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Development of Google Sites Based Learning Media on Chemical Bonds with Multilevel Chemical Representation

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Abstract: Website-based online learning media are needed by students to make it easier to understand multilevel representations of chemistry during the COVID-19 pandemic. This study aims to develop learning media based on *google sites* on chemical bonding material containing multilevel chemical representations and determine product quality. This media development adapts the 4-D development model, consisting of four stages: define, design, development, and disseminate. Quality assessment was carried out by material experts, media experts, chemistry teachers, and students responded. The research instrument was a product quality assessment sheet and student response sheets. The results showed that the quality of the media developed based on the assessment by the media obtained an ideal percentage of 97.5% in the excellent category, material experts obtained an ideal percentage of 85% in the excellent category, and chemistry teachers obtained an ideal percentage of 97% in the excellent category. Learning media based on *google sites* on chemical bonding material containing multilevel chemical representations also responded positively with a percentage of 93.75%. It can be concluded that the developed media is suitable for use in the learning process to improve students' multi-representation abilities on chemical bonding material.

Keywords: Chemical bonds; Google sites; Multilevel representation

Introduction

The COVID-19 pandemic is a big challenge for the world of education around the world (Daniel, 2020). Almost all countries limit school learning activities, disrupting the learning process (Burgess & Sievertsen, 2020). Learning media is needed in the learning process because teachers can convey material to students to be easier to understand (Nurrita, 2018). However, due to the COVID-19 pandemic, the ministry of education in Indonesia implemented a policy for students to carry out learning activities from home (Aliyyah et al., 2020).

Online learning is a solution in learning activities during the COVID-19 pandemic. According to Herliandry et al. (2020), online learning can conveniently convey material information in various situations and conditions. However, students think online learning is less effective than offline learning (Nurlatifah, 2021). Therefore, for the learning process to run optimally, online learning must be done through content design using appropriate learning media (Adnan & Anwar, 2020). Effective learning media can support the learning process, making it easier for teachers to teach and more accessible for students to understand the material (Komariah, 2016).

One subject requiring learning media is chemistry (Hardeli et al., 2021). Chemistry is a subject considered complex and abstract by students (Chittleborough, 2004). One of the chemical materials considered difficult by students is chemical bonds (Sari et al., 2020; Pérez et al., 2017). According to Safitri et al. (2018), a chemical bonding material is considered difficult based on the errors experienced by students, including (1) students do not understand the process of forming ionic bonds, so they cannot describe the representation correctly, (2) students cannot yet understand the process of forming ionic bonds. Distinguish compounds with ionic and covalent bonds, and (3) students do not understand the

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concept of metallic bonds, so they cannot explain how metal bonds can be formed. Afifulloh & Cahyanto (2021) added that the results of students' daily tests on chemical bonding material under the minimum completeness criteria. Teachers have difficulty conveying chemical bonding material, especially in bond formation. This difficulty is because the learning media used are not suitable for online learning during the pandemic.

Increasing students' understanding of chemical representations can be done by visualizing three chemical representation levels: macroscopic, symbolic, and submicroscopic (Sukmawati, 2019). According to Chittleborough (2004), these three levels are interrelatedand contribute to students' construction of meaning and understanding. Therefore, efforts are needed to visualize and relate the three levels of chemical representation, one of which is the use of learning media (Agang et al., 2021).

One learning media used during this pandemic is website media with Google Sites (Japrizal & Irfan, 2021). According to Mukti & Anggraeni (2020), learning media based on Google Sites can support online learning because of its flexible nature to be accessed on various devices such as smartphones, laptops, and tablets. This makes it easier for students to access without taking up storage space on the device they are using, and there is no need to install applications. Media websites based on Google Sites can also improve student learning outcomes (Dewi, 2020). Website-based learning that contains audio and visuals can increase students' interest in learning in class (Mutia et al., 2020). Taufik et al. (2018) added that Google Sites are the easiest and most straightforward way to build web-based learning media for teachers. The teacher only uses drag and click to set up access control and requires no programming knowledge. In addition, Google-based websites are free of charge or free and easy to access. It is hoped that learning media based on Google Site chemical bonding material can make it easier for teachers to explain multilevel chemical representations and make it easier for students to understand the learning materials provided by the teacher.

