DESIGNING AN ONLINE PD PROGRAM WITH 4C/ID FROM SCRATCH
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The original impetus for the design of our professional development (PD) program came from the first author’s interest in PD in general and what makes it effective. We begin our presentation with a brief explanation of the core literature that affected our thinking and then introduce the context in which and for which the PD program was designed. This is followed by a presentation of the steps we took to design our PD program with 4C/ID. For ease of reading, we split the design process into 15 distinct steps, each focusing on a major milestone in the design process and introducing the challenges we faced during the process. We finish the presentation with our reflections on the design process and final remarks.

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INTRODUCTION
Many university English language teachers (ELTs) employed on limited-term full-time and part-time contracts to teach mandatory English classes to freshmen and sophomores in Japan face two challenges: the obligation to teach between 13-16 hours per week on average and the pressure to conduct and publish research to stay competitive on the job market. While the activity of teaching is officially supported by initiatives under the faculty development policy (MEXT, 2008), the research part is assumed to be something that does not require formal support. This lack of support poses a particular challenge to early-career university ELTs in Japan as the requirements for such hires typically include a master’s degree in a language-related field but not necessarily a research track. For example, the institution of the first author tends to employ fresh graduates of MA TESOL courses with a background in teaching but little to no research experience. Nevertheless, new hires are required to publish an article in a peer-reviewed journal within the first two years of their employment to qualify for a contract extension. The authors of this paper designed a professional development (PD) program with the goal of assisting those teachers in developing the necessary skills to conduct and publish their first study.

IMPORTANT CONCEPTS
Professional development of teachers has been discussed in academic literature numerous times, and there is yet hardly an agreement on how to conceptualize the phenomenon (Boylan et al., 2018). In this study, PD refers specifically to that of university ELTs in Japan. Taking the context into consideration, we define PD as the process where university ELTs continuously learn about and improve the two primary functions of their job: teaching and research.

Our understanding of PD in higher education has evolved largely through the contributions of research into various faculty development (FD) initiatives. Steinert et al. (2016) succinctly summarized that research and produced a set of recommendations for future studies, one of which calls for more pedagogically rigorous approaches to the design of PD interventions for university teachers. We interpreted this call...
as an invitation to apply theories and concepts from the field of instructional design (ID) to the design of our PD program.

THE DESIGNERS
The PD program presented here was an undertaking of the three authors of this report. There was no involvement from the institution of the first author beyond giving permission to design and conduct the program and distributing the funds of an external grant procured for its development.

At the moment of writing this case, the first author was a Ph.D. candidate in Instructional Design at a Japanese university and also a full-time teacher at the institution this program was designed for. While hired on a limited-term contract, his contract conditions were different from those employed in the later years, making him immune to the publication requirements for a period of seven years. This provided him with ample time to conduct his research and reflect on the challenges it involved, which served as an additional motivation for this PD program.

The second and third authors were both accomplished researchers and specialists in ID. Their role in the project was that of supervisors and included such tasks as overseeing the design decisions made by the first author and ensuring the adequacy of the content of the program.

For ease of referencing, we will use “we” to refer to activities at least 2 of the three authors were involved in at some point during the design process. Where something was done solely by the first author, “the first author” will be used instead.

CONTEXT AND REASONS FOR THE PROGRAM
The institution of the first author typically hires 2-4 new ELTs on limited-term full-time contracts and a larger number of teachers on limited-term part-time contracts every year. The main requirements for new hires are that they possess a master’s degree in TESOL or related fields and be native or near-native speakers of English. For full-time contracts, having something published in a peer-reviewed journal is a plus, but not a requirement. In the experience of the first author, the typical new hire tends to be a native English speaker with a recently obtained MA degree in TESOL and little to no research track.

Despite this fact, all newly hired full-time teachers must conduct and publish their research in a peer-reviewed journal within the first 2 years of their employment to qualify for a contract extension. So far there have only been two types of support provided to them. First, the teachers are offered an opportunity to submit a proposal and later a draft of their research project to the in-house journal review committee. By doing so, they receive feedback that helps them develop their research project into a publishable paper. The second type of support comes in the form of informal conversations with more experienced peers, which teachers are free to seek.

Despite being a valuable source of support, the feedback loop from the in-house journal review committee occurs a limited number of times over the year. Furthermore, being part of a formal review process means the feedback on both the proposal and subsequent article drafts focuses on the content rather than the process of doing research. The challenges the researcher may be facing while conducting research are rarely, if at all, addressed.

On the other hand, informal support from more competent peers may address some of the process-related issues but is subject to other teachers’ availability. More experienced peers tend to be equally busy doing research to meet their own contractual obligations or looking for new jobs as their contracts approach expiration.

THE GOAL
The main goal of the designed PD program was to provide a structured learning environment that helps newly hired full-time and part-time ELTs at the University of the first author to develop the core skills they would need to take their own research from start to finish: from inferring research ideas from their environment, interests, and relevant literature to producing a valid research question, from designing a study to taking the necessary steps to complete it, from choosing the right outlet for publication to ultimately publishing their work.

Since the program was meant to be taken during participants’ free time and at their own pace, the authors opted for online delivery of the program via Moodle, with which they had already been familiar.

