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THE ANALYSIS OF JUNIOR HIGH SCHOOL STUDENTS' COMMUNICATION AND COLLABORATION SKILLS IMPROVEMENT USING MULTIMEDIA-BASED INTEGRATED INSTRUCTION (MBI_2) IN LEARNING REFLECTION CONCEPT

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ABSTRACT

This study identifies communication and collaboration skills improvement of junior high school (SMP) students when learning physics using Integrated Multimedia-based Instruction (MBI_2). In this one-shot case study, the subject was thirty-one eight grade students in one of the public schools in Bandung, West Java. Students' communication and collaboration skills were evaluated by learning and laboratory activity observation. Results showed that communication and collaboration skills were improved with four meetings that suggested that MBI_2 could improve junior high school students' communication and collaboration skills.

Keywords: multimedia learning; communication skill; collaboration skills; reflection concept

ABSTRAK

Penelitian ini mengidentifikasi perbaikan keterampilan komunikasi dan kolaborasi siswa Sekolah Menengah Pertama (SMP) ketika belajar Fisika dengan menggunakan *Integrated Multimedia-based Instruction* (MBI_2). Dalam *one-shot case study* ini, subjek adalah 31 siswa di salah satu sekolah negeri di Bandung, Jawa Barat. Keterampilan komunikasi dan kolaborasi siswa dievaluasi melalui observasi kegiatan pembelajaran dan praktikum. Hasil menunjukkan bahwa keterampilan komunikasi dan kolaborasi membaik dalam empat pertemuan yang mengimplikasikan bahwa MBI_2 dapat memperbaiki keterampilan komunikasi dan kolaborasi siswa SMP.

Kata kunci: pembelajaran multimedia; keterampilan komunikasi; keterampilan kolaborasi; konsep refleksi

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INTRODUCTION

In facing the dawn of the 21st Century and the challenges it poses, skills that are essential for navigating the 21st Century grouped as I) ways of thinking, II) ways of working, and III) tools for working in which it is put broadly under Knowledge, Skills, Attitudes, Values, and Ethics or K-SAVE groups (Griffin, Care, and McGaw, 2012). There are ten skills within those four groupings (Griffin et al., 2012; Binkley et al., 2012), namely ways of thinking group (creativity and innovation; critical thinking; problem-solving and decision making; learning to learn and metacognition), ways of working group (communication and collaboration/teamwork), tools for working group (information and ICT literacy), as well as skills for living in the world (changing emphases on local and global citizenship; aspects of life and career development; as well as personal and social responsibility).

Skills within ways of working group can be considered an imminent point of interest in science domain since workforce demanded good communication skills from science graduates, but most students' communication skills were inadequate (Gray, Emerson, and MacKay, 2005). A similar finding was found for collaboration skills in which although team skills are considered an essential skill in the current and future situations; the employer found science graduate to have an underdeveloped skill (Sarkar, Overton, Thompson, and Rayner, 2016). The importance of communication and collaboration skills was also a skill that em-

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ployers regarded to be more significant in the future job market (Coll and Zegwaard, 2006). Specifically for physics graduates, Sharma et al. (2007) found that team working and communication skills are highly valuable skills in which employers emphasize that the habits were formed within the education system.

Tracing back to how communication and collaboration skills are developed within the education system, TIMSS study in 2015 found that although communication and collaboration skills have been emphasized in the curriculum in numerous countries, only 5% of students can communicate their understanding of physics to solve problems in practical and abstract contexts (Mullis, Martin, Foy, and Hooper, 2016). Empirical studies also supported this finding in which communication skill was found to be a concern in a wide range of educational levels, from adolescent (Stanton-Chapman, Denning, and Jamison, 2010) to preservice teacher (Sperandeo-Mineo, Fazio, and Tarantino, 2006). In terms of collaboration skills, Torenbeek, Jansen, and Hofman (2011) study proved that collaboration skills affecting students' achievement. In addressing communication (Spektor-Levy, Eylon, and Scherz, 2009) and collaboration (Deiglmayr and Spada, 2010) skills problems, those studies indicated that improvement could be achieved if intervention is specifically structured to develop communication and collaboration skills.

