

Research Article

Developing a Problem-Solving Focused Presentation That Includes Student Worksheets and Video Segments

Ida Bagus Nyoman Sudria*, Ida Ayu Fanny Karisma Gupta, I Wayan Suja, I Wayan Redhana

Universitas Pendidikan Ganesha, Indonesia, jalan Udayana 11 Singaraja Bali 81116 Indonesia

ORCID

Ida Bagus Nyoman Sudria: <https://orcid.org/0000-0001-5677-4097>

I Wayan Suja: <https://orcid.org/0000-0002-6035-7576>

I Wayan Redhana: <https://orcid.org/0000-0002-0803-8199>

Abstract.

This research and development aimed to create a PowerPoint (PPT) prototype that incorporates video segments to prove targeted hypotheses. Development of the product followed a modified Luther's model with six stages: the concept of PPT actively engaging students through problem-based learning, designing student active learning via a worksheet-based PPT, especially with inductive reasoning, collecting materials, PPT assembly supported by hypothesis proving videos with about a five-minute duration, product testing, and the distributing product for online learning. This research and development successfully developed the desired PPT prototype (in the Indonesian language) with three PPT unit samples created on the topics of chemical learning of acid and base solutions. The PPT prototype followed the worksheet structure. It begins with listing background information, obtained from short introduction paragraphs, then questioning to arrive at the investigative questions, formulating hypotheses, designing proving hypotheses, collecting data, data analysis, and confirming the claimed hypothesis validity. The prototype had very good validity for most concerned learning aspects, according to content and media experts. It was also supported by appreciation from a chemistry teacher. Good product readability was implied from the completed worksheets done by secondary school student samples who had low, average, and good levels of prerequisite knowledge related to the scientific conceptions being taught.

Keywords: power point, problem-based learning, video segments

1. INTRODUCTION

Science learning mandates students to engage in finding the target scientific conception through inquiry [1] either as guided or open inquiry to grow investigative spirit. Construction of scientific conceptions through innovative science learning models based on scientific methods should be optimally facilitated through laboratory practicum [2–4]. However, the terms of school laboratory practicum that have been used “too often without precise definition” [2]. The school laboratory practices tend to demonstrate

Corresponding Author: Ida Bagus Nyoman Sudria; email: ibnsudria.undiksha@gmail.com

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scientific facts and do not involve students in finding problems and planning to prove hypotheses [2, 3]. Online or offline learning presentations generally use powerpoint (PPT) presentations. However, it is still difficult to find science learning PPT with insertion of video segments of proving hypotheses which align to worksheets following the scientific learning approach. Experimental video is also needed in blended learning and hybrid learning, especially for playing back data recording that is often needed if there is a lack of clarity in scientific claims.

This research and development aimed to develop a worksheet-based PPT prototype for science learning following the steps of an innovative science learning model with base of the scientific method by inserting video segments to prove targeted hypotheses in the form of micro or meso learning. This PPT prototype follows a problem-based learning model. Main displays of the intended PPT consistently follow the PBL syntax with video inserts of hypothesis proving segments. The PPT display is preceded by a page stating the organization main display of a PPT learning unit and a main menu page consisting hyperlink to include main documents of learning objectives, student worksheet, and main PPT of a learning unit. The worksheet and main PPT unit follow PBL syntax with accommodation of scientific phases of observing, questioning, data collecting, data associating, and communicating. To increase engagement in inquiry, students are directed to try to work individually on the several beginning parts of the worksheet as a pre-classroom learning task of drafting the investigative plan. Classroom meetings conduct small group investigations referring to the applied worksheet. Factual information and procedural assistance needed by students are facilitated via PPT displays with insertions of video segments of proving hypotheses. The classroom meeting is closed with a post-classroom meeting task of completion, revision, and improvement of the filled worksheet including exercises problems in the learning unit. Such prototypes of PPT micro and meso learning can optimize learning with innovative science learning models with a scientific approach. The short duration of computer-based learning leads to the rapid development of online learning, especially through micro learning [5].