THE DESIGN MODEL
The major initial challenge in the choice of a suitable design model pertained to the fact that this PD program was to become a core part of the first author’s Ph.D. thesis. It meant that there had to be a literature-driven rationale behind the choice of the model. Since the literature describing the elements of effective PD and FD interventions already existed (Desimone, 2009; Desimone et al., 2002; Garet et al., 2001; Steinert et al., 2016), the first author wanted the chosen ID model to address many, if not all, of those elements.

To find such a model, the first author compared the design principles of various ID models (Merriënboer, 2019; Merrill, 2009; Reigeluth et al., 2016) with the elements of effective PD (Desimone, 2009; Desimone et al., 2002; Garet et al., 2001). The second and third authors served as advisors at this stage, guiding the first author toward relevant literature and confirming his understanding of the reviewed models. After
numerous discussions, 4C/ID was chosen for its accurate reflection of the elements of effective PD and FD, its strong research backing and its being an underutilized model in the field of PD.

4C/ID and the Main Design Challenge

As the name implies, 4C/ID consists of 4 components: learning tasks, supportive information, procedural information, and part-task practice (Merriënboer, 2019). 4C/ID is a model of design that has significantly grown in complexity since its first appearance in English-language publications in the 90s (Merriënboer et al., 1992) by incorporating findings from various strands of research, notably those of cognitive load theory (Paas & Merriënboer, 1994) and self-directed learning (Merriënboer & Sluijsmans, 2009).

We already knew that there was no literature in English explaining how 4C/ID had been previously used to design PD interventions for university teachers. As we continued our literature review, we also discovered that only a small number of examples of 4C/ID implementation (Daniel et al., 2018; Susilo et al., 2013) or application (Frerejean et al., 2019; Maddens et al., 2020; Marcellis et al., 2018; Vandewaetere et al., 2015) was available to reference when we started this project in 2020.

Besides these articles, our go-to reference for 4C/ID was the manual created by the authors of the model (Merriënboer & Kirschner, 2017). However, we found it to be written in a manner that prioritized the depth of understanding of the model over the practical utility of the manual as such. In addition to, or perhaps as a result of the focus on completeness, the manual did not make clear the “triggers” (Verstegen et al., 2006) at which previously designed artifacts, and which artifacts, may have needed to be changed during the design process. This necessitated experimentation and learning-by-doing approaches being employed when designing our PD program.

Due to the expected complexity of the design process and the need to ensure the core principles of the model were properly instantiated, we decided to document our thinking, observations, materials used, and interim design artifacts created. OneNote was chosen for this purpose for several reasons. First, it enabled the creation and storage of the previously mentioned information in an organized manner. Second, it offered collaboration functionality and a unique “infinite canvas” feature. The former was essential due to this project being a collaborative undertaking. The latter enabled large amounts of information to be visually organized in a manner that assisted in processing it. We did not see it as an opportunity to present our work as a design case at that time, but it is these logs that eventually became the foundation of this paper.

DESIGN PROCESS PRESENTATION

The presentation of the design process in the next section is a result of two activities: detailed documentation of the design process of the program in note-taking software called OneNote and subsequent reflection on that process. The documentation process helped to highlight and identify the interim design artifacts that were produced along the way and what informed their design. The reflection part assisted in the analytical processing of our experiences designing with 4C/ID and in converting the complicated process of referencing the Ten Steps manual (Merriënboer & Kirschner, 2017) and other relevant published papers to clearly defined design events each of which revolves around those interim design artifacts.

In this article, we hope to offer a vicarious experience of designing with 4C/ID to the reader. We do so by splitting the design process into 15 design events, referred to as steps, that center on concrete interim design artifacts. Interim design artifacts are often used as a source of inspiration or a stepping stone for the final design product but are rarely reported in the literature. We feel their presentation offers an important insight into how the final product comes together. We accompany their presentation with the rationale behind each step that highlights the challenges we faced and the solutions devised.

OVERVIEW OF THE DESIGN PROCESS

We split the design process into 15 steps:

1. Creating a competence framework to identify expert performance.
2. Creating complexity descriptors.
4. Creating a skill hierarchy.
5. Creating an outline of learning tasks.
6. Defining what skills can be drilled and what can not.
7. Creating performance objectives.
8. Creating assessment tools.
9. Drafting a worked example.
10. Finalizing support levels of the learning tasks.
11. Drafting supported tasks.
12. Aligning assessment tools and performance objectives with the demands of the learning tasks.
13. Creating supportive and procedural information.
14. Choosing the presentation flow of the supportive/procedural information.
15. Putting it all together.

The presentation for each step consists of a rationale for it and a brief description of what the authors did, supplemented with examples of relevant design artifacts.
1. Creating a Competence Framework to Identify Expert Performance

In the beginning, the first author was largely working alone on this design case. The main challenge at this stage was his lack of experience with and knowledge of the research process, which made it difficult to create a learning task without additional input. Believing that a more solid grounding in the theory of doing research was necessary before a valid learning task could be created, he analyzed a range of literature describing researcher competencies from other fields, examples of those competencies, and textbooks describing the research process in general. He then compared and contrasted items from the discovered frameworks and inferred missing competencies and skills from sources dedicated to the subject of conducting research in social sciences.