Computer-Assisted Instruction (CAI) has been widely used since the 1960s, and meta analysis suggested that achievement gains when learning is assisted with computer, it consistently surpass other instruction forms (Fletcher-Flinn and Gravatt, 1995). Bayraktar (2001) meta-analysis of CAI in the science education domain also found that incorporating computers in science instruction can be beneficial, with physics as a science subdomain receiving relatively higher benefits than other science branches. Multimedia-based Instruction (MBI) is a derivative of CAI and studies found MBI to be highly beneficial for learning physics because the use of multimedia enables accessible physics experiments representation (Kirstein and Nordmeier, 2007) and improve physics achievement (Chen, Stelzer, and Gladding, 2010). Furthermore, a recent meta analysis also positively affirm the continued use of multimedia with an integrated design (Schroeder and Cencki, 2018). Unfortunately, the use of MBI specifically targeted to improve students' communication and collaboration skills are currently scarce.

Integrated Multimedia-based Instruction or (MBI_2) is a multimedia-based instruction develop for physics learning (Hermawan, Siahaan, Suhendi, and Samsudin, 2017) and has been implemented previously in physics learning to improve science process skills (Siahaan, Suryani, Kaniawati, Suhendi, and Samsudin, 2017) but not yet specifically use for improving communication and collaboration skills. Therefore, this paper reports the use of MBI2 for improving students' communication and collaboration skills.

METHOD

The MBI_2 program consisted of guidance, curriculum, materials (light reflection sub concept), worksheets, e-book, and evaluation. The guidance submenu covers information about using the program, whereas the curriculum segment consisted of information concerning basic competencies, indicators, learning objectives, and concept maps. Students can access reflection concept explanation (concept submenu), learning activity and experiments (task and worksheets), handbook (e-book), and evaluation by clicking the corresponding sub menu button (Figure 1). Students' communication and collaboration skills were developed via learning activities divided into four 80 minutes sessions. A matrix design of learning implementation is described in detail in Table 1.

Thirty-one eighth-grade junior high school students from a public school in Bandung participated in this study. Students' communication and collaboration skills were evaluated based on learning observation. The observation checklist and indicators were then calculated into a score of students' communication and collaboration skills. Rubric for evaluating written communication was adapted from the Association of American Colleges and Universities "Written Communication Rubric" (2014) and Zane (2011), whereas for measuring collaboration skill was adapted from the International Reading Association's (2005) Read Write Think "Collaborative Work Skills Rubric."

Written Communication total score and its corresponding category were: 1) Very low (Total score: 6-9), 2) Low (10-13), 3) Adequate (14-17), 4) Good (18-21), and 5) Very Good (22-24). As for collaboration skill, the Total score and its corresponding categorical interpretation were:

Table 1. MBI$_2$ Learning Design with Its Communication and Collaboration Skills Aspects

Sub Topic	Learning Activity Using MBI$_2$	Communication Skills Aspect	Collaboration Skills Aspect
Reflection Laws	Stimulate students to explain the specular and diffuse reflection through practicum and animation observation.	Writing (Student Work Sheet)	• Contributions • Time management • Problem solving • Working with others • Research techniques
	Stimulates students to illustrate incoming beams and reflected rays reflected through animation / image observation.	Writing (Student Work Sheet)	
	Stimulate students to explain the light reflection law through practicum and animation observations	Writing (Student Work Sheet)	
Plane Mirror	Stimulate students to determine the distance of the object image through practical activities.	Writing (Student Work Sheet)	• Contributions • Time management • Problem solving • Working with others • Research techniques
	Stimulate students to illustrate the diagram of image formation on a plane mirror through practicum and animation observation.	Writing (Student Work Sheet)	
	Stimulate students to explain the characteristics of plane mirror images through practicum and animation/ picture observation.	Writing (Student Work Sheet)	
Concave Mirror	Stimulate students to determine the concave mirror special ray through practicum and animation / picture observation.	Writing (Student Work Sheet)	• Contributions • Time management • Problem solving • Working with others • Research techniques
	Stimulate students to illustrate the image formation diagram on the concave mirror through animation observation.	Writing (Student Work Sheet)	
	Stimulate students to explain the characteristics of the concave mirror image through the animation / picture observation.	Writing (Student Work Sheet)	
Convex Mirror	Stimulate students to determine the convex mirror special ray through practicum and animation / picture observations.	Writing (Student Work Sheet)	• Contributions • Time management • Problem solving • Working with others • Research techniques
	Stimulate students to illustrate the image formation diagram on a convex mirror through animation observation.	Posts (Student Work Sheet)	
	Stimulate students to explain the characteristics of a convex mirror image through the animation / picture observation.	Writing (Student Work Sheet)	

