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DEVELOPING INTERACTIVE MULTIMEDIA FOR LOCAL CULTURE-BASED TEXT WRITING IN *MAÎTRISE DE LANGUE ÉCRITE* COURSE

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Author JS designed the production of macromedia flash learning media applications, the analysis, and interpretation of the manuscript. Authors M and JF designed the learning applications, proofread the manuscript, checked grammatical errors and spelling. All authors read and approved the final manuscript.

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ABSTRACT

The *maitrise de langue ecrite* (MDLE) course is considered conventional in French teaching textbooks and needs to be reformed by using interactive multimedia which is expected to provide students with opportunity to experiment and explore. This study aimed at designing and developing interactive learning multimedia for texts writing which was based on local culture and such writing practice became part of MDLE course that required writing competency in French for the B1 DELF level. Research and development (R&D) was applied and adopted Thiagarajan's Four-D stages and media was developed by using Macromedia Flash 8, a software program for creating two-dimensional animation. The final product of the learning media Macromedia Flash Professional 8 was packaged in a Compact Disc (CD) and its capacity of a file size was 200 MB. The learning media files were formatted in .swf, .fla, .flv formats, and a windows projector was operated on computers with the Windows XP, Windows 7, Windows 8, and Windows 10 Operating System (OS). The contents of the media included researchers' profiles, materials, worksheets, and references for each chapter. The results show that the average of the overall scores from the alpha test I and II as validated by the materials experts were 92.85% and 100%, and by the media experts were 88.89% and 100%. Furthermore, the Beta test also show that students' responses assessments were 86.1%. Thus, media products based on Macromedia Flash Professional 8 was approved as valid as learning media.

Keywords: French; interactive media; local culture; macromedia flash 8; multimedia; R&D; writing; development.

1. INTRODUCTION

The advancement of technology has influenced and contributed to improvements in every aspect of life, especially in the educational settings. The utilization of other variations of learning media, such as videos, pictures, or animations has always been on demand to enhance the students' interest and interaction during the process of teaching and learning. This utilization also has been foreseen to escalate their writing ability and create efficient, attractive, and interactive nuances during the learning process. Nevertheless, the writing subject in MDLE course has been conducted conventionally through printed textbooks. This

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conventional way of lecturing has affected the situation and the atmosphere of the class, so much so that it became monotonous and tedious in return. Based on the observation conducted by the researchers, it was observed that there were weaknesses in the application of textbooks; the students tended to forget to bring them during the learning process in the classroom, and the students didn't have any interest to read them afterward. Therefore, these weaknesses has affected the students' writing ability and made their performances to be below expectations.

On the other hand, there has been a type of learning that utilized the existing local culture. Local culture-based context from the local culture in that specific region. This idea would assuredly bring positivity to the students. In this case, the learning process concerning writing about various types of texts could trigger the students to think of any ideas and experiences that have been obtained through the local context. Thus, the students would be actively interested in the cultures that they have known and recognized. In return, it would also optimize the learning process to achieve the learning objectives. Following today's developments, lecturers are required to merge or utilize available facilities via the internet and other technologies. Besides, lecturers have been expected to be able to create or develop learning media where the media is not accessible or available yet.

Numerous tools could be utilized, especially for learning. One of the tools that could be applied is known as interactive multimedia learning. This tool was inculcatedas attractive as possible within the France materials. The interactive multimedia learning is considered as beneficial to be developed as a learning material, resulting in a pleasant learning experience and creating easier access for the information or knowledge sent, which could be received and comprehended accurately. Therefore, the developed interactive multimedia used was Macromedia Flash. Multimedia has been known as a combination of media, such as texts, pictures, audios, and animation. Multimedia learning allows the students to experiment and explore so that the students could participate directly during the learning process. The objective of this study was aimed at designing as well as developing a model for multimedia interactive learning which was used for texts writing and the text writing itself was based on North Sumatera's local culture and such writing practice became part of MDLE course that required writing competency in French for the B1 DELF level.

2. LITERARY REVIEW

2.1 Learning Media

Learning media according to Martin and Briggs in Sumiharsono includes all the resources needed to communicate with learners [1]. This can be both hardware and software. Furthermore, Sanaky in Dewi states that the keywords of learning media include: the presence of introductory tools or instruments, the involvement of physical instruments in distributing learning materials, the existence of learning resources from which learning materials are obtained and the relationship between learners, teachers , material with learning objectives [2].

