

# The development of acid-base e-chemistry magazine as interactive teaching materials

O Tarawi<sup>1</sup>, A M Noer<sup>1</sup> and R Linda<sup>1</sup>

<sup>1</sup>Chemistry Education, Universitas Negeri Riau, Pekanbaru, Indonesia

Corresponding author: rozalinda@gmail.com

**Abstract.** E-Chemistry Magazine that has been developed is a teaching materials that utilizes the development of technology to improve the quality of a learning process. The objective of this research is to develop an interactive e-chemistry magazine for the acid-base course unit. The method used in this research is the Plomp model research and development (R&D) design. This research consists of three phases, (a) preliminary research phase, (b) prototype or development phase, and (c) assessment phase. The result of this research indicates that acid and base e-chemistry magazine is considered to be strongly valid by the content and media experts. The responses from teachers and students regarding the acid and base e-chemistry magazine are very good and very interesting. This suggests that the production of acid and base e-chemistry magazine meets the decent criteria to be used as interactive teaching materials in the learning of chemistry for the acid-base course unit.

**Keywords:** *e-module, e-chemistry magazine, kvisoft flipbook maker, acid-base*

## 1. Introduction

It is said that the 21st century is a century of knowledge [1], [2], a century of information technology, a century of globalization or a century of openness [3]. Therefore, in the 21st century, there is a complete rapid and unpredictable change in all aspects of life such as economics, transportation, technology, communication, information, education, and others [4].

The phenomenon that occurs in the education section in the 21st century, especially in national education, is the occurrence of globalization or openness, internet culture, and cyber society. This is due to the onset of internet technology development that currently allows internet users to engage in various cyberspace interactively between themselves and the computer or other fellow users either individually or groups in their environment or in other continents within an indefinite duration of time [5].

Regarding the phenomenon in this education section, national education faces various challenges namely: educational paradigm shift, preparation of human resources competence in the 21st century, the challenges to develop the curriculum 2013 which is adjusted to the 21st century education, and also the challenges of education/learning technology related to the 21st century education as well as education/learning technology challenges related to the implementation of curriculum 2013 [6].

The challenges are creating a bigger impact with the industrial revolution of 4.0 or the Fourth World Industrial Revolution which is an era viewing information technology as a base of human life [7]. Along with these challenges, the current implementation of learning needs to be supported with the use of technology-based teaching materials. Technology-based teaching materials are going to



make students able to adapt to the flow of information technology developments. Students who are accustomed to using IT-based media indirectly will also develop their skills in the field, so there are more qualified graduates who can compete globally and master the development of technology [8].

One of the technology-based teaching materials that can be used as a supporting content for students in the learning process is an e-module or a module that is packaged in an electronic form. Electronic module (e-module) is a kind of independent teaching materials compiled systematically with certain learning units, which are presented in electronic format, in which each learning activity is connected to a link as a navigation that encourages students to be more interactive with the program. The program is equipped with video tutorials, animations and audio to enrich the learning experience [9].

Currently, the development of e-modules as alternative teaching materials can be operated in some applications. One of them is *kvisoft flipbook maker* [10]-[14]. This application will become a guide in the learning process because the application is not only fixed on writings, yet some other elements can also be inserted, such as animated motion, video, and audio. Those elements can make a learning media interactive and interesting. Therefore, the learning becomes not monotonous [15].

Along with the development era, there have been a huge number of innovations in the development of e-module. One of which is the E-module Magazine. E-Magazine, is an interactive e-module adapted from the characteristics of magazine in which the language delivered is simpler, it contains interesting information related to the application of learning media in everyday life, and it provides an interactive evaluation in the form of crosswords and quizzes [16] so that it can be used in the chemistry course units.

Chemistry is a part of natural science acquired and developed based on experiments to find answers to the questions of what, why and how natural phenomena are specifically related to composition, structure, nature, transformation, dynamics, and energetics of substances [17]. From the perspective of students, chemistry is a difficult subject since it is abstract and complex that it requires reasoning and high-level thinking [18], [19]. Thus, students face difficulties in learning and create mistakes in understanding the chemistry subject [20].