Method

The development model used in this study adopts the 4-D research model, which includes the stages: define, design, develop, and disseminate. The defined stage is a literature study, field survey for needs analysis, and curriculum analysis for problem identification. A needs analysis was conducted through a literature study and interviews. Curriculum analysis was carried out by studying the 2013 curriculum literature. The design phase was carried out by making instruments, selecting formats, and designing initial products, namely preparing a prototype of learning media based on google sites containing multilevel chemical representations for the subject matter of chemical bonds. Making research instruments consists of quality assessment instruments and student responses to the product. The instrument used is an instrument that the instrument validator has validated. Format selection is made by collecting learning material references from good learning sources. Making the initial design is done by compiling as a whole to systematically describe the overall content of the material in the google sites. Each component in Google Sites is developed with colors, animations/images, easy-to-understand language, and learning materials are equipped with videos containing multilevel chemical representations. The development stage involves media development, product validation, and product quality assessment. This development research resulted in google sites-based learning media on chemical bonding material with multilevel chemical representations. The learning media developed are then assessed for quality by material experts, media experts, chemistry teachers, and student responses to the products developed.

The data obtained in this study are quality assessment data by material experts, media experts, chemistry teachers, and data on student responses to the product. The data collection instruments used were product quality assessment sheets and student response sheets. The data on the quality assessment results by material experts, media experts, and chemistry teachers were analyzed by changing the results of the product quality assessment in the form of letters (qualitative data) into scores (quantitative data). Then the average score was calculated from the assessments of material experts, media experts, and chemistry teachers. Furthermore, the average score for all aspects of the assessment and each assessment aspect is converted into a qualitative value following the ideal assessment criteria with the provisions listed in Table 1 (Widoyoko, 2011).

Table 1. Criteria for Ideal Assessment Category

Score range (i) quantitative	Qualitative
$Xi + 1.80\ SBi < \bar{x}$	Very good
$Xi + 0.60\ SBi < \bar{x} \leq Xi + 1.80\ SBi$	Well
$Xi - 0.60\ SBi < \bar{x} \leq Xi + 0.60\ SBi$	Enough
$Xi - 1.80\ SBi < \bar{x} \leq Xi - 0.60\ SBi$	Not enough
$\bar{x} \leq Xi - 1.80\ SBi$	Very less

The ideal percentage of media quality is calculated for all aspects of the assessment by the Formula 1.

$$\% \text{ ideality of each aspect} = \frac{\textit{The average score of all aspects}}{\textit{The gighest score ideal for all aspects}} x100\% \quad (1)$$

The ideal percentage of student responses to chemistry learning media is calculated for each aspect using the following Formula 2:

$$\% \text{ ideality of each aspect} = \frac{\textit{The average score of each aspects}}{\textit{The gighest score ideal for each aspects}} x100\% \quad (2)$$

Result and Discussion

This development research resulted in google sites-based learning media on chemical bonding material with multilevel chemical representations. The research model adapts the 4-D model, including four stages: define, design, develop, and disseminate. However, it is only limited to the dissemination stage. In the define stage, the needs analysis was conducted by interviewing the chemistry teacher of SMA Colombo Sleman and MA PPPI Miftahussalam Banyumas. Based on the interviews, information was obtained that learning chemistry in schools did not contain many concepts of multilevel chemical representation, especially on chemical bonding material. Curriculum analysis is also conducted to determine core competencies, essential competencies, and indicators of competency achievement to be developed in the media.

The *design stage* is carried out by making instruments and designing the initial product. The assessment instrument contains usability, arrangement, design, content, and chemical representation aspects. Format selection is made by collecting learning material references from various valid sources. The references include university and high school chemistry books. The materials collected include chemical bonds in ionic compounds, covalent compounds, metals, and the role of chemical compounds in everyday life. The initial design of learning media was made on the *Google Sites platform* with the help *of Corel Draw X7 software*, *Adobe Illustrator CC 2021, Adobe After Effects CC 2021, Adobe Premiere Pro CC 2021*, *Wave Editor*, and *Noise Reducer*. The process of designing instructional media design consists of the design of learning videos containing multilevel chemical representations and *website designs* developed through *google sites.*

The development stage is carried out with media development and product quality assessment. The website platform used in the development of learning media is google sites. The choice of purple in chemical bonding google sites gives a unique impression, especially on the logo, to make it look dominant and attract students' attention in increasing interest in learning. The type of font used on the website is PT Sans. PT Sans is designed with good pressure, open form, and a neutral yet friendly appearance. They are making website display designs such as headers, logos, navigation, and website menu icons using Corel Draw X7 software. Learning media based on google sites on chemical bonding material containing multilevel chemical representations can adapt to the device used. The product is compatible with mobile, desktop, and tablet displays.