Micro learning delineates a single focus, idea, or topic, with complete structure and content, self-contained or inseparable in providing meaning, and can be addressed effectively with a distinctive database name [6–8]. The video segment of proving a hypothesis/experiment is a component of micro learning. A scientific learning for a mono or multivariate hypothesis is micro learning. The results of the Leong, Sung, Au, & Balncard [9] review showed that overall micro learning publications are “a knowledge supply in line with the increase in internet searches (a practical demand), and micro learning also plays an important role in self-learning, policy makers, educators,

researchers and participators". Micro learning can reduce cost-efficiency on knowledge transfer in a project-based organization [7], improve intrinsic motivation [10]. However, a strong appreciation of short duration micro learning for mobile learning can compartmentalize knowledge entities and decline meaningful learning [11–15] for strong interconnected conceptual understanding. Meso learning will minimize such problems.

Audiovisual facilities can be an indispensable learning resources and/or media for learning science with a scientific approach, especially in visualizing the collection and recording of data to prove hypotheses. The general used presentation of PPT should be able to use available online big data storage for facilitating a rather big memory document such a video segment of proving a hypothesis with up to a 6-minute duration or a complete worksheet document via hyperlinks [16]. A lesson plan for a PPT conduction can involve pre-classroom meeting tasks, learning activities during classroom meetings, and post-classroom meeting tasks which refer to activities in the student worksheet. Thus, it could develop a PPT in consideration to convenient time limit and concise displays of main pages without ignoring rational phases of the scientific method in learning science.

PPT has important media characteristics for science learning presentations. The development of a PPT prototype of science learning with a problem-based learning model follows the basic model of media development by Luther [17] and with support of alpha and beta testing [15] to its created PPT unit samples. Video segments and worksheet documents which need rather big memory would be placed such in the available google document storage and accessed via hyperlink.

2. RESEARCH METHOD

This R&D of power point considered micro or meso learning benefits for effective science learning presentation either via online and/or blended or offline classroom learning by optimizing the support of computer-based multimedia aspects especially of video segments to prove the hypothesis. Development of the product used integration of Luther's and Dick & Carry R&D models [17, 18] which includes six stages, namely concept, designing, collecting material, assembly, testing and distributing the product of the program.

The concept of product development is focused on making a worksheet-based PPT prototype by inserting videos of experimental parts of proving hypotheses about the targeted scientific conceptions. The PPT and worksheet should be aligned and consistent to follow the PBL syntax. The reasoning in this case follows inductive reasoning.

Designing stage involved program mapping, synopsis, and storyboard of worksheet-based PPT creation [17]. The design applied the stages of PBL which accommodated the scientific approach with the five main stages of scientific learning namely observing, questioning, data collecting, data associating, and communicating. The program mapping involved integration of content information as well as support of hypothesis proving video segments which are required in the lesson plan and learning texts especially in the main display of PPTs with accordance to the applied worksheets. The consistent student activities on work following the scientific approached worksheet also serve as assessment of comprehensive targeted scientific learning competencies. A synopsis constituted a presentation of learning activities and content with support of video based on the experiment design. A synopsis constituted a presentation of learning activities and content with support of video segments based on the experimental design. A storyboard of the PPT applied concise information with the support of explanatory text and video segments for proving the hypothesis that are inserted via hyperlinks to the part of the lesson at pages of main displays. The separate menu for the applied worksheet facilitates the complete worksheet document to reduce the complexity of the usage of PPT displays and to facilitate comprehensive monitoring of student scientific competence through performances in working on the worksheet before, along, and after the classroom meeting.

Material collecting involved curriculum analysis to ensure description of contents of the referred lesson plan, worksheet, learning content, and assessment were still relevant to science curriculum. Material collecting included narrations of information segments, recordings of experiment segments, pictures, photos, tables, animations, and audio narratives required for creating the video segments. The collecting of learning material considered the experiment designs in the worksheets.