As a result of this process, the first author created a researcher competence framework (see Figure 1), a list of competencies structured in accordance with Bloom’s Revised Taxonomy (Anderson & Krathwohl, 2000). Completing this interim design artifact provided him with an overview of the skills involved in doing research and a general understanding of what learning tasks would have to include.

2. Creating Complexity Descriptors

According to 4C/ID, learning tasks must belong to task classes (Merriënboer & Kirschner, 2017, p. 12). Each task class corresponds to a complexity level, with complexity defined as the intrinsic “difficulty” of the task (versus the extrinsic difficulty of the task, which is perceived differently by each learner depending on their prior knowledge, experience, etc.; Merriënboer & Kirschner, 2017, p. 16). Complexity can be operationalized in many ways: the amount of knowledge necessary to perform the task, interaction between skills, necessity for specialized tools, etc. etc.

The initial investigation of relevant literature in the previous step revealed another design challenge: the great variety of scopes and types of research projects. Since the expected level of our participants was that of somebody with little to no research experience, it was logical to aim for training skills that would enable them to publish in smaller (such as in-house publications) journals. This meant it was important to define the target levels of complexity to avoid creating unnecessarily complex learning tasks.

Another impetus for defining complexity descriptors at this stage was the fact that the research competence framework developed in the previous step was not sufficiently detailed to enable the creation of learning tasks that would accurately reflect the nature of “doing research.” Creating complexity descriptors was thus considered to be another important step toward designing authentic tasks.

To create the descriptors, the first author inferred what constituted expert researcher performance from articles produced by other successful researchers. He examined research literature in magazines and journals that university ELTs in Japan typically publish in. The analysis consisted of inductively inferring descriptors from the papers to produce a list of them (see Figure 2, next page) and then deductively applying the descriptors to other research papers in those publications to check their validity. The face validity of the descriptors was additionally checked by two experts, the third author of this paper and a third party, both with extensive experience in publishing, procuring research grants, and assisting other young researchers in their academic endeavors. In the process of discussing the descriptors, we naturally had different opinions about what constituted complexity in research but agreed that there was no one correct way to operationalize it. More importantly, we agreed the created descriptors were valid and sufficiently accurate.

3. Creating a Skill Hierarchy

A skill hierarchy is an outline of all skills necessary for the performance of the target skill and, consequently, of the learning tasks to be designed. While a skill hierarchy is primarily used for formulating performance objectives in later steps, the first author created it at this stage for the same reasons he created the complexity chart in the previous step: to further deepen his understanding of the research process and to give himself a better overview of the skills around which an authentic learning task could be designed.

The first author inferred the skill hierarchy from both the competence framework and complexity descriptors created in the previous steps as well as the examples of expert performance he examined to create the two. To distinguish the skill hierarchy from the competence framework, new information was added to later assist in the design of the learning tasks.

More specifically, all the skills necessary for the performance of the target skill were included and organized in a way that
Snippet of the complexity descriptors chart created in Step 2. The subcategory section presents the name of each descriptor followed by an explanation of its different complexity levels.

Snippet of the skill hierarchy created in Step 3. The hierarchical relationship between the skills is expressed from left to right where skills on the right side of the diagram enable the skills to their left. Orange boxes indicate the necessary knowledge for that skill branch with blue boxes containing the skills themselves. Several blue boxes were colored green to indicate recurrent skills in Step 6.

Snippet of the performance objectives created in Step 7. Besides the focus on “doing”, the objectives contain various conditions and quality standards for their performance.

Snippet of the assessment rubric created in Step 11. With the assessment items inferred from the performance objectives, the rubric criteria are slightly paraphrased versions of the source material. A simple scale was also added.

FIGURE 2. A collection of snippets of various design artifacts with arrows indicating the sequence in which each preceding design artifact informed the creation of the next.
highlighted the hierarchical relationship among them. To do so, the following questions were posed and answered: what skills are necessary to perform the target skill and what sub-skills are necessary to perform those skills, and so on? To avoid continuing the breakdown of the skills ad infinitum, the first author ended it with a skill unknown to the average target learner that is enabled by a skill or skills he expected the participants to know based on their educational background. Outlining the skill hierarchy in this fashion proved particularly helpful for creating the flow and content of the learning tasks in later steps (see Figure 2).

Creating the skill hierarchy prompted another reflection: skills and knowledge that enable those skills seemed inextricably connected. Indeed, most sources the first author reviewed did not draw clear lines between the two. While the 4C/ID model implies a clear distinction between process-related and knowledge-related information, with the latter not typically included in the skill hierarchy, it was evident from the reviewed literature that the “doing” and the “knowledge” parts equally informed the research process. It thus seemed logical from the design process perspective to include both in the skill hierarchy for completeness. To do so, the first author added boxes at the end of each skill branch (colored orange) that included information about theories and concepts necessary for the performance of the corresponding skills. Structuring a skill hierarchy in this manner proved to provide a more complete picture of the target skill than focusing solely on the skills alone (see Figure 2).