A good learning media is one that meets the assessment parameters based on the quality aspect of the learning media. Walker & Hess in Arsyad provide criteria in reviewing learning media software based on quality which includes quality of content including accuracy, instructional quality that describes learning opportunities and assistance and technical quality which includes readability and ease of use [3].

2.2 Interactive Multimedia

The term multimedia which was popularized in the 1980s combines writing, image and sound technologies. La Nouvelle Revue Pédagogique (February 1996) gives the term in two words: the Latin prefix "multis" denoting "several" and "media" meaning broadcasting, distribution or transmission of signals, carriers of written, audio or visual messages. Multimedia symbolizes the combination of elements with the organization of information technology. Multimedia includes the following three criteria, Computing includes digitizing data (voice, text, video or other devices) and managing them. Interactive allows users to freely navigate between configurations. Multimedia combines sound, text and images on the same medium.

2.3 Macromedia Flash

Cholid states that Macromedia Flash can be interpreted as an interactive and dynamic media consisting of text, images, graphics, audio and animation designed to create vector-based animations with small results [4]. Rich Shupe Robert Hockman add that Macromedia Flash is a great tool for web designers, interactive media practitioners, and multimedia practitioners [5]. Flash accents are used for creating animated creations, as well as importing and manipulating various types of media

(audio, video, beepmap, vector, text, graphics, and data).

From some knowledge about Macromedia Flash described above, it can be concluded that Macromedia Flash is an educational animation software that is intended to make it more attractive and easier to understand for students and their applications on computers and images from projectors. Macromedia flash is often used for making presentations and learning support. Indeed, software is more attractive and can be designed as needed. To create learning media with Macromedia Flash, it is not necessary to have special skills, it is enough to have expertise in graphic design.

Macromedia Flash has several menus that make it easy to create interactive learning materials, including: 1). menu to add a button directly to the learning material, 2). menu to create and manage assessment questions, 3). menu that allows to process images, videos and animations, 4). A very complete model is available as a basis for the design of learning materials, 5). How to use it very easily as a Power Point, but presents many benefits. According to Bowden, macromedia flash is a design tool that is set up primarily to allow the creation of efficient animations, especially for web pages [6]. According to Andi, Macromedia Flash is software that clearly presents audio-visual messages and materials to students, so that they can be illustrated in a more interesting way for students with animated images that can stimulate students' interest in learning to achieve certain goals [7].

2.4 Learning Relationship with Multimedia

Alessi argues that the use of audiovisual (images, videos) with all its advantages for learning, multimedia is now a supporting tool for teaching/learning languages [8]. He also stresses that multimedia is not seen only from the devices but the results in the form of evidence of the effective use of these media in language learning. What he then points out is that multi media must act as a tool to transfer knowledge. The use of multimedia must be balanced and not more dominant on the device used which can make the media play a more dominant direction. Therefore he must balance between film elements (fiction or from authentic documents) and educational elements.

Lin describes that learning in hypermedia systems requires users to have the skills of planning, monitoring, reflecting, and managing their personal learning strategies [9]. Therefore giving students, in self-training tools, products to "explore", must be accompanied by pedagogical mediation, where students do not go their own way, they must be led to know the benefits of effective use of encyclopedic CD-ROMs, for example tutorials with educational videos and videos that are liked by students. Learning relationship with multimedia.

2.5 Writing Materials in the *Maîtrise De Langue Ecrite* Course

In case of writing activities for many fields such as in administrative matters, in hospitals, in family relations, friendship and social, announcements among others Cuq argues that writing changes messages from spoken language to written language [10]. Furthermore, Cruce adds that the act of writing aims to take advantage of something to be said and informed in writing [11]. The subjects that will be the topic of writing in this MDLE course include activities about:

A. Bereiter gives his ideas that writing descriptive text, which allows the writer to describe in detail what or how an object, place, scene, character, animal, house, room, person among other [12] for example, describing tourist areas in Parapat and its surroundings with lexical content such as climate, names of tourist attractions, tribes, livelihoods of residents, etc., and grammatical content such as *préposition de lieu*, adjectives, l*e mode indicatif présent*, *passé* and *imparfait*.
B. Writing narrative text, which is used to tell a fictional, real or documentary story or event by a narrator (see Bereiter, ibid. For example, telling the legend of an area such as the story of Lake Toba with lexical content of rare words that are no longer used today, in the field of grammar, will deepen the use of *passé composé*, *imparfait* and the use of *les mots de connecteurs*.
C. Bouchard argues that writing argumentative texts can be related to how students give their argument on what they are willing to live in a small town, for instance [13]. Usually the text is written in the present sentence, and the grammatical content includes mastering the expression of hope and the use of *connecteurs logiques*.