The assembly stage applied the assembly of the collected materials for a learning unit of about 2-hour classroom meetings. The home page displays three hyperlink figures (1) learning objectives, (2) scientific approached worksheet, and (3) main learning PPT. Main PPT proposed having less than 10 main pages with hyperlinks of insertion segmented information of required text narration, images, and videos of experiment segments. While access to objectives and LKPD via a hyperlink respectively on the home page.

Alpha and beta testing were carried out [18][19] to confirm validity of the product. Alpha testing intended to demonstrate well performances and appropriateness of the learning program of the desired PPT prototype and PPT unit samples created using the prototype. Beta testing as a validation of the product involved a chemistry content expert, media expert, and a chemistry teacher as practitioner with judgment categories

of very good (VG), good (G), poor (P), and very poor (VP) for every item of judgment aspect. Revision of PPT components with poor and very poor judgments and other constructive comments were carried in resulting in the revision version. Readability of the PPT samples based on student performances on worksheet work was also conducted involving several chemistry secondary school students with good, average, and low on prerequisite conceptions to the chemistry topic contents in created PPT. The readability analysis of the PPT with respect to the completeness of student work on the applied worksheet.

The last R&D phase, product distribution conducted to ensure the product is accessible as the online learning presentation. This early distribution stage was limited via Google Drive sharing to the validators and to the samples of students.

Qualitative data analyses were conducted on the obtained data for every R&D stage. The results are presented descriptively. R&D data for effectiveness of the product development included data of the stages concept, designing, materials collecting, assembly, testing, and distributing. Data analysis criteria concerned rational modes.

3. RESULTS AND DISCUSSION

The product of this R&D was a PPT prototype with three PPT unit samples for chemistry learning of acid and base topic followed by a PBL model with inductive reasoning. Every PPT unit with a cluster of concepts is organized in one scientific learning cycle. The video segments of proving hypotheses with primary and/or secondary data were successfully created and inserted into the PPTs which are still written in Indonesian language. The learning contents of the acid and base solution topic included acid and base identification, pH scale and natural acid-base indicators for unit 1; strengths of acid and base for unit 2; and Bronsted-Lowry's concept and Lewis's concepts of acid and base for unit 3. Classroom meeting time allocations are respectively 4 hours for unit 1 as well as unit 2, and 2 hours for unit 3. An hour of classroom meetings is 45 minutes. Alfa and beta testing results still involved a limited number of student samples. The judgments showed the validity of the PPT prototype and its created unit samples.

The concept stage considered the need of effective science learning presentation via online learning in the form of micro or meso learning. Every PPT unit consists of learning objectives, concise main PPT pages referring to worksheets with consistency to scientific learning approach. As a scientific-based learning model, PBL model should accommodate the phases of scientific method, namely observing, questioning, data collecting, data associating, and communicating the finding as developed by Sudria et

al. [20]. The concept was realized by integrating and inserting the video segments of proving hypotheses into the PPT referring to the worksheet via hyperlinks. The created video segments of proving the hypothesis effectively inserted into main pages of PPT following the experimental design desired in the applied worksheet. In addition, the presence of the phenomenon of learning object background at the beginning of the worksheets as the strength of the developed learning device [19, 20] could be still maintained.

Design stage resulted in a PPT prototype following applied learning model syntax. The PPT prototype consists of concise main pages on which hyperlinks of needed explaining texts, videos of experiment segments, and worksheet can be open and closed by clicking its hyperlink buttons. Heavy documents mainly for video segments and worksheets were stored in online Google Drive and shared as limited or open access. Every video of the hypothesis proving segment has a duration less than six minutes.

The mapping stage resulted in PPT with completeness of science learning aspects and consistency to the applied learning model stages and to scientific phases. Synopsis of the PPT design for each learning unit consistently followed the stages of PBL accommodating the five scientific learning phases of observing, questioning, data collecting, data associating, and communicating in the inductive reasoning. For lighter programs, the inserted videos via hyperlink for every PPT unit prioritized experiment video segments of data collecting and data recordings. The results of the end designing stage of making storyboards were mainly significant for making video segments and the whole PPT units with scenarios involving visual and audio materials, and other supporting components.

