

Research Article

Developing human movement system booklet as a biology teaching material supplement for XI grade students



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ABSTRACT

Learning is a process of interaction between students and educators as considerable as learning resources in learning environment. The use of media in learning plays an important role in providing clearer explanation for difficult materials or concepts for students. This research aimed at developing booklet as a biology teaching supplement, especially in human movement system material for XI grade. This R&D research used the Plomp model which consisted of preliminary research, prototype development phase, and assessment phase. The data were analyzed qualitatively and quantitatively. The booklet developed was validated by 3 validators. The human movement system booklet for XI grade was categorized as very valid (94.11), stated as very practical by students (94.59) and teachers (92.19). It is suggested for teacher to use the human movement system booklet developed for XI graders.



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INTRODUCTION

Biology is part of science education that studies living things and phenomena. Learning biology is not merely memorizing the material, it needs a profound understanding. The process of knowledge transfer and interpretation in biology learning will operate optimally if it is supported by appropriate learning media, which is used to communicate and interact between teachers and students in the learning process. Learning media can be interpreted as a tool used to help teaching and learning processes so that they run smoothly. It acts as an intermediary in helping teachers to explain difficult materials or concepts to be clearer and easier to understand (Daryanto, 2010). Moreover, it stimulates students' attention, interests, thoughts, and feelings to achieve learning goals. Accordingly, learning media in education should be created based on students' necessities. Thus, the teaching materials created are more meaningful, acceptable and easy understood by students. Booklet is one of recommended teaching materials to develop (Ajizatunnisa et al., 2018; Pralisaputri et al., 2016).

Booklet is learning media which consists of around 48 pages. Compared to brochure, booklet is relatively thinner book which contains complete and brief content as well as easy to carry (Satmoko & Astuti, 2006). It is expected could promote students' learning effectiveness (Pralisaputri et al., 2016). Acknowledging booklet function in transferring knowledge, reading booklet plays a vital role in teacher-student communication (Pimpa & Rojanapanich, 2020). Furthermore, it enables students to learn optimally as the content is developed based on basic competency (Yani et al., 2018). An attractive and comprehensive booklet can be a breakthrough to enhance student learning achievements, motivation (Ajizatunnisa et al., 2018) as considerable as increase discussion quality (Adri et al., 2017).

Based on interview results conducted by researchers with one of biology teachers in SMA Negeri 7 Padang, on July 2019, it was revealed that one of the most difficult biology topics is the human movement system. It was found that about 77.14% of students expressed difficulty to comprehend this topic and approximately 60% students' achievements were under minimum mastery criteria (Kriteria Ketuntasan Minimum/KKM). Previously, the interviewed biology teacher applied biology textbook which refers to Kurikulum 2013 and student worksheet (Lembar Kerja Peserta Didik/LKPD). Although learning content has agreed to the indicator of competency achievement, yet, some language aspects were difficult to understand, the pictures included were colorless, unclear, and less attractive. Therefore, it did not motivate the students to learn. Besides, learning material scope was quietly dispersed so that students found restrictions to conclude and used the material independently. In line with the interview results, field observation results informed that there were confusing terminologies in the learning media used by the teacher.

In accordance with the above results, observations done toward students depicted that as many as 85.71% of students studied biology by reading. The majority of students (91.42%) stated that they need other learning resources which support their understanding about human movement system. Meanwhile, 82.85% of them stated that they need others learning resources that can be understood independently. Students suppose resources with criteria such as understandable language, whole in content, concise and clear, smaller in size and practical, any additional information and explanations for difficult terms, colorize and accompanied by pictures to attract interest and increase their motivation to learn.

However, booklet, which has potentials to increase students' achievement effectively (Yani et al., 2018; Zalita et al., 2017), gain their competency in cognitive, affective, and psychomotor (Rani et al., 2020) has not been applied yet to support biology learning. Thus, this study aimed at developing booklet as a biology teaching supplement, especially in human movement system material for XI graders.

The results of this study will contribute to enrich insights and increase student motivation to learn. Moreover, it can also be used as an alternative media to assist teachers as well as a reference in conducting effective and efficient learning activities.

METHOD

This research and development study was conducted in the Department of Biology, FMIPA UNP, and SMA Negeri 7 Padang. The resulted product was supplement learning media in term of booklet which covered human movement systems material for XI graders. The product was tested in natural science (IPA)-majored XI grade of SMA Negeri 7 Padang in the odd semester of academic year 2019/2020. The subjects of this study were two lecturers of Biology Department of FMIPA UNP, one Biology teacher of SMA Negeri 7 Padang, and 35 XII natural science-majored graders of SMA Negeri 7 Padang.

The instruments used in this study were teacher interview guide, student observation questionnaire, self-evaluation questionnaire, expert review questionnaire, one-to-one questionnaire, small group questionnaire, field test questionnaire, and practicality questionnaire for students and teachers. The interview sheet and student observation questionnaire used in this study were developed by the researchers and have been validated by validators i.e. lecturers of Biology Department, FMIPA UNP who are competent in instrument assessment development field. The qualifications of the validators were doctoral degree and has teaching experience in the subject for more than 3 years. Meanwhile, self-evaluation questionnaire, expert review, one-to-one, small group, field test, and practicality were modified from previous studies (Octiana et al., 2020). The teacher interview sheet consisted of 23 questions, the student observation questionnaire consisted of 14 questions which covered curriculum analysis, concepts, students, and literature review. The self-evaluation and expert review questionnaires consisted of 26 questions which covered the feasibility of content, language, presentation, and graphics. The one-to-one, small group, and field test questionnaires consisted of 10 questions which covered five aspects in terms of appearance, presentation, language, images, use of fonts, and usefulness. While the student practicality questionnaire consisted of 19 questions, and the teacher practicality questionnaire consisted of 18 questions which covered four aspects, namely, ease of use, the effectiveness of learning time, benefits, and attractiveness.