One of the course units in chemistry class XI SMA/MA is acid and base. This unit is about the substances of acid and base which are closely related to everyday life. Based on the mock-up test result, it is determined that the percentage of students achieving the minimum passing grade, which is 76, of acid-base course unit is in respectively SMAN 8 Pekanbaru 50%, SMA Cendana Pekanbaru 85%, MAN 2 Pekanbaru 80%, and SMAN 2 Bangkinang 50%.

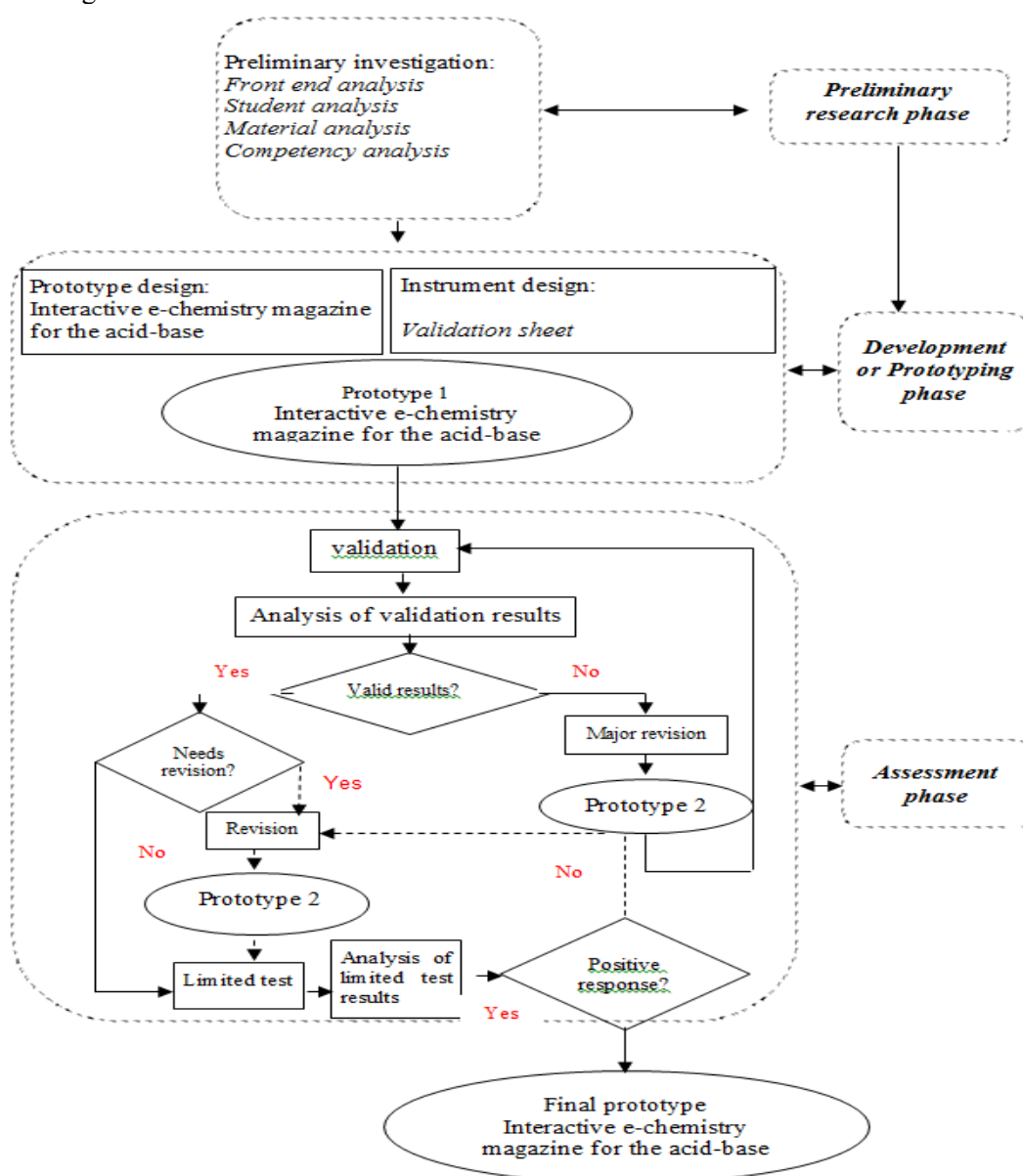
Based on the interview and observation results in the same school, the teaching materials used in the learning process are still in the form of printed books, worksheets, and modules that are available on the internet. With the limitation of these teaching materials, the impact is that the students become not independent, unmotivated and less active in the learning process [16]-[21]. It turns out that the learning process in the classroom becomes not optimized.