(a) (b)

Figure 1. The Example of Developed MBI$_2$ (a) Menu Section (b) Light reflection Experiments

1) Very low (Total score: 5-8), 2) Low (9-11), 3) Adequate (12-14), 4) Good (15-17), and 5) very Good (18-20). Both categorizations were based on Arifin (2014).

RESULTS AND DISCUSSION

Written Communication Skills

The recapitulation of students' written communication skills is presented in Table 2. Written communication progression was found in each meeting. The average score of written communication increased by 2.39 points (from second to third meeting) to 3.8 points (third to fourth meeting). From the first meeting until the fourth meeting, there was significant improvement of students' written communication skills marked by students' proficiency level that changes into a higher category.

Table 2. Students' Written Communication Skills Score Average and Category

Meeting	Written Communication Skills Average Scores	Category
1	10.98	Low
2	14:49	Adequate
3	16.88	Adequate
4	20.68	Good
Max.Score	**24.00**	

Insight from students' worksheets indicated that students grew accustomed to building their written communication skills. The average score in the first meeting only reached 10.98 (not nearly halfways from the maximum score) because students have not been accustomed to convey their understanding of the reflection concept, as depicted in their answer (Figure 2a). In the second meeting, students' answers (Figure 2b) showed that they are already starting to build their confidence in communicating their ideas and understanding. Light beam experiment in the MBI_2 also helps them to visualize the directional projection of light better.

Although progression still happens in the third meeting (2.39 points increases from the second meeting), it can be considered the lowest progression average. As reflected in their worksheet answer (Figure 3), students face difficulties writing or illustrating light and image formation on a concave mirror. The increasing concept complexity resulted in their diffident in communicating their understanding and ideas. This finding is corroborated with Chang et al. (2007) as well as Tural (2015) study that students commonly found difficulties in understanding about how image is formed with lenses or mirror.

The highest written communication progression was found between the third and fourth meetings (3.8 points increment). Animation which illustrated how rays and images are formed on a concave and convex mirror, helps students understand and visualize light reflection. Students' understanding and ability to visualize light reflection phenomena were embodied in their ability to communicate their ideas and understanding accurately (Figure 4). In parallel to Kirstein and Nordmeier (2007), the use of multimedia-based learning makes physics experiment representation accessible.

