in the EAS. The EAS is reviewed after reconciliation, but before verification, so that any key corrections that are necessary can be incorporated at the verification stage. There will be a separate EAS for each test unit for each language of assessment.

In order to facilitate the ERA adaptation, translation and verification process, the
online Translation Management System (TMS) includes the National Project Manager (NPM) interface that allows the NPM to track the progress of test units through the adaptation, translation and verification process. There are separate accounts for Translator, Reconciler, Verification personnel, and NPM for logging in the TMS. It is noteworthy that ERA stimulus and tasks can only be amended via the TMS. It follows that translators, reconcilers, verifiers and NPM in all participating countries/economies are required to become familiar with the use of the TMS and the translation of XLIFF files – text files composing both the contents and layout of the web pages. Translators and reconcilers need to use translation editing software (e.g. Trados Translator’s Workbench and open-source translation editor) that supports translation of XLIFF files. As such, TMS has been designed to produce XLIFF files that are compatible with these translation editors.

**FIGURE 4**

A flowchart showing the steps in the ERA Field Trial adaptation, translation and verification process (for Macao-China)

- Source versions (in English; with corresponding adaptation spreadsheets -- EAS)
- Translation 1 (into Chinese by the Macao-ERA research team)
- Translation 2 (into Chinese by the Hong Kong-China ERA research team)
- Reconciliation (of the two translated versions against the original source versions)
- Review of adaptations by translation referee; establish key corrections for Macao-China ERA research team
- Verification and key corrections by NPM of Macau-PISA Centre
- Format and layout check of ERA test units at ACER
- Final check by NPM of Macau-PISA Centre
DESIGN OF COMPUTER-BASED ASSESSMENT DELIVERY SYSTEM

An item template incorporating a simulated browser has been designed by Australian Council for Educational Research (ACER) to facilitate test item development. In the actual ERA option of the PISA 2009 Study, the majority of the items are multiple-choice questions, or questions which require closed responses (e.g. copy-and-paste, drag-and-drop, and clicking on an element of a list or menu) that will be automatically scored by the test delivery software. About one-third of the items require open constructed responses that need coding by reading experts. Software is developed to enable this coding to be done online over the Internet. There is no need for PISA Centre to scan and clean the responses. ERA is administered after the main PISA print-based session. Student’s test responses are communicated to ACER via Internet. For the ERA Field Trial, five 15-minute test units (i.e. clusters of items) are developed. These are arranged into five electronic forms (i.e. AB, BC, CD, DE, EA), so that each cluster appears first in one form and second in another form.

Question Intent is a classification made according to the aspects for both print and electronic reading: (1) Access and retrieval; (2) Integration and interpretation; and (3) Reflection and evaluation. Other than aspect, classification elements for each ERA item are: (1) Environment (authored or message-based); (2) Situation; (3) Text type; (4) Text feature; (5) Item format; and (6) Navigation tools and features. The Full/Partial/No Credit description of the open constructed items follows the format adopted for print-based reading, first with a general description, and then with some examples of student responses. Both units and cluster of items within units are delivered in a fixed order, or the so-called ‘lockstep’ fashion. The lockstep procedure means that the student will not be able to return to an item or unit once they have moved to the next item/unit. Each time the student clicks the next button on the test a dialog box will display a warning. The student is informed about to move on to the next item and it will not be possible to return to the previous item. This approach enables test developers to specify the starting page for each item. In this way, all students begin in the same place within the stimulus and, if they have navigated through a series of less relevant pages, do not have to find their way back to begin the item task. In order that enough items should be administered there is a need to increase the duration of the ERA test to 40 minutes. Effectively, ERA assessment takes about one and a half hour, including tracking student participation, logging on the test delivery system and responding to the practice tests.