The results of collecting material were focused on developing the worksheet-based PPT prototype following the PBL model which accommodates the five scientific phases in inductive reasoning developed by Sudria et al. [20]. The chemistry learning contents referred to the syllabus of the current general science curriculum. Materials for creation of video segments in proving hypothesis included pictures, photos, tables, animations, and audio narration were prepared using (1) Adobe After Effects for editing images, animations, and effects, (2) Adobe Premiere Pro for creating and editing content, and (3) Video Scribe.

The assembly stage successfully composed a PPT prototype which created the three comprehensive targeted learning units of the acid and base topic. The PPT prototype consists of a home page with three main menus as well as hyperlink buttons to the three main documents namely learning objectives, worksheet, and the main PPT of the

learning unit. Only displays of the main pages of the PPT document are completed with further hyperlinks to the needed part/s of micro content/s such as information texts, problem formulations, hypothesis, hypothesis proving designs, video segments of proving hypothesis, data analysis, and explaining statements. Required documents of video segments of proving hypotheses and complete worksheet which required big memory are stored in the online Google Drive. These online documents are available for hyperlinks on the PPT pages. The three PPT unit samples using the developed PPT prototype showed well and effective performances in presenting online science learning.

Examples of several displays on PPT unit 1 created in this R&D are presented in Figure 1. The introduction of the main displays PPT organization with consistency following PBL syntax is shown in Figure 1a and the home base page of the three main menus (Figure 1b). All parts of micro content hyperlinks are presented in the main pages of the PPT. A number of display examples in PPT unit 1 are introductory phenomenon of the learning object background that needs to be observed to get information towards the formulation of the investigative problems (Figure 1c), problem orientation (Figure 1d), organizing students towards investigation (Figure 1e), the formulation of the investigative problems that expectedly arise from students (Figure 1e), the formulation of the desired hypothesis (Figure 1f), the design of proving hypothesis number 1 and 2 (Figure 1g), taking experimental data for hypothesis 3 (Figure 1h) and for hypothesis 4 (Figure 1i). Result recapitulations of beta testing are presented in Table 1 for the PPT as the main product, in Table 2 for the worksheet as supporting product, and in Table 3 for student performance on worksheet work.

The results of alpha and beta testing are as follows. The alpha testing of the products of the three created PPT units showed very well performances as expected in its design for the introduction page, home base page, online displays of the worksheets and the main PPT unit as well as the learning objective accessed via the home base hyperlinks, Displays of the PPT main pages, displays all of the video segments, narration texts, and other micro contents/information needed via the hyperlinks on the PPT main pages. The results of the beta testing on the aspects of the product in the form of media expert validation, content expert validation, and high school chemistry teachers' opinions toward the product are shown in Figure 1 for PPT and Figure ?? for the worksheets. Many presentation and learning aspects were given in good and very good judgments. Distribution of the five sample students in completeness work on worksheets of the three PPT samples as indication of the reliability of the PPT samples were shown in Table 3. Unit 1 and unit 3 have good readability, since at least one student

completed all aspects. While unit 2 with all scientific conceptions of the target classified as quantitative is indeed a little more difficult, especially starting from the aspect of formulating hypotheses to conclusions, it still shows legibility as interpreted from all aspects of tasks in the worksheet done partially. Incomplete performance tends to be improved by using the remaining remedial opportunities for mastering the topic.