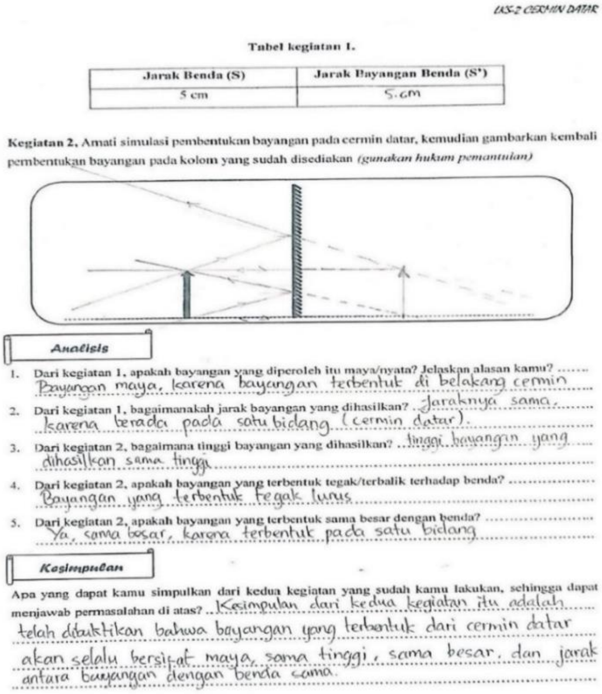
Collaboration Skills

Students' collaboration skill was evaluated based their activity when working in a group for laboratory activity. The recapitulation of students' collaboration skills is presented in Table 2. In a similar vein with communication skill, the average improvement from the first to the fourth meeting was 5.06 points, in which the highest increment was found from the third to the fourth meeting (2.61 points). The increment in the third and fourth meetings also marked by the definite improvement to a higher-level category.

Table 3. Students' Collaboration Skills Score Average and Category

Meeting	Collaboration Skills Average Scores	Category
1	9.94	Low
2	11.71	Low
3	12.39	Adequate
4	15.00	Good
Max.Score	**20.00**	

Improvement in communication and collaboration skills is presumably connected. The MBI_2 contributed to students' understanding of light refraction to communicate their understanding of light refraction in writing. When they were then assigned to their respective group to do laboratory activities, this understanding enables them to convey their ideas and become active collaborators.



LKS-2 CERMIN DATAR

Tabel kegiatan 1.

Jarak Benda (S)	Jarak Bayangan Benda (S')
5 cm	5 cm

Kegiatan 2. Amati simulasi pembentukan bayangan pada cermin datar, kemudian gambarkan kembali pembentukan bayangan pada kolom yang sudah disediakan *(gunakan hukum pemantulan)*

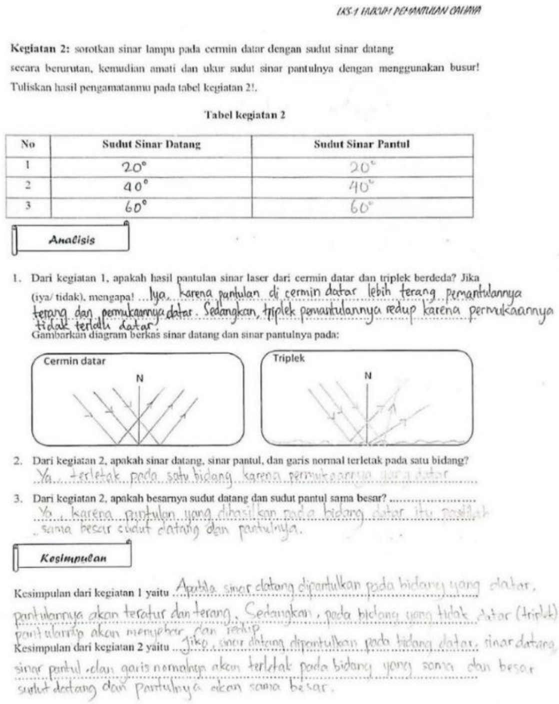
Analisis

1. Dari kegiatan 1, apakah bayangan yang diperoleh itu maya/nyata? Jelaskan alasan kamu? Bayangan maya, karena bayangan terbentuk di belakang cermin
2. Dari kegiatan 1, bagaimanakah jarak bayangan yang dihasilkan? Jaraknya sama, karena berada pada satu bidang (cermin datar).
3. Dari kegiatan 2, bagaimana tinggi bayangan yang dihasilkan? tinggi bayangan yang dihasilkan sama tinggi
4. Dari kegiatan 2, apakah bayangan yang terbentuk tegak/terbalik terhadap benda? Bayangan yang terbentuk tegak lurus
5. Dari kegiatan 2, apakah bayangan yang terbentuk sama besar dengan benda? Ya, sama besar, karena terbentuk pada satu bidang

Kesimpulan

Apa yang dapat kamu simpulkan dari kedua kegiatan yang sudah kamu lakukan, sehingga dapat menjawab permasalahan di atas? Kesimpulan dari kedua kegiatan itu adalah telah dibuktikan bahwa bayangan yang terbentuk dari cermin datar akan selalu bersifat maya, sama tinggi, sama besar, dan jarak antara bayangan dengan benda sama.