The TAO (French acronym for “Testing Assisté par Ordinateur”) computer-based assessment platform, developed by the Centre de Recherché Public (CRP): Henri Tudor
and the *Univeristé du Luxembourg*, is used to deliver ERA. TAO is a modular and versatile platform for collaborative and distributed computer-based assessment delivery and management (see Latour, et al., 2008 for the platform functionalities and architecture of TAO). TAO is an “open-source” development. ACER staffs, in collaboration with CRP Henri Tudor staff, are adapting TAO for use in the ERA (see Goldhammer, et al, 2008 for the item authoring process using ERA Hypertext-Builder which enables the rapid development of complex electronic reading stimuli such as websites, email clients and forums). The ERA is delivered on school computers via a USB flash drive or CD-ROM. In the test delivery interface, there is a time-bar at the top of the screen to show how much time in the testing session the student has left. Also, the question numbers change colour as the student has completed them. There is a *Help* button with general instructions about features of the system. Students are able to copy and paste and to use a *Find* function within a web-style page. The TAO system, once operational, will capture time taken for each response, and the pathways and links followed by the student within each item (see Figure 5 for the design features of the ERA delivery system interface). There is an intention to explore the possibility of scoring related to the precision and efficiency of students’ responses. In the appendix, a mock-up of a test unit entitled “Alan’s Story” is presented to illustrate what it is like when the test unit is delivered using TAO.

**FIGURE 5**

The ERA delivery system interface
To sum up, OECD requires that any computer-delivered assessment in PISA 2009 be implemented using existing school infrastructure. ERA is based on a test delivery system that runs off its own operating system so as to ensure that the test environment will be well controlled and students are not able to navigate to other programs outside of the test. Hence, all students will use the same Linux operating system and the same browser loaded from the bootable CD/USB. This way they will receive a similar testing experience. Using a bootable medium also prevents students from accessing other resources stored on their computers and ensures that the security of the test materials by preventing their copying elsewhere. In addition, it avoids problems associated with internet use such as inadequate upload/download speeds and bandwidths, computer security settings, as well as local and system-wide firewalls. For the technically-minded, the test items are bundled together on a CD/USB with a Linux-based operating system, a TAO assessment platform and a Mozilla Firefox web browser for viewing the TAO interface. Flash media player is included to enable the viewing of the stimulus material and student responses are stored in RAM during the test and written to a USB stick at the conclusion of the test. For security reasons, each CD/USB, not altered during the test, must be recovered at the conclusion of an ERA session. It can be re-used in a subsequent session.

PROBLEMS IDENTIFIED IN MACAO-CHINA PISA 2009 FIELD TRIAL

During the Macao-China PISA 2009 Field Trial, a number of problems were encountered when students were responding to the ERA assessment system. These problems are summarized in Table 1 below.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boot Failure</td>
<td>CD boot problem – Non-recognition of ICT hardware/software by the delivery system. This is because of unusual hardware configurations, or the hardware drivers for the very recent models have not yet been incorporated into the version of Linux being used.</td>
</tr>
<tr>
<td>USB Failure</td>
<td>USB port recognition problem – Another hardware recognition problem occasionally experienced is associated with the recognition of the USB port. Wider range of hardware drivers compatible with updated version of Linux is needed.</td>
</tr>
</tbody>
</table>
TABLE 1 (Continued)
Problems identified in Macao-China PISA 2009 Field Trial

<table>
<thead>
<tr>
<th>Problem</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect Screen</td>
<td>Video graphics card recognition problem – When not recognized, the screen display of the monitor defaulted to the lowest resolution. Where this is under 1024 x 768 pixels, the problem causes the interface to appear larger than the screen size of the display monitor. Students need to scroll horizontally and vertically in order to view the items and assessment tasks.</td>
</tr>
<tr>
<td>Browser Failure</td>
<td>Browser crash problem – Caused by insufficient computer resources, the ERA delivery system, displayed via a web browser program called “Iceweasel”, crashes and no results are written to the USB stick. The student is returned to the login page.</td>
</tr>
<tr>
<td>Software Freezing</td>
<td>Delivery system display problem – The confirmation dialog image is not displayed but the functionality still exists. This problem happens after the student clicks the Next arrow and the interface becomes covered with a translucent pink pane.</td>
</tr>
<tr>
<td>Data Collection Failures</td>
<td>Data lost due to freezing and crashing – In cases where such problems occur, all collected student data are lost. All data from previous units should have been saved even if the student is unable to finish the test. In the Main Study, data will be written to the USB after the completion of each test unit.</td>
</tr>
</tbody>
</table>