The chemical bond google sites page consists of Home, KI – KD – GPA, Learning Materials, Practice Questions, Recap Values, and Bibliography. The homepage of the chemical bonding google sites contains logos, navigation, website information, and icons. The view of the homepage can be seen in Figure 1.

Figure 1. Home View

The website's KI - KD - GPA page contains information on Core Competencies, Basic Competencies, and Competency Achievement Indicators. The display of the KI – KD – GPA page can be seen in Figure 2.

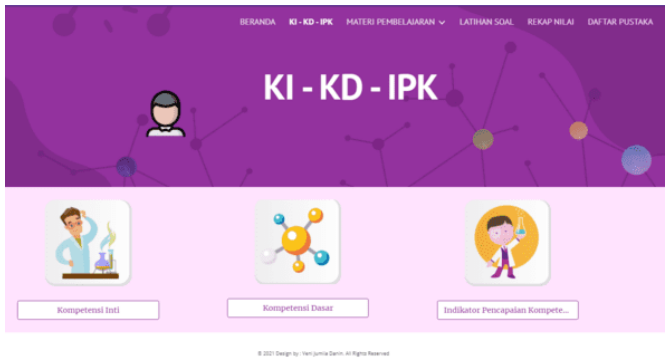

Figure 2. KI – KD – GPA page display

The learning material page on the website contains a summary of the material accompanied by a chemical bond learning video containing multilevel chemical representations. The material presented consists of sub-chapters Valence Electrons, Lewis Structures, Elemental Stability, Ionic Bonds, Covalent Bonds, Coordination Covalent Bonds, and Metallic Bonds. Learning materials are displayed through the icon of each sub-chapter, and there is also a drop-down menu on the navigation of

learning materials. The display of learning materials on the product can be seen in Figure 3.

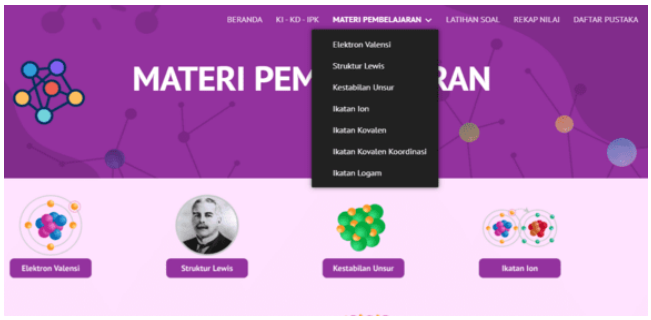

Figure 3. Display of learning materials

On the material page, a learning video is also presented. Making learning video designs using Adobe Illustrator CC 2021, Adobe After Effect CC 2021, and Adobe Premiere Pro CC 2021 graphic design software. In addition, the Wave Editor and Noise Reducer audio editor applications are also used. Videos are made to represent ionic bonds, covalent bonds, coordinate covalent bonds, and metallic bonds at macroscopic, submicroscopic, and symbolic levels. The learning video on chemical bonding material containing multilevel chemical representation begins with the video's title, namely the types of chemical bonds equipped with their understanding, and continues with the concept of multilevel chemical representation uploaded on Youtube. The display of learning videos on the website can be seen in Figure 4.

Figure 4. Display of learning videos

The practice page contains questions as an exercise for students after understanding the learning material. The practice questions are arranged according to the Competency Achievement Indicators, and the writing is done on google forms. Practice questions contain 25 multiple choice questions that are displayed randomly. The display of the practice questions on the product can be seen in Figure 5.