4. Creating a Guide for the Performance of the Entire Target Skill

A guide for the performance of the entire skill is a general step-by-step guide for what a learner will do from start to finish. We created such a guide because we felt it could serve two useful purposes. For potential learners, it could serve as part of supportive information (to be explained further later). For us as designers, it would help to define the general flow of all learning tasks in the intervention. With most of the work investigating the skills involved in the research process already completed, the first author inferred such a guide from the competence framework and complexity descriptors created in the previous two steps.

5. Creating an Outline of Learning Tasks

At this stage, the second and third authors stepped in as active designers of the program. Reflecting on the design artifacts produced by the first author so far, we realized creating even a single learning task for such a complex skill as conducting research would be a laborious process. We also knew there remained many 4C/ID design principles to attend to. To reduce the possibility of designing unnecessary learning tasks, we decided to make a tentative list of all the tasks we would have to create as well as the possible design elements within them.

6. Defining What Skills Can Be Drilled and What Cannot

Before we could formulate the performance objectives presented in the next step, it was necessary for us to identify which skills could or should be drilled (Merriënboer & Kirschner, 2017, p. 84). A skill is considered drillable if it consists of a clearly defined sequence of actions whose performance inevitably produces correct results. For example, researchers may have established routines for conducting certain research activities (perhaps, a mental list of items they refer to to check all the necessary steps have been taken when performing a statistical analysis), which can be taught and potentially automated. If learners systematically check themselves against those items, it can be counted as a skill of “self-monitoring”. On the other hand, skills that cannot be drilled are the ones that may have patterns in
performing the skill. A good worked example is a model that learners build the necessary schema for the process of a proficient practitioner performs the target skill to help. The purpose of a worked example is to introduce how important ways.

As can be seen from the two prior examples just discussed, the same skills can often be categorized as either drillable or non-drillable, and deciding which skills fall into which category will ultimately depend on the requirements of the training program.

In our PD program (see Figure 2), after deciding what skills should be drilled (called “recurrent skills” in 4C/ID) and what should not (called “non-recurrent skills”), we colored the drillable skills green to differentiate between the two types. In our case, only a handful of skills fell into the drillable category.

**7. Creating Performance Objectives**

After completing the categorization of skills, we proceeded to infer performance objectives from the skill hierarchy created in step 3. Following the suggestions for how performance objectives should be written (Merriënboer & Kirschner, 2017), we added information about the tools and objects required in the performance of these objectives and expected quality standards, be they value- or criterion-based.

In the earlier example (see Figure 2), the performance objectives are presented as rephrased skills from the skill hierarchy and are structured in the same manner: the objectives deeper in the hierarchy enable the objectives higher. The objective statements are phrased using action verbs from Bloom’s Revised Taxonomy (Anderson & Krathwohl, 2000) and include the tools and objects used in their performance as well as such standards as criteria, values, and attitudes.

We would also like to note that as we continued our design journey through steps 3-6, we naturally edited both the competence framework and the skill hierarchy considering new insights gained in the later steps. Step 7 being a derivative of the skill hierarchy required a particularly careful revision of the hierarchy. We made numerous refinements that we felt improved the overall design in subtle yet important ways.

**8. Drafting a Worked Example**

The purpose of a worked example is to introduce how a proficient practitioner performs the target skill to help learners build the necessary schema for the process of performing the skill. A good worked example is a model for the performance expected from the learners when they engage in the final task (a task where they receive no support and minimal to no scaffolding). It highlights heuristic decision-making and problem-solving processes, algorithmic procedures, the circumstances under which the target skill is performed, and natural challenges that practitioners face such as a sudden change of plans, conditions, et cetera.

Worked examples can be presented in visual, text, or any other format appropriate for the demonstration of the skill in question. In the case of visual demonstration, it can be a video of an expert performing the target skill narrated to explain what the expert is doing and why, if video demonstration is impossible or unnecessary, a narrative in text format can be used. In both cases, it is important not to only show what is being done, but why it is being done, what the expert is thinking, what challenges are being dealt with, and how.

The worked example in our case was for the skill of “conducting research”, which required several cognitive processes (reasoning, decision-making, problem-solving, etc.) to be highlighted. Influenced by the personal learning experience of reading detailed descriptions of research projects in anthropology (Bernard, 2006), the first author suggested the use of narratives to demonstrate the actions and the thinking of an expert researcher. We used two different published academic articles as a foundation for two narratives: one for a qualitative study and one for a quantitative study. The inductive process of creating the worked examples involved reading the two articles and writing a narrative explaining what a researcher had to do at each step of the process. Since published articles did not represent the full scope of activities involved in conducting a research project (e.g., the inception of a research question or the process of writing and preparing a manuscript for publication), additional content had to be “invented” by referring to the design artifacts from the previous steps and using our own experiences as researchers.

**9. Finalizing Support Levels of Learning Tasks**

According to 4C/ID, there should be a progression of difficulty from an easier to a more difficult learning task within each task class. The term “support” is used to describe the measures by which learning tasks are made easier or harder for the learner within the same task class (Merriënboer & Kirschner, 2017, p. 17). Support is commonly operationalized as the amount of the task that is already completed versus the amount of the task that learners need to complete on their own. On the most supported side of the spectrum, there are worked examples, and on the least supported side are conventional tasks where learners are given task conditions and are instructed to accomplish them on their own. The way support is provided in between these extremes constitutes another important design decision,
with such task types as reverse, imitation, non-specific goal, and completion tasks suggested by the authors of 4C/ID (Merriënboer & Kirschner, 2017).