To rectify these problems for the forthcoming Main Study, ACER proposes that a performance diagnostic test comprising two parts – i.e. a memory diagnostic and a processing diagnostic – should be conducted. The memory diagnostic is implemented when the delivery system boots and it determines whether the computer has enough memory to run the test. The processing diagnostic advises if the computer’s processing speed is less than optimal in order to run the ERA assessment. If both tests are passed the system will proceed directly to the login page. In addition, these diagnostic tools will test for driver recognition, memory capacity, processing speed and resolution support, as well as providing information on whether it is necessary to reconfigure boot settings on the computers.

ON-LINE CODING OF ERA RESPONSE DATA

About one-third of the items are open-ended. These response data require expert coding that may be facilitated with an online coding system. After submission of the ERA raw response data, the open response data will be compiled at ACER. Coders log in the on-line coding system and receive an allocation of responses for coding by their
coding supervisor in accordance with a pre-set coding guide. This practice eliminates the need for separate data entry and cleaning. Headed by the National Project Manager, the composition of the coding team comprises Coding Supervisor, Leading Coder and a team of trained coders (see Figure 6 for the personnel requirements and functionalities of the coding team). Specifically, the Coding Supervisor is responsible for organizing and managing the ERA coding operation, arranging and conducting coder training, allocating coding jobs and monitoring overall progress. Leading Coder should possess subject matter expertise, coding experience, and good computer literacy skills. Apart from being one of the assigned coder, he/she can review codes raised by coders during coding and check coding done by coders 2, 3, 4 etc.

**FIGURE 6.**

Personnel requirements and functionalities of the coding team

<table>
<thead>
<tr>
<th>National Project Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominate coding team members</td>
</tr>
<tr>
<td>Obtain coding reports</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coding Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assign coders and allocating coding jobs</td>
</tr>
<tr>
<td>Review codes raised by coders during coding</td>
</tr>
<tr>
<td>Check coding done by coders</td>
</tr>
<tr>
<td>Obtain coding reports</td>
</tr>
<tr>
<td>Code responses / View items (If needed)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leading Coder (Coder 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review codes raised by coders during coding</td>
</tr>
<tr>
<td>Check coding done by coders 2, 3, 4 …</td>
</tr>
<tr>
<td>Code responses / View items</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coder 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code responses / View items</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coder 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code responses / View items</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coder 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code responses / View items</td>
</tr>
</tbody>
</table>
SUMMARY

Electronic assessment of reading literacy across countries/economies is a new research agenda in PISA studies. Macao is the first economy in the Chinese-speaking communities participated in the ERA option of the PISA 2009 Reading Literacy Study. This paper documents key concepts and vital logistics in the successful implementation of the field trial of the literacy study. The first three sections of the paper delineates the print and electronic reading assessment framework and the associated constructs on which ERA test items are designed for the assessment of 15-year-olds in the participating countries/economies. The next three sections proceed to describe the process of item adaptation, translation and verification, as well as issues pertinent to the design of the computer-based assessment delivery system. As this was the first time participating countries/economies trialled out ERA assessment, there are a number of problems which had to be addressed in preparation for the main study. Problems identified in Macao are also similarly encountered in other countries/economies. The last section of the paper outlines a strategy of online coding of ERA response data. Scaling of ERA coded response data ensues and this will be reported in another paper in the future.

ACKNOWLEDGMENTS

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REFERENCES


APPENDIX

A mock-up of a test unit “Alan's Story” comprising Task 2.1-2.6 using the TAO delivery platform (alongside question intent, access paths and scoring guides)

Task 2.1

Why did Alan play several games only?

- A. The other games were quite boring.
- B. Museum was quite large.
- C. He did not have enough time.
- D. He spent a lot of time exploring other games.