(a)



LKS-1 HUKUM PEMANTULAN CAHAYA

Kegiatan 2: sorotkan sinar lampu pada cermin datar dengan sudut sinar datang secara berurutan, kemudian amati dan ukur sudut sinar pantulnya dengan menggunakan busur! Tuliskan hasil pengamatanmu pada tabel kegiatan 2!.

Tabel kegiatan 2

No	Sudut Sinar Datang	Sudut Sinar Pantul
1	20°	20°
2	40°	40°
3	60°	60°

Analisis

1. Dari kegiatan 1, apakah hasil pantulan sinar laser dari cermin datar dan triplek berbeda? Jika (iya/ tidak), mengapa? Iya, karena pantulan di cermin datar lebih terang pemantulannya terang dan permukaannya datar. Sedangkan, triplek pemantulannya redup karena permukaannya tidak terlalu datar.
Gambarkan diagram berkas sinar datang dan sinar pantulnya pada:

2. Dari kegiatan 2, apakah sinar datang, sinar pantul, dan garis normal terletak pada satu bidang? Ya, terletak pada satu bidang karena permukaannya datar
3. Dari kegiatan 2, apakah besarnya sudut datang dan sudut pantul sama besar? Ya, karena pantulan yang dihasilkan pada bidang datar itu adalah sama besar sudut datang dan pantulnya.