We felt it was at this stage of the design process that we should decide how the tasks created in step 5 would be supported and if more tasks needed to be inserted in between to ensure support would fade away naturally. In our thinking about how support could be gradually removed, we settled on a combination of two approaches. The first approach included using two different task types called completion and imitation (Merriënboer & Kirschner, 2017), both explained in the next step in more detail. The second approach was the use of a technique called “emphasis manipulation” (focusing learners’ attention on specific parts of the overall task) to provide a gradual removal of support (see Figure 2). The use of this technique required not only a thorough understanding of its concept but also the boundaries of its application. To do so, the first author contacted one of the authors of the 4C/ID model to clarify our interpretation of the technique. As a result of this activity, the final support gradation was decided to be as follows:

• Most supported: Task 0 (2 worked examples)
• Tasks with reduced support: Completion tasks
  - Task 1: Learners have most of a well-written academic paper available to them. They must write a discussion section after analyzing the available parts of the paper.
  - Tasks 2 and 3: Learners have progressively less material available to them. They must finish the analysis and discussion sections (task 2) or collect and analyze data and finish the report (task 3).
• Tasks with reduced support: Imitation tasks
  - Task 4: Learners are provided with a model and are asked to conduct similar research in their own setting. The attention is drawn to the research design and the creation of research tools.
  - Task 5: Learners are provided with a model and are asked to conduct similar research in their own setting.
• No support: Conventional task
  - Task 6. Learners are told to conduct their own research at a similar level of complexity.

10. Drafting Supported Tasks

There are several types of supported tasks, some of which provide more support and some less. Beyond worked examples, the next level of reduced support is provided by completion tasks (tasks 1, 2, and 3).

Completion tasks are tasks where the learner has access to completed parts of the task and needs to complete the rest. We found two common ways to create such tasks: “fill-in-the-blanks” tasks where incomplete parts are inserted in key locations throughout the entire task and “missing parts” tasks where a learner has access to completed chunks of the entire task and is required to complete one or several other chunks. While we realized the former type offered more control to the designer over which aspects of the target skill need to be supported and, by extension, could provide more granular support to learners, we also felt it was unfeasible considering the size and complexity of the target skill.

Thankfully, in our case, the target skill “conducting research” could be represented with the use of a structural model with a location-in-time relationship (Merriënboer & Kirschner, 2017, p. 188), which means the performance of the skill can be split into distinct phases. This meant that an approach where the entire task is divided into chunks representing different research activities (e.g., collecting and analyzing relevant literature, producing a research design, creating research tools, etc.) could be used. These chunks could then be removed as necessary in different supported tasks: the less support is provided, the more of the chunks need to be completed by the learners themselves.

The goal of the first partially supported task was to prompt learners to study completed parts of a real research project and to finish a part of it by themselves. Specifically, the task leaves out the discussion section of a real academic paper and requires the learner to conduct appropriate operations to produce a discussion section. The task the authors designed in this phase provided the following information to the learner:

• A partially complete product: a real article the task is based on up to the discussion section (other parts of the article were edited as well: for example, the abstract is shortened to hide the conclusions of the original authors and the literature used in the discussion section is removed from the reference list)
• Conditions for task completion
• Guiding questions to help learners explore the available parts of the original article. These questions draw learners’ attention to the key parts of the paper, assisting in a more efficient analysis of the available information. They also prompt learners to imagine what the authors of the paper might have done in those situations to encourage the learners to think about the process of doing research rather than simply focusing on its outcome.
• Supportive information in the form of a heuristic step-by-step guide to writing a discussion section (designing supportive information is a separate step to be performed later, but we felt that designing parts of it in conjunction with the learning task would be more time-efficient).

11. Creating Assessment Tools

Flexibility and stability are two important qualities of an assessment tool in 4C/ID. Flexibility, as it is used by the authors of this paper, refers to the ease of adjusting assessment tools in accordance with the specifications of individual learning
Task: Introduction missing

Read the methodology, analysis, results and conclusion sections of the articles below (note: the article will NOT have the first 4 paragraphs that comprised the literature review and introduced the research question - these paragraphs are present in the example below for reference). Find relevant literature that can help build a convincing case for this study (no more than 10 sources) and formulate a fitting research question for this study.