2.6 Studies in Design and Development Research

Richey, Klein and Tracey argue “designers work with all types of instruction, including employee training workshops, online and web-based instruction, and train-the-trainer programs. Moreover, in the current

milieu, instructional designers also deal with noninstructional interventions created to solve workplace problems for which training is not the appropriate solution" [14]. They place media and delivery system as one of the domains of the Instructional Design Knowledge Base. The domains themselves include: learning and performance contexts, content structure and sequence, instructional and noninstructional strategies, learners and learning processes, designers and design processes, and media and delivery systems. Ndongfack carried out his research on "Teacher Profession Development on Technology Integration Using the Mastery of Active and Shared Learning for Techno-Pedagogy (MASLEPT) Model." Mishra and Koehler (2006) as cited in Ndongfack (2015) uphold that teachers' Technological Pedagogical Content Knowledge (TPACK) is paramount in any teaching and learning process. TPACK framework constitutes three knowledge domains and seven constructs notable Technology Knowledge (TK); Pedagogy Knowledge (PK); Content Knowledge (CK); Pedagogical content knowledge (PCK); Technological Content Knowledge (TCK); Technological Pedagogical Knowledge (TPK); and Technological Pedagogical Content Knowledge (TPACK. It provides a framework for understanding the complexity of integrating technology into specific subject matter [15]. Hence, media becomes one of seven constructs and it then becomes important to do carry out research on the use of media as the learning tool which is hoped to be effective and efficient in its application. When doing MASLEPT Ndongfack wrote that the initial draft of the course materials was evaluated by two subject matter experts as one of the five approaches used in validating instructional design models and products as he cited from Richey 2005 and Richey and Klein 2007.

Several studies on the application of design and development research (DDR) are explained here. Firstly, in their article "A Guide for Novice Researchers: Design and Development Research Methods" Ellis and Levy argue regardless of domain differences and individual points of emphasis, two essential aspects of the defining characteristics of design and development research emerge: the design and development research results in production of some form of artifact, and the process is indeed research, not to be confused with product development [16]. they add significantly that "Design and development research focuses on building that bridging artifact that can serve to strengthen the interaction in the conceptualization and evaluation cycle. Fig. 1 illustrates the central concept behind the design and development research framework using the bridging artifact." Peffers et al. (2007) as cited by Ellis and Levy developed a 6-phase model including: a) identify the problem motivating the research; b) describe the objectives; c) design and develop the artifact; d) subject the artifact to testing; e) evaluate the results of testing; and f) communicate those results.

Secondly, Klein individually claims that "in its simplest form, design and development research is the study of the process and impact of specific design and development efforts, or the study of the design and development process as a whole, or of particular process components" [17]. He adds that "such research can involve a situation in which someone is studying the design and development work of others" although he considers that "…, it can also involve a situation in which someone is undertaking design and development activities and studying the process at the same time. …, there is a distinction between doing design and development and studying the process." He argues that DDR reaches these goals through two large categories of studies: (1) product and tool research, and (2) model research. These two major categories differ in terms focus and outcome. The first type pertains primarily to studies of the design and development of products and tools. Often the entire design and development process is documented. The second type of design and development research relates to studies of the development, validation or use of design and development models.

Thirdly, in case of approaches to model validation Tracey proposes two models: designer usability and product impact study [18]. The first consists of participants, procedures and results. Participants were divided into two teams based on an equal distribution of skills, knowledge and backgrounds. Each team, labeled Team 1 and Team 2 included one volunteer from business and one from education. Procedures might contain (1) materials regarding the organization in which the newly developed instruction will be used; (2) written content on team-building, the content of the instruction to be developed; (3) audience, environment, and gap analysis information; and (4) the Dick and Carey Instructional Systems Design (ISD) model (as Tracey cited from Dick, Carey, & Carey, 2001). Results indicate instruction produced and designers respond. The second model, namely product impact study, is concerned with the effects of using the model through the creation of the instructional products themselves, and the impact of these products on learners. It has participants, procedures, instrumentation, results (consisting of performance on post-test results, attitude results, outcome predictors), and validation (covering designer use and product impact).