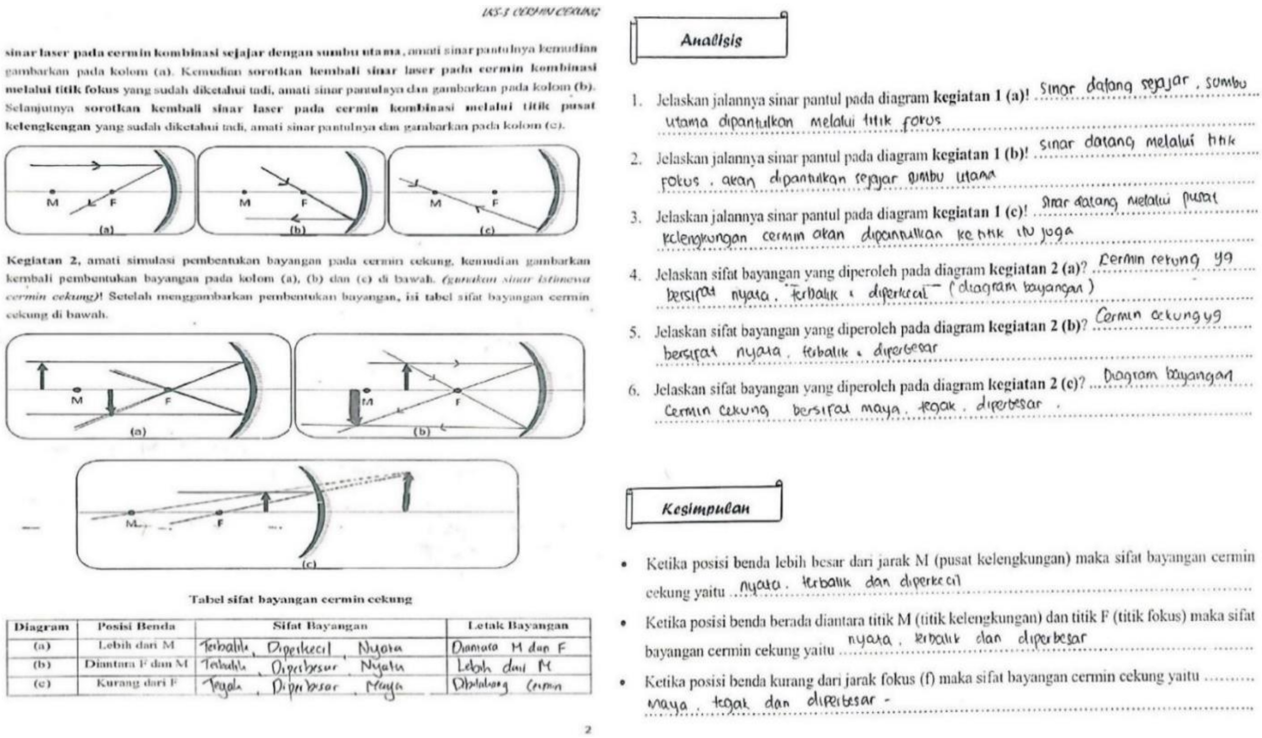
Kesimpulan

Kesimpulan dari kegiatan 1 yaitu Apabila sinar datang dipantulkan pada bidang yang datar, pantulannya akan teratur dan terang. Sedangkan, pada bidang yang tidak datar (triplek) pantulannya akan menyebar dan redup.

Kesimpulan dari kegiatan 2 yaitu Jika sinar datang dipantulkan pada bidang datar, sinar datang, sinar pantul, dan garis normalnya akan terletak pada bidang yang sama dan besar sudut datang dan pantulnya akan sama besar.

(b)

Figure 2a-b. Student's Answer Example from Meeting 1 (a) and from Meeting 2(b)



LKS-3 CERMIN CEKUNG

sinar laser pada cermin kombinasi sejajar dengan sumbu utama, amati sinar pantulnya kemudian gambarkan pada kolom (a). Kemudian sorotkan kembali sinar laser pada cermin kombinasi melalui titik fokus yang sudah diketahui tadi, amati sinar pantulnya dan gambarkan pada kolom (b). Selanjutnya sorotkan kembali sinar laser pada cermin kombinasi melalui titik pusat kelengkengan yang sudah diketahui tadi, amati sinar pantulnya dan gambarkan pada kolom (c).

Kegiatan 2, amati simulasi pembentukan bayangan pada cermin cekung, kemudian gambarkan kembali pembentukan bayangan pada kolom (a), (b) dan (c) di bawah. *(gunakan sinar istimewa cermin cekung)*! Setelah menggambarkan pembentukan bayangan, isi tabel sifat bayangan cermin cekung di bawah.

Tabel sifat bayangan cermin cekung

Diagram	Posisi Benda	Sifat Bayangan	Letak Bayangan
(a)	Lebih dari M	Terbalik, Diperkecil, Nyata	Diantara M dan F
(b)	Diantara F dan M	Terbalik, Diperbesar, Nyata	Lebih dari M
(c)	Kurang dari F	Tegak, Diperbesar, Maya	Dibelakang Cermin

2

Analisis

1. Jelaskan jalannya sinar pantul pada diagram **kegiatan 1 (a)**! Sinar datang sejajar, sumbu utama dipantulkan melalui titik fokus
2. Jelaskan jalannya sinar pantul pada diagram **kegiatan 1 (b)**! sinar datang melalui titik fokus, akan dipantulkan sejajar sumbu utama
3. Jelaskan jalannya sinar pantul pada diagram **kegiatan 1 (c)**! Sinar datang melalui pusat kelengkungan cermin akan dipantulkan ke titik itu juga
4. Jelaskan sifat bayangan yang diperoleh pada diagram **kegiatan 2 (a)**? Cermin cekung yg bersifat nyata, terbalik, diperkecil (diagram bayangan)
5. Jelaskan sifat bayangan yang diperoleh pada diagram **kegiatan 2 (b)**? Cermin cekung yg bersifat nyata, terbalik, diperbesar
6. Jelaskan sifat bayangan yang diperoleh pada diagram **kegiatan 2 (c)**? Diagram bayangan cermin cekung bersifat maya, tegak, diperbesar.

Kesimpulan

- Ketika posisi benda lebih besar dari jarak M (pusat kelengkungan) maka sifat bayangan cermin cekung yaitu nyata, terbalik dan diperkecil
- Ketika posisi benda berada diantara titik M (titik kelengkungan) dan titik F (titik fokus) maka sifat bayangan cermin cekung yaitu nyata, terbalik dan diperbesar
- Ketika posisi benda kurang dari jarak fokus (f) maka sifat bayangan cermin cekung yaitu maya, tegak dan diperbesar.