The result of the research development of e-module combining science process skills by Fengky Adie Perdana dkk [22] has been developed by integrating the science process skills with the criteria very well, judging from the result of validation content, validation media, validation of peer education and practitioners, with an average value 3.80. Development of electronic modules using *kvisoft flipbook maker* on chemistry equilibrium by Sri Indra Wahyuni dkk [13] has been successfully designed by using the Plomp model of R&D method and it is considered valid for the use of learning activities with the percentage of media experts 94.8%, content experts 88.46%, and the practical test with a teacher's response of 95.29%. The interactive e-module development is done through chemistry magazine with the application of *kvisoft flipbook maker* for the second semester of chemistry subject in high schools by Roza Linda [12] has been successfully developed with the Plomp model of R&D research design and a valid declaration of content validator with a score of 93.75% and 94.45%, and the media validator with the score of 91.79% and 94.18%. E-module is also considered helpful for the students and the teachers with a percentage of 88.45% and 87.70 % for the equilibrium edition of the ion and the pH of buffer solution which is 91.43% and 94.25% for the solubility equilibrium edition.

And the development of chemical e-module based on problem of learning by LM. Zulfahrin UZ dkk [23] has been developed with the feasibility test of the material have obtained a score 81 and the percentage is 98.9% with the category very well. Percentage of media validation results is 97.1%. The article carries the research study and the development aiming to create a valid interactive e-chemistry magazine for the acid-base course unit.

## 2. Research method

This research used the Plomp model of research and development (R&D) design which consists of preliminary research phase, prototype or development phase, and assessment phase [24]. The research flow be seen in figure 1.



**Figure 1.** Research flow development of an interavtive e-chemistry magazine for the acid-base.

This research is conducted from June to September 2019. The development phase of acid and base e-chemistry magazine is conducted at the Faculty of Education Universitas Riau in the Master of

Chemistry Education study program and the small-scale trials phase is conducted at SMA Cendana Pekanbaru.

The data collection methodologies conducted in this research are interviews and questionnaires. The interview is conducted by interviewing teachers and students about the chemistry teaching-learning process in the school. Questionnaires are conducted during the expert validation of content and media, and also the small-scale trials. The instruments used are the interview sheet of teachers and students, the validation sheet of the content and media of acid and base E-Chemistry Magazine, and the questionnaires of the teachers' and students' responses.

The data analysis techniques of validity, practicality, and interest of acid-base E-Chemistry Magazine on the Likert scale [25].

**Table 1.** The categories of likert assessment scale.

Assessment Scale	Notes
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree

Based on The Categories of Likert Scale Table 1, the calculation of the average percentage in each component is using the formula as follows:

$$P = \frac{n}{N} \times 100\% \quad (1)$$

P: Score percentage (rounded off), n : The total score, N: Maximum scores

After obtaining the results of the calculation of the percentage score then compared with the table criteria of validity, practicality and interest [26]-[28] as in table 2 below:

**Table 2.** The criteria of validity, practicality, and interest.

Percentage	Criteria		
	Validity	Practicality	Interest
81-100	Strongly valid	Very good	Very interesting
61-80	Valid	Good	Interesting
41-60	Less valid	Less good	Less interesting
21-40	Not valid	Bad	Not interesting
< 20	Strongly not valid	Very bad	Not interesting at all

### 3. Results and Discussion

The development result by the researchers is the production of the acid base E-Chemistry Magazine as interactive teaching materials. The research was conducted using the Plomp model of research and development (R & D) design [24].

In the preliminary research phase, a preliminary investigation consisting of the analysis of front end, students, competence and content is conducted. Analysis of the front end is conducted in a variety of relevant literature and interview with high school or MA chemistry teachers in Pekanbaru and Bangkinang namely SMAN 8 Pekanbaru, SMA Cendana Pekanbaru, MAN 2 Pekanbaru, and SMA N 2 Bangkinang.