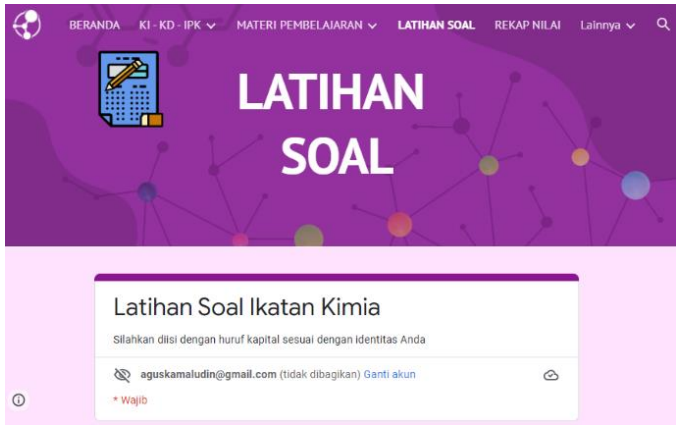

Figure 5. Exercise page display

The score recap page contains information on student scores after doing the practice questions as a means of evaluation. The score recap displayed contains information on the full name, class, school origin, and scores obtained by students. The display of the value recap page on the product can be seen in Figure 6.

Figure 6. Display of the value recap page

The bibliography page contains a list of books used in making material on the website. The products that have been developed are then assessed for quality by material experts, medical experts, chemistry teachers, and student responses. The data from the quality assessment by material experts can be seen in Table 2.

Table 2. Quality assessment data by material experts

Assessment Aspect	Number of Indicators	Score	Ideal Maximum Score	% Ideal	Category
Content	3	10	12	83.33	Very good
Chemical Representation	2	7	8	87.50	Very good
Total	5	17	20	85.00	Very good

Based on Table 2, the results of the assessment by material experts on the content aspect obtained a score of 10 with a maximum score of 12 and the ideal percentage of 83.33%; aspects of chemical representation obtained a score of 7 with a maximum score of 8 and the ideal percentage of 87.50%. The assessment results by material experts obtained an ideal percentage of 85% and were included in the Very Good category. The assessment results by media experts can be seen in Table 3.

Table 3. Data validation of learning media by media experts

Assessment Aspect	Number of Indicators	Score	Max Score. Ideal	% Ideal	Category
Utility	2	7	8	87.50	Very good
Arrangement	4	14	16	87.50	Very good
Design	4	15	16	93.75	Very good
Total	10	36	40	90.00	Very good

Based on Table 3, the results of the assessment by media experts on the usability aspect obtained a score of 7 with a maximum score of 8 and the ideal percentage of 87.5%; the regulatory aspect obtained a score of 14 with a maximum score of 16 and the ideal percentage of 87.5%; the design aspect obtained a score of 15 with a maximum score of 16 and the ideal percentage of 93.75%. The assessment results by media experts obtained an ideal percentage of 90.0% and were included in the Very Good category.

Data on the quality of Google sites learning media containing multilevel chemical representations was assessed by five chemistry teachers. The quality assessment of google sites containing multilevel chemical representations is divided into five aspects: usability, regulatory, design, content, and representation. Data on the results of product quality assessment by chemistry teachers can be seen in Table 4.

Table 4. Data on the assessment of the quality of learning media by *reviewers*

Assessment Aspect	Number of Indicators	Score	Max Score. Ideal	% Ideal	Category
Utility	2	39	40	97.50	Very good
Arrangement	4	76	80	95.00	Very good
Design	4	79	80	98.75	Very good
Content	3	58	60	96.67	Very good
Chemical Representation	2	39	40	97.50	Very good
Total	15	291	300	97.00	Very good

Based on Table 4 shows that the results of the assessment of the quality of the media by the chemistry teacher on the usability aspect obtained a score of 39 with a maximum score of 40 and the ideal percentage of 97.5%. The regulatory aspect obtained a score of 76 with a maximum score of 80 and an ideal percentage of 95%. The design aspect obtained a score of 79 with a maximum score of 80 and the ideal percentage of 98.75%. The content aspect obtained a score of 58, with a maximum score of 60 and the ideal percentage of 96.67%. Aspects of chemical representation obtained a score of 39, with a maximum score of 40 and the ideal percentage of 97.5%. The assessment results by the chemistry teacher as a whole obtained an ideal percentage of 97%, so it was included in the Very Good category. *Google sites* -based learning media on chemical bonding material with multilevel chemical representations responded by ten high school students, incredibly the Mathematics and Natural Sciences major. Student response data can be seen in Table 5.