Figure 3. The Example of Student's Answer in Meeting 3

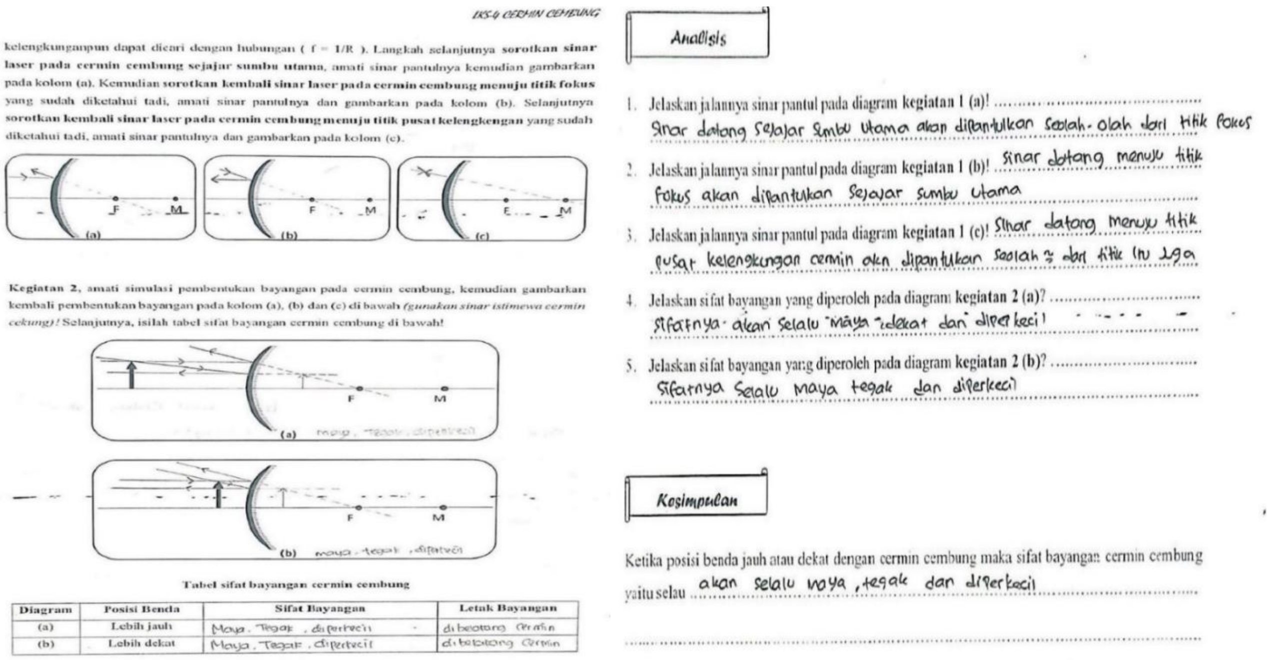


Figure 4. The Example of Student's Answer in Meeting 4

In designing multimedia for teaching physics concepts, Yeo, Loss, Zadnik, Harrison, and Treagust (2004) suggested that the instructor should provide the students with explicit guidance when using multi-media in physics classrooms, mainly if they access it on their own. MBI_2 used in this current study has a particular section to inform the user of how to navigate the program, so confusion when using the program can be avoided.

Analysis of students' answers proved that improvement in how students communicate understanding and ideas and how they work collaboratively, but it is also noteworthy to pointed out that improvement can be considered moderate. As also reported previously, multimedia-based instruction improved communication (Siahaan et al., 2017) and collaboration (Hermawan et al., 2017) skills moderately. Furthermore, a Meta-analysis (Schroeder and Cencki, 2018) corroborated this moderate level benefit, but as Schroeder and Cencki (2018) addressed, multimedia-based instruction still performed better compared to other types of instructions.

CONCLUSION

The use of MBI_2 in physics learning, particularly in light reflection material, can improve students' written communication skills and enhance their collaboration skills. The improvement was due to MBI_2 ability to provide students with the opportunity to visualize physics phenomena better, which improves students' understanding of light reflection. The opportunity to work within a group when conducting laboratory activities and understand the light reflection concept enables them to have a fruitful discussion and become active collaborators.

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