Question Intent: Access and Retrieval

Access paths:

Access Wonderful Toys in Alan’s BLOG to retrieve the correct answer to the multiple choice question.

Task 2.1 Scoring Guide:
Code 1: C. He did not have enough time.
Code 0: Other response.
Task 2.2

Do you think Alan will visit the Toy Museum again?
Please provide reasons for your choice.

Question Intent: Reflection and Evaluation

Access paths:
Access Wonderful Toys in Alan’s BLOG to reflect and then to provide a plausible answer to whether visiting the said museum a second time.

Task 2.2 Scoring Guide:
Code 2: Yes – Alan would like to play some other games. He remarked that it was a pity that he had played several games only.
Code 1: Yes – Alan mentioned that it was an exciting and joyful experience, and he had a great time there.
Code 0: No – Alan does not have time.
Task 2.3

[Start at the Email homepage]

Start from "Inbox" and read the mail sent from the online toyshop. Then click the embedded hyperlink to confirm the purchase order form sent earlier by Alan to the toyshop. In your confirmation reply on behalf of Alan, make sure that the data is correct. You can use Alan's data that may be referred to in his e-mail account. After correcting the erroneous data, click "Confirmation" for confirmation reply.

Question Intent: Access and Retrieval

Access paths and actions:
Send a confirmation reply integrating information assessed from two sources (i.e. purchase order form, Alan's profile information that may be accessed in his e-mail account); Locate three items (Email sent from toyshop, purchase order form, Alan's e-mail account) by clicking a series of links in order.

Task 2.3 Scoring Guide:
Code 2: For correcting two pieces of incorrect data (i.e. mailing address, surname) in the confirmation order form;
Code 1: For correcting one piece of erroneous data;
Code 0: For inaccurate or incomplete data persists after correction.
Task 2.4

Explain the feeling(s) of Alan for shopping online.

Question Intent: Integration and Interpretation

Access paths:
Make an interpretation of the feelings expressed in Mixed Feelings in Alan’s BLOG so as to provide a plausible answer for shopping online.

Task 2.4 Scoring Guide:
Code 2: Mixed feelings (Toy is available. Price a bit high but still affordable, but need to pay first)
Code 1: Contended because toy is available and price is high but still affordable/ Worried because need to pay money first
Code 0: Other response.
Task 2.5

What is the Email address of the toy museum suggested by Michelle? Copy the Email address into the text box below.

Question Intent: Access and Retrieval

Access paths and actions:
Access Macao Toy Museum web site. Then click the “email us” hyperlink to access the Email address.

Task 2.5 Scoring Guide:
Code 2: Correct Email address.
toymuseum@pisa.macau.mo
Code 1: Email address with wrong spelling.
trymuseum@pisa.macau.mo
toymuseum@pisa.macau.mo
Code 0: Other response.
Task 2.6

Which of the **two** museums (the one visited by Alan and another one suggested by Michelle) would you prefer to visit? Why?

**Question Intent:** Reflection and Evaluation

**Access paths and actions:**
Access *Wonderful Toys* in Alan’s BLOG and/or the *Macao Toy Museum* website to reflect and evaluate one’s preference for visiting either museum.

**Task 2.6 Scoring Guide:**

**Code 1:** Some plausible answers targeted at the characteristics for either museum after *reflecting* on one’s personal experiences:
- **Singapore Toy Museum**
  - cartoon characters, dolls and puzzles
  - games related to favorite cartoon characters
- **Macao Toy Museum**
  - PISA award winning toy museum
  - toys dated back from 1900
  - games Lego, Wii games and working models made of cards
  - special exhibition or theme on display

**Code 0:** Zero credit for irrelevant characteristics and personal experiences quoted:
- **Singapore Toy Museum**
  - a number of full sets or series of toys collected since 1980 (0, zero credit point because collection in Macao Toy Museum is more comprehensive dated back from 1900)
- **Macao Toy Museum**
  - because I like toys very much (0, zero credit point because this is only a casual explanation)
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