The results of literature studies and interviews of high school or MA chemistry teachers are known that the teaching materials used in the schools are still printed in the form of printed, worksheets, and some learning modules. This teaching materials are assessed as less interesting for the students because it only contains subject descriptions, formulas and drawings. That is why the students become less interactive in the teaching-learning process. Afterward, an analysis of the students is conducted. The preliminary questionnaires and interview results conclude that the students' understanding of acid-base course unit is low. Therefore, the students are keen on interactive teaching materials that can be used to learn the concepts of acid and base independently.

The next step is an analysis of competence and content analysis. A competence analysis is carried out on the high school/MA chemistry syllabus issued by the Ministry of Education and Culture. The content analysis is aimed to study the concepts of acid and base which correspond to the lesson indicators and objectives derived from the syllabus.

In the development or prototype phase, it aims to design the problem solving occurring in the initial investigation. This phase includes prototype design and instrument design. Before the production of the prototype in the form of acid and base E-chemistry magazine, tools and media are collected, which are in the form of text, image, audio, video, animation, flash, link, and software, that support the design of acid and base e-chemistry magazine. After all tools and media are collected, outlines that correspond to the components of acid and base E-chemistry magazine are created.

After the designing process of acid and base e-magazine finishes, the following step is assessing the acid and base e-magazine based on the assessment instrument that has been designed. This designed instrument is the assessment instrument for the validity (media and content experts) prototype and the assessment instrument for the practicality and interest of the users (teachers and students) regarding the acid and base e-magazine which has been developed.

In the assessment phase, validation is conducted on the developed acid and base e-magazine by six experts, consisting of 3 content experts and 3 media experts. The validation assessment of content expert consists of the content substance and learning design aspects while the validation assessment of media experts consists of display aspect (visual communication) and software utilization. The validation result of the content experts regarding the prototype is shown in table 3.

**Table 3.** The validation result of acid-base e-chemistry magazine by content experts.

No	Aspects	Content Expert Validator Team				Criteria
		I	II	III	Average	
1.	Content Substances	89.58%	89.58%	81.25%	86.80%	Strongly valid
2.	Learning Design	90.00%	95.00%	95.00%	93.34%	Strongly valid
	Average	89.79%	92.29%	88.13%	90.07%	Strongly valid
	Criteria	Strongly valid	Strongly valid	Strongly valid	Strongly valid	

The assessment of the three content expert validators, the result is that the developed acid and base e-chemistry magazine for the aspects content substances and learning design has fulfilled the criteria validity with an average percentage of 90.07% and categorized as strongly valid because it is in the interval from 81 to 100% [26], [27]. This results also correspond with the research “development of e-magazine interactive learning media on the subject rotational dynamics for class XI high school” by Jalilah Rahmastuti Nurjanah, Sukarmin and Dwi Teguh Rahardjo (2014) which showed that the electronic magazines developed were valid with very good criteria [16], the research “the development of web-based interactive contextual e-modules on the subject of chemistry of carbon compounds” by Yulia Nalarita and Tomi Listiawan (2018) which showed that e-module based on material expert tests were valid with a percentage of 90.79% with criteria very worthy [29] and the research “the development of chemical e-module based on problem of learning to improve the concept of student understanding” by LM. Zulfahrin UZ, Haryono and Sri Wardani (2019) which showed the feasibility test of the material have obtained a score of 81 and the percentage is 98.9% with the category very well [21], then according to the study, acid-base e-chemistry magazine declared strongly valid.

The results of the content expert validators shows that the material presented in the developed acid-base e-chemistry magazine has clear, complete and correspond with the demands of core competencies and basic competencies in the 2017 curriculum syllabus for acid-base material [17].

The language used in the acid-base e-chemistry magazine has correspond with Indonesian language rules that are good and right, communicative and easy to understand. A good e-module uses simple sentences so that the information conveyed is clear and user friendly [9]. Presentation in the acid-base e-chemistry magazine has correspond with the indicators and learning objectives that have been

formulated. Presentations in the acid-base e-chemistry magazine equipped with pictures, videos, animations, quizzes, crossword and interesting info about acid-base material. It aims to make students more motivated and enthusiastic in learning and to increase understanding students' of acid-base material. The e-chemistry magazine is also equipped with evaluation questions created using the wondershare, so students can know directly the value/final results after answering all the questions in the evaluation question. Evaluation questions are a tool used to measure the success of the achievement of learning objectives that have been formulated [30]. The subsequent validation is validation by media experts. The content expert validation result on the prototype is presented in table 4.