Additional conditions/reflections:

- Document your literature search. Present the keywords and databases/search engines you used. What difficulties did you run into?
- Present the tools for searching and storing your sources you used.
- Present the techniques and tools (if any) you used to help you prepare the literature review
- Share your reflections on the process of performing the task

Supportive information

Use of reference managers (basic controls, organization structure)
SAP for writing literature review
SAP for search (boolean, quotes, wildcard*)
Typical structure of an introduction part in a paper
Video resource 1:
How to Write a Literature Review in 30 Minutes or Less
Video resource 2:
How to Write a Literature Review (UCD Writing Centre)
Video resource 3:
How to Write a Research Paper Introduction
Video resource 4:
How to Write a Good Literature Review

Guidance

Literature search
1. Download and install a reference manager (Zotero recommended)
2. Create a folder for your literature review
3. Identify your keywords
4. Input the keywords in a database search/search engine
   a. If too many relevant results
      i. Use booleans, quotation marks and wildcard
   b. If too few relevant results, try other keywords
      i. Infer new keywords from observed results
   c. Collect relevant references + abstracts using reference manager and a text editor (MSWord, etc.)
      i. Use browser plugin to collect relevant references + abstracts in reference manager

Literature review
1. Organize the discovered literature by Title and Abstract
2. Read the abstracts and select most relevant sources
3. Add detail to the most relevant sources if necessary (expand them to a summary level).
   a. Details include concepts, definitions, methodology and tools used, analysis procedures, key findings and author’s interpretation/opinions.
4. Organize the sources by theme (similarities/differences, cause-effect, problem/solution, chronological, spatial, temporal, effective/ineffective, etc.)
5. Highlight what the studies you’ve reviewed found
   a. Summarize relevant studies
   b. Critically evaluate studies that are particularly close to your research question for gaps in knowledge (findings, context, methodological gaps, etc.)
6. Connect your summaries and critical evaluation to your study and research question

12. Aligning Assessment Tools and Performance Objectives with the Demands of the Learning Tasks

4C/ID advocates that learning tasks drive the decisions of what skills are to be taught and what exactly is going to be assessed and at what level, and not the other way around as is typical in the design of traditional learning interventions (Merriënboer & Kirschner, 2017, p. 47). It is for this reason that we performed this step. Since we already had all the resources necessary to both create an assessment tool (previous step) and adjust it to the necessary complexity level, we performed this step simultaneously with the previous one.

Depending on what complexity level the designer is working on at the moment, different actions may need to be performed. For low complexity levels, the designer might have to remove certain elements from the skill hierarchy, objectives, and assessment tools (all three should be edited together to keep them consistent) to best reflect what is necessary for the performance at that level. For higher complexity levels, the opposite transformations may be necessary.

In our case, two factors necessitated the creation of simplified versions of the original assessment rubric.

First, we reviewed the worked examples to decide what skills needed to be taught and assessed at the lowest level of complexity. As a result, we produced a simplified assessment rubric by removing several performance objectives pertaining to skills that were not employed at the lowest complexity level.

Second, we considered the fact that we chose completion tasks to design various support levels in step 9 meant that learners needed to only perform necessary operations on the incomplete parts. Furthermore, the choice of emphasis manipulation for both completion and imitation tasks also meant that only certain parts of the later tasks were to be focused on. While the parts that were focused on in the preceding tasks would be repeated for additional practice and mastery, they did not need to be evaluated at the same level of detail. This meant we could remove several performance objectives unnecessary in the early tasks and combine several objectives into single ones in the later tasks for skills that no longer needed to be assessed precisely.

13. Creating Supportive and Procedural Information

In step 6, we identified what skills needed to be drilled. That distinction became necessary for designing supportive and procedural information. Supportive information is information necessary for the performance of the skills that cannot be drilled. Procedural information is information necessary for the performance of the skills that can be drilled. Both include two sub-types of information (Merriënboer & Kirschner, 2017, p. 48). First, knowledge-related information: mental models such as theories and conceptual models necessary for the performance of skills that cannot be drilled (supportive information) and basic concepts and facts necessary for the performance of rule-based skills that can be drilled (procedural information). Second, they include process-related information: cognitive strategies such as approaches to task-specific problem-solving (supportive information) and cognitive rules often presented as algorithmic step-by-step guides with “if-then” logic (procedural information).

At this point, we had a clear vision of what our learning tasks aimed to accomplish in terms of specific learning objectives.
The learner can
1. Produce a research question that addresses a real or theoretical problem, can be answered with available resources and is logically connected to relevant literature
   a. Identify a real or theoretical problem by either inferring one from available literature (noting the "gap") or by observing your own immediate environment.
   i. Infer contextual, methodological or theoretical gaps in the available literature to build a case for your study either by observing and reflecting on the existing issues, referring to the limitations/further research section or by analyzing the literature for those gaps
      1) Find relevant literature using keywords in academic databases and search engines, utilizing boolean operators and filters (date, etc.)
         a) Formulate search terms based on the purpose of the search (looking for theories, constructs, tools, methods, etc.)
         b) Evaluate discovered sources on the basis of publication date, publication type, journal reputation and on the basis of relevance (titles, abstracts, keywords)
         c) *Use boolean operators (AND, OR, quotes and wildcard) and filters to expand or narrow down the search output
         d) *Use reference managers (e.g., Zotero) to keep the discovered literature available for easy retrieval
      2) Compare contextual factors in the studies to your context using simple observations, own reflections and/or literature describing that context
      3) Contrast and compare the methodological approaches both between studies and with descriptions of those approaches in dedicated literature
      4) Look for missing knowledge (connections, correlations, causation, descriptions) to identify gaps in theory
   b. Create a logical connection between relevant literature and the research question by systematically analyzing and synthesizing it
      i. Analyze relevant literature efficiently (time) by using skimming/scanning techniques to look for relevant information
         1) Look for specific information in the title, abstracts and the full report (theories, concepts, constructs, operationalizations, definitions, outcomes, data collection tools, data analysis methods, etc.)