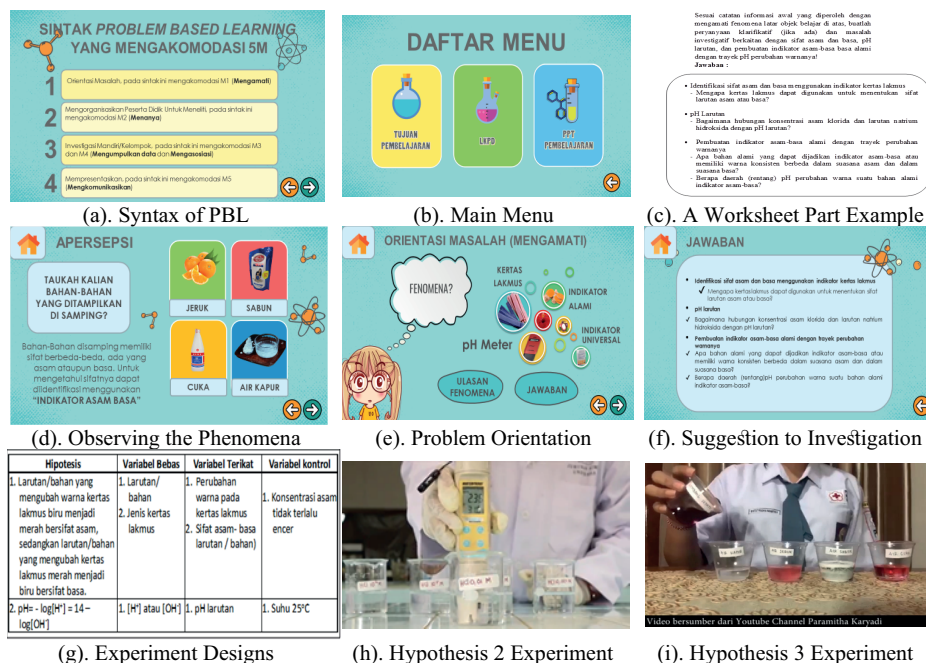


Figure 1: Several display examples in the PPT unit 1.

An effective science worksheet-based PPT has been successfully developed in this R&D. The PPT prototype accompanied with the three created PPT unit samples has adequate validity based on the results of content and media expert judgments, teacher opinions, and the readability shown by the effects of its application on worksheet individual works by the five representative student samples. The PPT with revision of several aspects that could still be improved based on the assessment given by the experts, teacher and students tends to have better validity. The revised product replaced the previous product that had been stored in the online google.drive.com. The product is available by asking for access to the email of ibnsudria.undiksha@gmail.com or dayu fanny44@gmail.com. The interconnectedness of all concepts in a cluster such as for the example of learning PPT unit 1 is featured by inseparable for all of the three included concepts that are (1) the concept acid and base responses to acid-base indicator, (2) pH scale as a negative logarithmic value of the H^+ ion concentration of an acid or the concentration of OH^- ion of a base in solution, and (3) pH area of color change of natural acid-base indicators. The suitability of clustering several concepts in such a unit is a

TABLE 1: Validity of created PPT judged by experts and perceived by secondary school chemistry teacher.

Given Validity	Aspects with Validity Category Given by		
	Media Expert	Chemistry Content Expert	Chemistry Teacher
Very good	Graphical eligibility includes cover letters and colors; content design includes type-face, spaces used, video segments can help students work on LKPD	PPT design.	PPT design, clarity of presentation of video clips proving the hypothesis according to PB.
Good	Graphical feasibility includes cover design; content design includes titles and subheadings, letters, instructions, appropriateness of texts and pictures, layout of texts and images, relevance of images and narrative texts with content, animations used; sound and music to accompany the atmosphere; the relevance and clarity of animation; relevance and clearness of video segments proving hypothesis, and display relevance to PBL and scientific stages.	Feasibility of content includes conformity with the syllabus, systematic clarity, adequacy and relevance of learning activities in accordance with PBL stages and scientific methods; the relevance of the video pieces proving the hypothesis include the clarity of factual knowledge (as independent, dependent, and controlled variables); procedural and conceptual; up-to-date material includes problems and examples according to the demands of learning chemistry and PBL; and clarity of serving pages	Content suitability with the syllabus, pictures and material content, video clips of proving the hypothesis according to the scientific method and helping students fill out LKPD, up-to-date content, learning steps (systematics)