Table 1. Types of design and development research [17]

	Product & tool research	**Model research**
Emphasis	Study of specific product or tool design and development projects	Study of model development, validation or use
Outcome	Lessons learned from developing specific products and analyzing the conditions which facilitate their use	New design and development procedures or models, and conditions which facilitate their use

Context-Specific Conclusions ⇒⇒⇒ ⇒ Generalized Conclusions

Lastly, Sahrir et.al. states their reasons why DDR is chosen in their research: "the employment of design and development research (DDR) methodology as the selected approach is justified in this study by its pragmatism in testing the theory and validating the practicality" [19]. In case of challenges and obstacles, Sahrir et.al. know that DDR provides an alternative to conduct rigorous and systematic design research based on solid theoretical foundations. It possesses the necessary approaches to design and develop the principles of the games prototype with the flexibility of revision in iterative cycles of user testing sessions in real and authentic setting. However, each endeavor is not without its own challenges and barriers.

3. METHODOLOGY

The word development has a broader definition when it is used within the research context than it has when used within the context of creating instructional products. The focus is no longer only on production, or even on both planning and production. It also includes comprehensive evaluation. As such, developmental research may well address not only formative, but also summative and confirmative evaluation. It may address not only needs assessment, but also broad issues of frontend analysis, such as contextual analysis issues [20]. Design and development research (DDR) is defined as "the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development" and becomes "an umbrella term for a wide range of studies that employ an assortment of traditional quantitative and qualitative research methods and strategies" [21].

The DDR has three goals: knowledge production, a more complete understanding of the field, and the ability to make predictions and the thre goals are carried out in "two main categories of research projects: (1) research on products and tools and (2) research on design and development models". These two categories of design and development research are termed as "Type 1 and Type 2 developmental studies." [22]. Type 1 developmental studies focus upon "a given instructional product, program, process, or tool." They reflect an interest in identifying either general development principles or situation-specific recommendations. Typically, Type 1 studies address not only product design and development, but evaluation as well. At times they may validate a particular design or development technique or tool. Type 2 studies, on the other hand, focus upon "a given design, development, or evaluation model or process." They may involve constructing and validating unique design models and processes, as well as identifying those conditions that facilitate their successful use. In case of participants, both Type 1 and Type 2 have three functions / phases respectively (see Table 2) below.

Table 2. Common participants in developmental research studies

Type of developmental research	**Function/Phase**	**Type of participants**
Type 1	Product design & development	Designers, developers, clients
Type 1	Product evaluation	Evaluators, clients, learners, instructors, organizations
Type 1	Validation of tool or technique	Designers, developers, evaluators, users
Type 2	Model development	Designers, developers, evaluators, researchers, and theorists
Type 2	Model use	Designers, developers, evaluators, clients
Type 2	Model validation	Designers, developers, evaluators, clients, learners, instructors, organizations

It is not uncommon for a developmental research project to also utilize multiple research methodologies and designs, with different designs again being used for different phases of the project (see Table 3).

With reference to collecting and analyzing data, data collection in a developmental study takes a variety of forms depending upon the focus of the research. The validity of the conclusions is often dependent upon the richness of the data set as well as the quality of the research design. Typical types of data collected in developmental research relate to:

- Documentation of the design, development, and evaluation tasks, including profiling the design and development context and collecting data: work time and expenses, problems encountered and decisions made, adjustments made in the original plans, designer reactions and attitudes, or records of concurrent work patterns;
- Documentation of the conditions under which the development and implementation took place, including factors such as equipment and resources available, participant expertise and background, or time and client constraints; and
- Identifying the results of pre-design needs assessments, formative, summative and confirmative evaluations, including documentation of the target populations and the implementation context, and measures of learning, transfer, and the impact of the intervention on the organization.