FIGURE 5. Example of a Process Related Guide.

and skills that learners would need to acquire to successfully achieve those objectives. We also knew that one of the core principles of 4C/ID was that necessary skills should not change, unless unavoidable for practical reasons, throughout the learning intervention. This meant we needed to design supportive and procedural information that would remain largely the same for all learning tasks of the same complexity level.

From our own professional practice, both as teachers and researchers and from our own learning experiences, we knew that in many fields, necessary knowledge-related supportive and procedural information could easily be found in textbooks and online resources. However, process-related information could often be difficult to obtain. This was clearly the case with our target skill. There were numerous free and paid resources explaining different components of conducting research, but none that would lay out the process of conducting research in a step-by-step and sufficiently detailed manner. We found literature that was inspirational to our own design, but none that would meet the criteria we previously described.

As a result, we chose to infer necessary process-related information from our worked examples. We identified areas in the performances of the experts in our examples that could be converted to pattern-like approaches to solving problems pertaining to the process of conducting research. A collection of such pattern-like approaches was made into step-by-step guides for learners (see Figure 5). We made sure that the process-related guides were phrased in a way that was adequately detailed to assist learners in the performance of relevant skills yet sufficiently general to be applicable to all the tasks in the task class.

At this stage, we also needed to decide how much of the knowledge-related and process-related information needed to be provided and how detailed they both needed to be.
Apart from reviewing the goals of the PD program, we also considered the expected level of the participants of the program. In our case, that level was of an MA TESOL graduate. Due to the fact that there was no uniform description of what such graduates were supposed to know, with that knowledge differing depending on the institution and course they graduated from, the first author of this paper used his own experience as an early-career researcher and conversations with more experienced colleagues, including those participating in the hiring processes at his institution, to identify what minimum knowledge he could expect from potential participants. He then added this information to the orange boxes in the skill hierarchy (see Figure 2) and chose several open educational resources that covered necessary concepts and theories.

14. Choosing the Presentation Flow of the Supportive and Procedural Information

In principle, 4C/ID advocates that supportive information is presented before learners attempt to perform target skills, and procedural information is provided on demand and during the performance of the skills as necessary (Merrienboer, 2019, pp. 5–7). Furthermore, the Ten Steps manual (Merrienboer & Kirschner, 2017) suggests 4 approaches to presenting such information: (a) deductive-expository, (b) deductive-inquisitory, (c) inductive-expository, and (d) inductive-inquisitory. The default recommendation for beginners is inductive-expository and for learners with much prior knowledge is deductive-inquisitory. The former is a process of presenting many concrete examples of a phenomenon under study followed by students’ attempts to infer general rules and create their own mental models of the phenomenon from the presented examples (followed by a presentation of those rules and models by the instructor, if necessary). The latter is a process of presenting the theory first and asking participants to come up with concrete examples of that theory by themselves.

At this stage, we debated whether knowledge-based supportive information should be presented in advance via a separate course but decided against it for two reasons. First, the first author felt the common weakness of many MA TESOL courses was exactly in their heavy reliance on theory with very limited to no practical component depending on the institution the course is taken at. Hence, he wanted more time to be dedicated to the “doing” part of the target skill. Second, we expected our participants to already be familiar with those concepts and theories to a degree that they were likely to need a refresher rather than a full-fledged course. This could be provided as procedural information via scaffolding.

The previously mentioned considerations led us to make process-related information the core of the program. Since we expected our participants to fall into the “beginner” category, we chose the inductive-expository approach to presenting supportive information. The presentation would begin with concrete examples (the worked examples) followed by the learners analyzing each example to infer necessary mental models and cognitive strategies related to the target skill. The presentation would end with the learners studying the process-related guides prepared by the authors and comparing them to their own. Coincidently, we had already placed the supportive information in the correct position in step 5: in the form of the worked examples as the first two learning tasks and the process-related guides introduced at the end of them.

15. Putting it all together for a pilot

In this final step, we had to decide what design artifacts from the previous steps needed to be presented to learners and in what order. Our online course began with a general section that contained announcements, an availability survey to determine the best times the participants can meet, supportive information resources (an open educational resource covering relevant concepts and theories and the process-related guides), a link to a Teams meeting, and a questionnaire to collect feedback at the end of the course.

At this stage, it was important to decide how participants would interact. We were guided by two principles informed by the literature on effective PD and FD (Desimone, 2009; Desimone et al., 2002; Garet et al., 2001; Steinert et al., 2016) and the ideas from the Reigeluth book (Reigeluth et al., 2016). Specifically, we wanted our program to allow participants to proceed at their own pace while providing opportunities for collaboration. While these two may seem contradictory, we saw the possible difference in learning paces as an opportunity to create the Vygotskian style of “able/less able” peer interaction. In other words, participants further in the program would help those early in the program with feedback and ideas drawn from their advanced knowledge of and experience with the target skill. The previously mentioned availability survey and a link to a Teams meeting along with several discussion activities introduced later were added to the program to facilitate collaborative learning.