**Table 4.** The validation result of acid and base e-chemistry magazine by media experts.

No	Aspects	Media Expert Validator Team				Criteria
		I	II	III	Average	
1.	Display (visual communication)	88.64%	90.91%	95.46%	91.67%	Strongly valid
2.	Software utilization	85.71%	92.86%	92.86%	90.48%	Strongly valid
	Average	87.18%	91.89%	94.16%	91.08%	Strongly valid
	Criteria	Strongly valid	Strongly valid	Strongly valid	Strongly valid	

The assessment of the media expert validator, it is observed that the developed acid and base e-chemistry magazines have met the criteria of media validity with an average percentage of 91.08% and categorized as strongly valid because it is in the intervals from 81 to 100% [26], [27]. Hilal Ahmad Wani [31] explains that the existence of the e-learning method supports a learning process because it utilizes computer technology which is currently developing. A considerable percentage in the media aspect regarding the assessment of acid and base e-chemistry magazine indicates that the developed acid and base e-chemistry magazine gives significant support in the teaching-learning process.

After going through the validation phase by the content and media experts and being declared as valid, the following phase is the acid and base e-chemistry magazine is tested using small-scale trials to acknowledge the teachers' response toward the practicality of the acid and base e-chemistry magazine as well as to recognize the responses of the students. The trial is conducted on 1 chemistry teachers and 3 students with the diverse understanding level of the students: novice, intermediate and advanced based on information from the teacher. The result of the teachers' and students' responses toward acid and base e-chemistry is presented in tables 5 and 6.

**Table 5.** The Result of the teachers' response toward acid and base e-chemistry magazine.

Average Percentage	Practicality Criteria
93.34%	Very good

**Table 6.** The Result of the students' response toward acid and base e-chemistry magazine.

Average Percentage	Interest Criteria
94.45%	Very interesting

Based on the trial result on the teachers and students through the teacher questionnaire response and students questionnaire response to the e-chemistry magazine, the results show that acid and base e-chemistry magazine has practicality very good criteria [26] with percentage 93.34% and very interesting criteria [28] with percentage 94.45%. This interesting assessment is based on a one-on-one interview with the students' regarding their opinion on the design of this e-chemistry magazine. This e-chemistry magazine design is coupled with the characteristics of the electronic magazine that has several advantages. These advantages include, electronic magazines packaged in a simpler language and have interesting information about the application of acid-base in everyday life, so students are more interested in reading, easier to understand the material and make learning not boring. This

indicates that the developed acid and base e-chemistry magazine as interactive teaching materials embodies decent criteria to be used as teaching and learning aids for acid-base course unit.

#### 4. Conclusion

The acid and base e-chemistry magazine as interactive teaching materials has successfully developed with the Plomp model of research and development (R&D) design. Afterward, the validation is conducted by media and content experts, resulting in average score whose criteria is strongly valid. Teachers' and students' response regarding the acid and base e-chemistry magazine results in the average score whose criteria is very good and very interesting. Therefore, the developed acid and base e-chemistry magazine is feasible to be used as interactive teaching materials in the chemistry subject for acid and base course unit.