4. RESULTS AND DISCUSSION

4.1 Results

4.1.1 Defining

Need Analysis: The former analysis used to know whether the students were familiar with Interactive Multimedia Learning. The analysis result of the need, the application of interactive multimedia during the learning process in the classroom can actively enhance the students' participation and encourage the students to learn.

Determining and Gathering the Required Resources: Besides the material resources, this research required a developer such as software that was needed to develop the learning media. The applications referred to were: Macromedia Flash 8, the main program used to design interactive multimedia, Adobe Photoshop, software used for editing pictures, photos, and effect-makers purposes and CorelDraw Graphic Suit, software used for the graphics-designing.

4.1.2 Designing

The materials in interactive multimedia were divided into three parts: *comment décrire*, *comment raconter une histoire chronologique au passé* and *comment argumenter*. Next, the researchers started to arrange questions and contents that were included in learning media such as material topics, the researchers' profiles, references, and assignments or exercises. After selecting the chosen material in the entry menu, the application showed the learning chapters that the users could choose below the materials menu. Then, after entering into the preferred chapter section, the user could use *page d'accueil* to return to the entry menu.

4.1.3 Developing

In the developing stage, the researchers validated interactive multimedia learning to the material and media validators (Alpha Test) before it was tested to the fifth-semester students of France education study program (Beta Test). The development of the Alpha test is shown in the Table 4 below.

Table 3. Common research methods employed in developmental research studies

Type of developmental research	Function/Phase	Research methodologies employed
Type 1	Product design & development	Case study, in-depth interview, field observation, document analysis
Type 1	Product evaluation	Evaluation, case study, survey, in-depth interview, document analysis
Type 1	Validation of tool or technique	Evaluation, experimental, expert review, in-depth interview, survey
Type 2	Model development	Literature review, case study, survey, delphi, think-aloud protocols
Type 2	Model use	Survey, in-depth interview, case study, field observation, document analysis.
Type 2	Model validation	Experimental, in-depth interview, expert review, replication

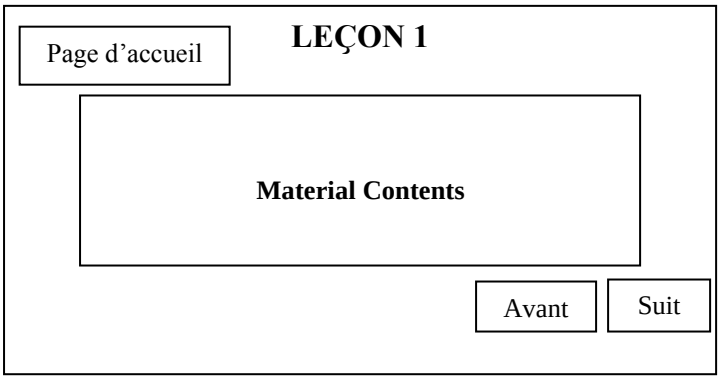

Fig. 1. The design template for the materials section

Table 4. The result of alpha test I and alpha Test II

Validators	Alpha test I	Alpha test II
Material Expert	92,85 %	100%
Media Expert	88,89%	100%
The average percentage	90,87 %	100%

In Alpha Test I, the material, and media experts have approved that the learning media was proper and appropriate to be used. The revision suggested by the material experts were only about the misspelled words and improper punctuations discovered in the learning material.

4.1.4 Distributing

After the product has been validated and revised, then it was ready to be tested by the students. In this step, the Beta Test was the operating trial-tested by 30 fifth-semester students of France education study program.

4.2 Discussion

In the aspect of the learning quality for the learning media in the MDLE course, the average percentage was 86,5% and categorized as very good. There were nine indicators of this aspect, such as 1) Giving learning opportunity, 2) Giving help to learn, 2) Motivating quality, 4) Learning Flexibility, 5) The relation between this learning program and others, 6) The social interaction quality during the learning process, 7) Test and scoring quality, 8) able to give impact to the students, and 9) able to provide impact for lecturers and the lecturing process.