Module 1 follows the General section and was the first learning experience for the participants. It consisted of the two worked examples followed by a discussion activity encouraging the participants to reflect on the examples in a guided manner. The module ended with a collaborative task where the participants were invited to re-analyze the worked examples with the goal of inferring process-related information from them. They were then asked to compare their own guides to the ones the authors created for the program and further reflect on them. This module constituted the introduction of supportive information: from concrete examples to theory.
Module 2 consisted of a warm-up discussion activity leading to the first incomplete task—a research article with a missing discussion section. The learners were asked to download a Word file that contained relevant process-related guides for writing a discussion section and instructions on how to log their reflections while performing the task. The file also contained the simplified assessment rubric designed for that task to be used by the instructor or other peers to assess each other. The peer assessment was to be performed via the Moodle activity called Workshop. The module would end with a live meeting to discuss the feedback the participants received for their performance.

For our pilot, we only fully designed the first two modules as they represented two core parts of the program—supportive information and the actual learning tasks. We plan a total of seven modules based on the design artifacts from the previous steps, which will be implemented once the pilot has ended and the feedback for it has been analyzed.

**EXPERIENCIAL DESCRIPTION**

In its pilot iteration, the course is voluntary and will be offered as a flexible-pace PD program to the early-career researchers at the department of the first author. A potential participant would be expected to (a) reply to a promotional message, (b) meet with the instructor (the first author) for an orientation, (c) negotiate an acceptable deadline for the first task, and (d) prepare and submit the necessary materials on Moodle. For each new task, the cycle will be repeated from step 3, and the learning process will be scaffolded via email, Moodle chat, and live group meetings.

During the orientation, participants will be introduced to the goal of the program (the focus on the practical skills of conducting research), its flow (from supported tasks to the final unsupported task of conducting their own research), and to the following minimum expectations, which we estimate will enable them to transition to their own research within a reasonable amount of time:

1. **Time**: A minimum of 2 hours of study per week while classes are in session and 8 hours per week during break.
2. **Pace**: An average pace of 1 module every 2 months (for a total of 4 months for the pilot and 12 months for the full course with the expectation to start work on their own research project no later than after one year).
3. **Meetings**: Regular group meetings with other participants and the instructor at least 1 time every 3 weeks.

**REFLECTIONS AND FINAL REMARKS**

In the previously mentioned steps, we attempted to present in detail the thinking and the decisions we made while designing our PD program. We also introduced the numerous challenges we faced during the process, all of which we are inclined to attribute to the inherent complexity of the 4C/ID model and the lack of easy-to-follow design guides. In this section, we briefly discuss three other observations that permeated the design process either in part or in its entirety and finish with our reservations regarding the coming pilot of the program.

First, we would like to comment on the fact that our design process started from obtaining knowledge of the subject matter and of the skills necessary for the performance of the target skill. This seemingly contradicts an important 4C/ID principle that learning tasks should be created first and skills and subject matter knowledge to be taught should be inferred from those tasks to avoid forcing possibly unnecessary skills and knowledge into the design of learning tasks, thus subtracting from their authenticity (Merriënboer & Kirschner, 2017, p. 47). We feel this guideline requires clarification. Our design experience has led us to believe that knowing what knowledge and skills constitute the "doing" of a particular skill informs the design process rather than the "doing" itself. In fact, a common approach to creating authentic learning tasks with 4C/ID, cognitive task analysis (Clark, 2014; Clark & Estes, 1996), follows a similar path of moving from "subject matter knowledge" to the design of a learning intervention, and not vice versa. Namely, when conducting a cognitive task analysis, a designer makes the implicit knowledge of an expert explicit by observing their performance, and it is based on this explicated knowledge that learning tasks are then created. By starting our design process with a detailed examination of the knowledge and skills involved in the performance of the target skill, we essentially followed the same pattern.

Second, due to the large number of design artifacts (skill hierarchy, performance objectives, tasks themselves, etc.) that had to be designed, we feel there is a need for a computer application to make it easier to organize and manage the interim design artifacts as well as create links between them for more effortless cross-referencing and editing. In our case, OneNote proved to be an essential but less than optimal tool for those purposes. As qualitative researchers benefit from the utility of qualitative analysis software, so does a designer can benefit from software that helps them organize and simultaneously work on various design artifacts.

This leads us to our third observation that complex design models such as 4C/ID require a larger body of implementation and application examples. To take it one step further, we believe the broader community of designers would also benefit from practitioner-friendly guides that streamline the design process by reducing the emphasis on theories and concepts and increasing the emphasis on actionable steps and informative examples of both finished and interim design products. Returning to our previous point, we see computer software designed to help with the management and organization of interim design artifacts as also capable
of dynamically providing tips and guidelines to the designer to help them optimize the design process.

Finally, we naturally have concerns regarding the feasibility of the program in the context of university PD. While we believe its focus on the practical skills of conducting research is likely to appeal to the target audience, the unusually large amount of time and cognitive resources required from participants to complete the modules may detract from its attractiveness and/or cause high rates of attrition. Other research suggests inefficiency may be an inevitable trade-off for the effectiveness of 4C/ID-based interventions (Ferrejean et al., 2021; Merriënboer & Kirschner, 2017; Wopereis et al., 2015), which may require us to make difficult design and implementation choices in future iterations of the program.

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