#### References

- [1] S T Arsad N and Osman K 2010 *Proc. International Conference On Learner Diversity 2010* (Bangi) vol 7 (Amsterdam: Elsevier) p 546-54 <https://doi.org/10.1016/j.sbspro.2010.10.073>
- [2] Mukhadis A 2013 *Jurnal Pendidikan Karakter* **3** 115-36
- [3] Wijaya E Y Sudjimat D A dan Nyoto A 2016 *Proc. Seminar Nasional Pendidikan Matematika* (Malang) vol 1 (Malang: Universitas Kanjuruhan Malang) p 263-78
- [4] Redhana I W 2019 *Jurnal Inovasi Pendidikan Kimia* **13** 2239-53
- [5] Muhali 2019 *Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: e-Saintika* **3** 25-50
- [6] Yuliati Y 2017 *Jurnal Cakrawala Pendas* **3** 21-28
- [7] Surani D 2019 *Proc. Seminar Nasional Pendidikan* (Serang) vol 2 (Serang: Universitas Sultan Ageng Tirtayasa) p 456 - 69
- [8] Kanematsu H and Barry D M 2016 *STEM and ICT Education in Intelligent Environments. Intelligent Systems Reference Library* (Berlin: Springer International Publishing) Chapter 2 pp 33-6
- [9] Atmaji R D dan Maryani I *Fundamental Pendidikan Dasar* **1** 28-34
- [10] Fonda A and Sumargiyani 2018 *Journal of Mathematics Education* **7** 109-22 <https://doi.org/10.22460/infinity.v7i2.p109-122>
- [11] Wibowo E dan Pratiwi D D 2018 *Desimal: Jurnal Matematika* **1** 147-56
- [12] Linda R Herdini Sulistya I S and Putra T P 2018 *Journal of Science Learning* **2** 21-25 <https://doi.org/10.17509/jsl.v2i1.12933>
- [13] Wahyuni S I Noer A M and Linda R 2018 *Proc. of the 2<sup>nd</sup> URICES* (Pekanbaru) vol 1 (Riau: Universitas Negeri Riau) p 178 - 89.
- [14] Fahmi S Priwantoro S W Cahdriyana R A Hendroanto A Rohmah S N and Nisa L C 2019 *Proc. The Sixth Seminar Nasional Pendidikan Matematika Universitas Ahmad Dahlan 2018* (Yogyakarta) (Bristol: IOP) p 1 – 6 <https://doi:10.1088/1742-6596/1188/1/012075>
- [15] Asmi A R Surbakti A N D Hudaidah C 2018 *Jurnal Pendidikan Ilmu Sosial* **27** 1-10
- [16] Nurjanah J R, Sukarmin dan Rahardjo D T 2014 *Jurnal Materi dan Pembelajaran Fisika* **3** 18-25
- [17] Irawati R K 2019 *Thabie: Journal of Natural Science Teaching* **2** 1-6
- [18] Tsapartis G and Zoller U 2003 *J.Chem.Educ* **7** 50-57
- [19] Lubezky A Dori Y J and Zoller U 2004 *J.Chem.Educ.Res.Prac* **5** 175-84
- [20] Wahyuni I T Yamtinah S Utami B 2015 *Jurnal Pendidikan Kimia* **4** 222-31
- [21] Accraf L B R Suryati dan Khery Y 2018 *Hydrogen: Jurnal Kependidikan Kimia* **6** 133-41
- [22] Perdana F A Sarwanto Sukarmin and Sujadi I 2017 *International Journal of Science and Applied Science: Conference Series* **1** 45 – 54 <https://doi.org/10.20961/ijsascs.v1i1.5112>
- [23] Zulfahrin LM UZ Haryono and Wardani S 2019 *Innovative Journal of Curriculum and Educational Technology* **8** 59-66 <https://doi.org/10.15294/ijcet.v8i2.31340>
- [24] Akker J V D Bennan B Kelly A E Nieveen N Plomp T 2013 *Educational Design Research* (Enschede: Netherlands Institute for Curriculum Development) Chapter 1 pp 10-51

- [25] Warbrod J R 2014 *Journal of Agricultural Education* **55** 30-47
- [26] Muriati S 2014 *Jurnal Florea* **1** 14–20
- [27] Prasetyo N A dan Perwiraningtyas P 2017 *Jurnal Pendidikan Biologi Indonesia* **3** 19-27
- [28] Irmawati Degeng I N S dan Djatmika E T 2017 *Jurnal Pendidikan* **2** 604-9
- [29] Nalarita Y dan Listiawan T 2018 *Multitek Indonesia: Jurnal Ilmiah* **12** 85-94
- [30] Budiono E dan Susanto H 2006 *Jurnal Pendidikan Fisika Indonesia* **4** 79-87
- [31] Wani H A 2013 *Jurnal Kajian Pendidikan* **3** 181-94