Fig. 2. The design template for the opening screen

Fig. 3. The design template for the entry menu

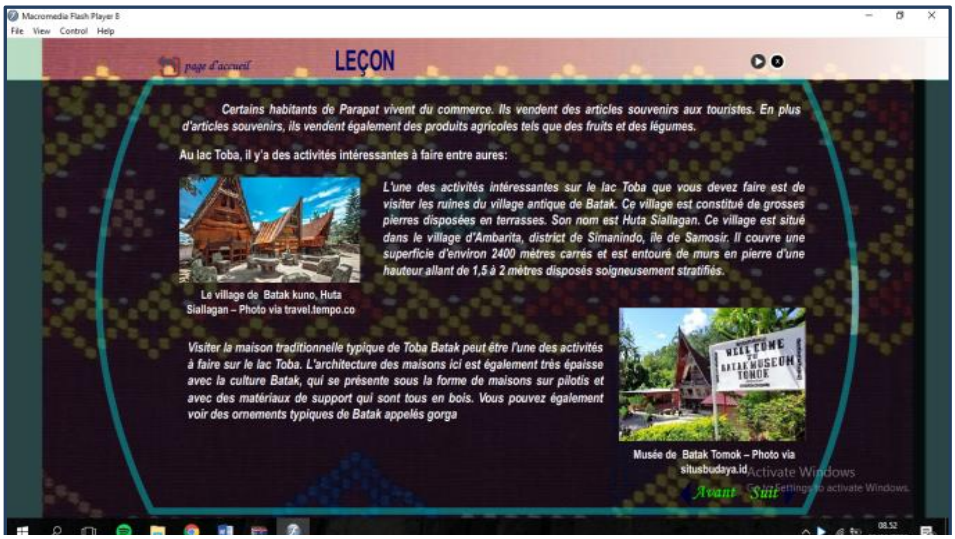

Fig. 4. The design template for the materials equipped with pictures section

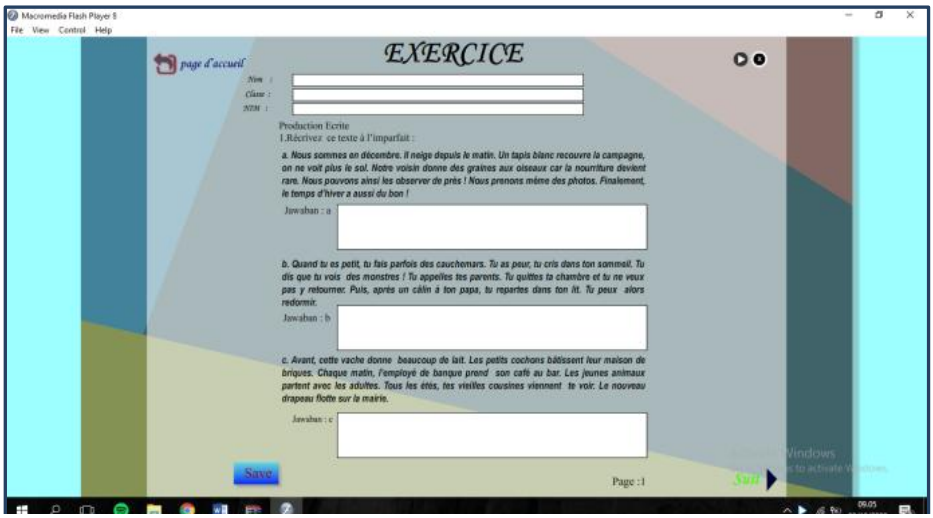

Fig. 5. The assigments or exercise design template

In the second aspect, the indicator which scored the highest was the learning flexibility that resulted in 92%. This was obtained due to the existence of learning media Macromedia Flash *8*-based that was able to conduct a flexible learning process. The second highest indicator was giving learning opportunities, which resulted in 89,3% and was categorized as very good. The third aspect that was assessed in MDLE course was the technicality quality, which resulted in 87,56% and was categorized as very good. There were three indicators in this aspect, such as 1) Readability 2) Easy to use, and 3) Template and viewing design quality.