conducive way to merge the same scientific phases of all of the targeted hypotheses of conceptual claims in one of the bigger scientific cycles, so that the conducts of opening, main, and closing of the lesson are only done once. The content scope of one scientific cycle changes from micro content to meso content, then builds a meso learning cycle. Thus, meso learning is more efficient in the allocation of time for lesson opening and lesson closing and contributes more to meaningful learning [11][12]. For certain needs, micro content can be aggregated according to type or field [6]. Hug [7][8] illustrates the scope of learning levels in micro content as micro level, sub-topic or limited topic as meso level, and topics or subjects as macro level education. Meso level as intermediate level among micro and macro levels. A scientific conception is a micro content which very well meets the criteria of “self-contained indivisible structured pieces of content” [6].

TABLE 2: Validity of created worksheets judged by experts and perceived by secondary school chemistry teacher.

Given Validity	Aspects with Validity Category Given by		
	Media Expert	Chemistry Content Expert	Chemistry Teacher
Very good	Completeness of the content plan; suitability of presentations and instructions with PBL and scientific stages.	Efforts to cultivate scientific attitude	Completeness and conformity with syllabus, tables, PBL presentation organization and scientific method, content scope
Good	Proportionality of the use of letters, attractiveness of design, summary of the initial phenomenon/background of learning objects, size of text segments, completeness of student work directions, tables, presentation organization aligned with PPT	Conformity of content with the syllabus, systematics, adequacy and clarity and relevance of the initial phenomena of the object of study, stages of PBL activities and scientific methods, clarity of direction for each stage of activity, relevance and adequacy of hypothesis proofing activities (as VB, VT, & VK); and clarity of presentation	The clarity and relevance of the initial phenomenon of the object of study, the accuracy of the worksheets presented in the PPT, the suitability of the stages of the scientific method for students

TABLE 3: The number from the five student samples with completeness of work asked in the worksheets.

Work on	Unit 1			Unit 2			Unit 3		
	Complete	Partial	Empty	Complete	Partial	Empty	Complete	Partial	Empty
Observing	4	1	-	2	3	-	2	3	-
Questioning	2	3	-	2	3	-	2	3	-
Writing hypothesis	1	4	-	1	4	-	1	4	-
Experiment variables	1	1	3	-	2	3	1	3	1
Designing experiment	5	-	-	-	4	1	2	3	-
Collecting data	5	-	-	-	4	1	2	3	-
Associating	3	2	-	-	5	-	2	3	-
Conclusion	1	3	1	-	2	3	1	3	1

4. CONCLUSION

This R&D has successfully developed an effective science worksheet-based PPT prototype following the PBL model which accommodates the phases of scientific method. It has good validity based on judgments given by content and media experts as well as appreciation given by the teacher and readability by sampled students. It consists of three created PPT unit samples for the chemical acid-base topic. The phases of the scientific method are referred to in the scientific learning approach. The PPT

prototype has characteristics as follows. (1) It has an introduction page mentioning that the organization of main pages of the PPT consistently follow the applied learning model syntax. (2) The fronts pages also show a home page of main hyperlink menus to the three main display documents of learning objectives, worksheet, and main PPT displays. The learning objective menu only shows the learning objective for the unit as well as the worksheet menu only shows the whole worksheet without further hyperlink. The only display of PPT main pages have further hyperlinks to needed supports of learning information such as video segments of proving the targeted hypothesis. Several or the whole worksheet of every PPT learning unit can be assigned as tasks for pre-, during, and post- classroom meetings. This arrangement will maintain convenience of the PPT use. (3) It is completed by video segments of proving the targeted hypothesis referred to the applied worksheet. The video segments are accessed via hyperlink on the PPT main pages. The success of developing this product has implications for an alternative effort to optimize learning activities with a scientific learning approach for online learning presentation, and can also be fruitful for direct classroom learning, blended learning, hybrid learning especially in replaying of data collecting and recording if there is questioning of the confirmed hypothesis claims

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