Table 5. Data on student responses to learning media

Aspect	Number of indicators	Average score	Ideal maximum score	% ideal
Utility	1	0.9	1	90.00
Content	1	0.9	1	90.00
Arrangement	2	1.9	2	95.00
Design	3	2.8	3	93.33
Chemical representation	1	1.0	1	100.00
Total	8	7.5	8	93.75

Based on Table 5, student responses to learning media based on google sites show that aspects of usability, content, arrangement, design and chemical representation have ideal percentages of 90%, 90%, 95%, 93.33%, and 100%, respectively. The overall ideal percentage is 93.75%, meaning that the developed media

is excellent according to the responses of high school students. The google sites-based learning media on chemical bonding material containing multilevel representations is suitable for learning.

Conclusion

The product developed in this research is a google sites-based learning media on chemical bonding material containing multilevel chemical representations that contain multilevel explanations of chemical representations on chemical bonding materials through animated videos. The quality assessment results by material experts obtained a score of 17 out of a maximum score of 20 with an ideal percentage of 85.00% and included in the Very Good category. The quality assessment results by media experts obtained a score of 36 out of a maximum score of 40 with an ideal percentage of 90.00% and included in the Very Good category. The results of the media quality assessment by SMA chemistry teachers obtained an average score of 58.2 from a maximum score of 60 with an ideal percentage of 97.00% and included in the Very Good category. The results of the response by ten high school students to learning media got a positive response by obtaining an average score of 7.5 from a maximum score of 8 so that it obtained an ideal percentage of 93.75% and was included in the Very Good category.

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Author Contributions

Veni Jumila Denin contributes to conceptualizing the research idea, developing products, analyzing data, and writing articles. Agus Kamaludin, a supervisor in research activities to article writing, reviewed and edited.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper

References

Adnan, M., & Anwar, K. (2020). Online learning amid the COVID-19 pandemic: Students' perspective. *Online Submission, 2(1)*, 45-51. https://doi.org/10.33902/JPSP. 2020261309

Afifulloh, M. & Cahyanto, B. (2021). Analisis kebutuhan pengembangan bahan ajar elektronik di era pandemi covid-19. *Jurnal Pendidikan Dasar Indonesia, 6*(2), 31-36. https://dx.doi.org/10.26737/jpdi.v6i2.2515

Agang, M. F., Tangi, H. C., & Komisia, F. (2021). Integrasi level makroskopik, submikroskopik, dan simbolik melalui pengembangan video pembelajaran pada materi kelarutan dan hasil kali kelarutan (KSP). *Jurnal Beta Kimia, 1*(1), 29-36. https://doi.org/10.201185/jbk.v1i1.5131

Aliyyah, R. R., Rachmadtullah, R., Samsudin, A., Syaodih, E., Nurtanto, M., & Tambunan, A. (2020). The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia. *Journal of Ethnic and Cultural Studies, 7(2)*, 90-109. https://dx.doi.org/10.29333/ejecs/388

Burgess, S., & Sievertsen, H. H. (2020, April 01). *Article: Schools, skills, and learning: The impact of COVID-19 on Education*. Retrieved from https://voxeu.org/article/impact-covid-19-education

Chittleborough, G. D., & Treagust, D. F. (2007). The modeling ability of non-major chemistry education and their understanding of the sub-microscopic level. *Chemistry Education Research and Practice*, 8, 724-292. https://doi.org/10.1039/B6RP90035F

Daniel, S. J. (2020). Education and the COVID-19 Pandemic. *Prospects, 49 (1)*, 91-96. https://doi.org/10.1007/s11125-020-09464-3

Dewi, N. C., (2020). Pengembangan e-learning berbasis google site untuk meningkatkan prestasi belajar siswa. *Jurnal Ilmiah Teknologi Pendidikan, 10*(1), 2010-2016. Retrived form https://ejournal.unib.ac.id/index.php/diadik/article/view/18149/8554