5. CONCLUSION

Based on the data obtained from the scoring assessment and revison, we conclude that:

1. Developing interactive multimedia in MDLE course was based on local culture conducted in 4 steps as followed: *defining, designing, developing, distributing*. The learning media is named *Multimédia Du Maîtrise de Langue*.
2. The appropriateness of the media learning validated by materials experts resulted in 92.85%, and media experts resulted in 88.89%. The revision was based on the suggestions and comments of the validators. The revision was conducted until the media learning scored 100% by both of the validators, which means *the Maîtrise de Langue* course was approved to be valid and appropriate.
3. The students' response to the mobile-based media learning in MDLE course was positive. This result was approved by the conducted survey that showed that 86,1% of students responded positively towards the application.
4. To be more specific, the application of the interactive multimedia learning application encourages and motivates the students to learn the materials for MDLE course independently as approved by 86% of the students who agreed with the statement.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sumiharsono R, Hasanah H. Media pembelajaran (Learning Media). Jember: Pustaka Abadi; 2018.
2. Dewi PK, Budiana N. Media pembelajaran bahasa: aplikasi teori belajar dan strategi pengoptimalan pembelajaran (Language learning media: application of learning theory and learning optimization strategies). Malang: UB Press; 2018.
3. Azhar A. Media pembelajaran (Learning Media). Jakarta: PT. Raja Grafindo Persada; 2014.
4. Cholid, Angga Achmad. Pengembangan media pembelajaran multimedia interaktif pada mata pelajaran biologi pokok materi peredaran darah untuk siswa kelas XI SMA N I Giri Kabupaten Banyuwangi (Development of interactive multimedia learning media on the subject of basic biology of blood circulation for class XI students of SMA N I Giri, Banyuwangi Regency). Diploma thesis, Universitas Negeri Malang; 2013.
5. Shupe R, Hockman R. Flash CS8 professional. projects for learning animation and interactivity (O'Reilly Digital Studio). Sebastopol: O'Reilly Media; 2006.
6. Bowden. Learning Macromedia Flash 8 Module 1 (Introductory) . Belmont: Guided Computer Tutorials. 2006;1.
7. Andi. Microsoft visual basic 6.0 untuk pemula, MADCOMS (Microsoft visual basic 6.0 for beginners MADCOM), Yogyakarta; 2008.
8. Alessi and Trollip. Multimedia for learning: methods and development. Massachusetts: A Pearson Education Company; 2001.
9. Lin PH. Evaluating students' learning achievement and flow experience with tablet PCs based on AR and tangible technology in u-learning, Library Hi Tech. 1994;35(4):602-614. Available:https://doi.org/10.1108/LHT-01-2017-0023
10. Cuq JP. Dictionnaire de didactique du français LE LS, Coll, Asdifle. Clé; 2003.
11. Cruce. Teaching how to write argumentative texts at primary school. Boston, MA: Kluwer Academic Publishers; 2008.
12. Bereiter C. La rédaction de textes: approche cognitive. Paris: Delachaux et Niestlé S. A; 2008.

13. Bouchard R. Texte, discours, document: Une transposition didactique de grammaire de texte. In L-E Français Dans Le Monde; 2011.
14. Rita C, Richey RC, Klein JD, Tracey MW. The instructional design knowledge base: Theory, research, and practice. New York: Routledge; 2011.
15. Ndongfack MN. Teacher profession development on technology integration using the mastery of active and shared learning for techno-pedagogy (MASLEPT) model. Creative Education. 2015;6:295-308.
16. Ellis TJ, Levy Y. A guide for novice researchers: Design and Development Research Methods. Proceedings of Informing Science & IT Education Conference (InSITE); 2010.
17. Klein JD. Design and development research: A rose by another name. Paper presented at AERA 2014 in Philadelphia, PA; 2014.
18. Tracey MW. Design and development research: A model validation case. Educational Technology Research and Development. 2009;57(4):553-571.
19. Sahrir MS, Alias NA, Ismail Z, Osman N. Employing design and development research (DDR) approaches in the design and development of online Arabic vocabulary learning games prototype. TOJET: The Turkish Online Journal of Educational Technology. 2012;11(2).
20. Richey RC, Klein JD, Nelson WA. Developmental research: studies of instructional design and development. In David H, Jonassen (Ed.). Handbook of research on educational communications and technology. 2nd Ed. New Jersey: Lawrence Erlbaum Associates, Publishers; 2008.
21. Richey RC, Klein JD. Design and development research. In J. Michael Spector, M. David Merrill, Jan Elen, and M. J. Bishop (Eds.). Handbook of research on educational communications and technology 4th Ed. New York: Springer; 2014.
22. Richey RC, Klein JD. Developmental research methods: Creating knowledge from instructional design and development practice. Journal of Computing in Higher Education. 2005;16(2):23-38.