Hardeli, Yerimadesi, Gazali, F., Khair, M., Margarita. (2021). Pembuatan media pembelajaran kimia berbasis IT bagi guru-guru MGMP kimia SMA/MA Kabupaten Tanah Datar. *Jurnal Suluah Komunitas, 1*(1), 12-17. Retrived from: http://sulben.ppj.unp.ac.id/index.php/suluah/article/view/104

Herliandry, L. D., Nurhasanah, N., Suban, M. E., & Kuswanto, H. (2020). Pembelajaran pada masa pandemi Covid-19. *JTP - Jurnal Teknologi Pendidikan*, *22*(1), 65-70. https://doi.org/10.21009/jtp.v22i1.15286

Japrizal, J., & Irfan, D. (2021). Pengaruh penggunaan media pembelajaran berbasis google site terhadap hasil belajar siswa pada masa COVID-19 di SMK Negeri 6 Bungo. *Jurnal Vokasi Informatika, 1*(3), *38-44*. https://doi.org/10.24036/javit.v1i3.33

Komariah, N. (2016). Pemanfaatan blog sebagai media pembelajaran berbasis ICT. *Al-Afkar: Jurnal Keislaman & Peradaban, 5(1)*. https://doi.org/10.28944/afkar.v5i1.111

Mukti, W., Puspita, Y., & Anggraeni, Z. (2020). Media pembelajaran fisika berbasis web menggunakan google sites pada materi listrik statis. *FKIP e-Proceeding, 5(1)*, 56-59. Retrieved from https://jurnal.unej.ac.id/index.php/fkip-epro/article/view/21703

Mutia, L., Gimin, G., & Mahdum, M. (2020). Development of blog-based audiovisual learning media to improve student learning interests in money and banking topic. *Journal of Educational Sciences*, *4*(2), 436-448. http://dx.doi.org/10.31258/jes.4.2.p.436-448.

Nurlatifah. (2021). Efektivitas pembelajaran online versus tatap muka. *Pedagonal: Jurnal Ilmiah Pendidikan, 5*(1), 15-18. Retrieved from: https://journal.unpak.ac.id/index.php/pedagonal/article/view/2893

Nurrita, T. (2018). Pengembangan media pembelajaran untuk meningkatkan hasil belajar siswa. *Misykat, 3(1),* 171-186. http://dx.doi.org/10.33511/misykat.v3n1.171

Pérez, J.R.B, Pérez, M.E., Calatayud, M.L., Garcia-Lopera, R., Montesinos, S., & Gil, E.T. (2017). Student's misconceptions on chemical bonding: A comparative study between high school and first year university students. *Asian Journal of Education and e-Learning*, *5*(1), 2321-2454.

Safitri, A. F., Widarti, H. R., & Sukarianingsih, D. (2018). Identifikasi pemahaman konsep ikatan kimia. *Jurnal Pembelajaran Kimia, 3(1)*, 41-50. http://dx.doi.org/10.17977/um026v3i12018p041

Sari, N., Siduruk, S., Meliawati, R., Sari, A. R. P., (2020). The difficulties of X grade high school students in Palang Raya city academic year of 2018/2019 in understanding chemical bond concept using two-tier multiple choice. Gamaproionukleus, *1*(1), 135-148. https://doi.org/10.37304/jpmipa.v1i2.3686

Sukmawati, W. (2019). Analisis level makroskopis, mikroskopis dan simbolik mahasiswa dalam materi elektrokimia. *Jurnal Inovasi Pendidikan IPA, 5*(2), 195-204. https://doi.org/10.21831/jipi.v5i2.27517

Taufik, M., Sutrio, S., Ayub, S., Sahidu, H., & Hikmawati, H. (2018). Pelatihan media pembelajaran berbasis web kepada guru IPA SMP Kota Mataram. *Jurnal Pendidikan dan Pengabdian Masyarakat, 1(1)*, 77-81. Retrieved from https://jurnalfkip.unram.ac.id/index.php/JPPM/article/view/490.

Thiagarajan, S., Semmel, D.S., & Semmel, M.I. (1974). *Instructional development for training teacher of exceptional children*. Bloomington Indiana: Indiana University.

Widoyoko, E. (2011). *Evaluasi program pembelajaran*. Yogyakarta: Pustaka Pelajar.