This study applied the Plomp Model (Plomp et al., 2013), which consists of a preliminary research stage, a development or prototyping phase, and assessment phase (Rani et al., 2020). The assessment stage consists of practicality and effectiveness tests. The booklet development process was conducted until practicality test which was covered in assessment stage, while the effectiveness test was not carried out due to the limited time, energy, and cost of the research. Meanwhile, the data analysis technique used was qualitative and quantitative analysis. The data obtained from the initial investigation stage, design, construction, and development of the prototype were analyzed qualitatively and presented in descriptive form. Meanwhile, the data gained from the test, evaluation, and revision stages in terms of validity and practicality were analyzed quantitatively using Microsoft Excel platform.

RESULTS AND DISCUSSION

This research produced a product in the form of a booklet on human movement system material for class XI SMA/MA which gained very valid and very practical criteria, therefore it can be used as a teaching material supplement. The booklet is developed through stages of research and development using the Plomp model.

Preliminary research phase

Initial investigation aimed at finding out basic problems in learning Biology in schools. This stage consists of curriculum analysis, concept analysis, student analysis, and analysis of teaching materials used in schools. At this stage, an interview was carried out with a Biology teacher at SMA Negeri 7 Padang. Moreover, observation was also done by distributing questionnaires to natural-science majored XII graders of SMA Negeri 7 Padang.

Curriculum Analysis. In this research, curriculum analysis was focused on the analysis of Core Competencies (*Konpetensi Intil/KI*) and Basic Competencies (*Kompetensi Dasar/KD*) of Human Movement Systems material i.e. *KD 3.5*. Based on the interview done with one of Biology teacher in SMA Negeri 7 Padang, it was known that some biology learning materials were difficult for students to understand, one of which was the human movement systems. The teacher stated that 60% students in each class found their score below the *KKM* on daily tests of the movement system topic. The observation results done on July 2019, by distributing questionnaires to 35 natural-science majored XII graders of SMA Negeri 7 Padang revealed that the movement system material was one of the materials studied in XI grade of odd semester which was challenging for students to understand. As high as 77.14% students stated that Human Movement System is difficult material to understand. A review of the Core Competencies and Basic Competencies done in the curriculum analysis stage depicted that students found difficulty in understanding Human Movement System material. Similarly, the difficulty in learning materials related to human anatomy in higher level i.e. university level was also identified by previous researchers (Estai & Bunt, 2016; Ngan et al., 2018). Yet, this basic knowledge of human anatomy is assumed as an influential factor in determining their future carrier (Kim et al., 2017)

Concept Analysis. Concept analysis was employed as the basis for designing the Human Movement System booklet developed. Based on *SK*, *KD*, and Competency Achievement Indicators (*Indikator Pencapaian Kompetensi/IPK*), the main concepts of human movement system must be well mastered by students. Based on the description of learning indicators, the concepts identified including body frame, bones, joints, movement system disorders, muscles, and technology related to human movement system. These concepts were planned to be presented in the booklet.

Student Analysis. Student analysis was done to examine the students' responses, as the research object, toward Human Movement System material. The results of student analysis are briefly served in Table 1.

Table 1. The analysis results of students' responses towards Human Movement System material

| No | Question | Answer | Frequent | Percentage (%) |
|----|---|--|----------|----------------|
| 1. | What difficulties did you have in studying the material? | Too much material | 31 | 88.57 |
| | | Complicated material | 33 | 94.28 |
| | | The available teaching materials are less attractive | 30 | 85.71 |
| | | The material is memorized | 30 | 85.71 |
| | | There are many confusing terms | 29 | 82.85 |
| | | The matter cannot be observed directly | 6 | 17.14 |
| 2. | How do you study biology? | Reading | | 85.71 |
| 3. | Do you need other learning resources that support your understanding of the material? | Yes | 32 | 91.42 |
| | | No | | |
| 4. | Do you need other learning resources about the material that can be understood independently? | Yes | 29 | 82.85 |

Teaching Materials Analysis. The last analysis performed was the teaching materials analysis. The results of the teaching materials analysis showed that in the learning process, students have been facilitated using *K-13* textbooks and *LKPD*, yet the both learning media were difficult to be understood by students. Thus, students' motivation to read the textbooks and *LKPD* provided was low which led to the low achievement. The results of observation done towards students showed that as high as 88.57% of students stated that the Human Movement System material was not presented attractively. Furthermore, it was difficult to understand and not equipped with relevant illustrations.

Development or prototyping phase

The data obtained from the initial investigation stage provides the background and reference for developing Human Motion System booklet. Furthermore, in this prototype creation and development stage, the researchers developed a Human Motion System booklet which was evaluated using formative evaluation. This evaluation covers several series i.e. self-evaluation, expert review, one-to-one evaluation, small group, and field test.

Developing Prototype I. The booklet was created using Microsoft Office Publisher 2013 aided with Microsoft Office PowerPoint 2010 application. The components in this Human Motion System booklet were (1) cover, (2) introduction, (3) table of contents and pictures list, (4) learning competencies, (5) concept map, (6) material, (7) info, (8) glossary, (9) bibliography, and (10) author's bio. The Human Motion System booklet was designed with colors combinations which attract students' attention to read. The cover colors of the booklet were white, light gray, dark green, light green, yellow, coral, and peach. The booklet contents were designed with using colors combination of dark green, light green, light gray, violet, bone, peach, yellow, orange, and red which employed white background. The undergirding consideration of color combinations was students' preferences which were stated in questionnaire. Most of the students tended to choose bright-classified colors. Moreover, the booklet developed combined several fonts, namely, Cambria, Microsoft Sans Serif, Arial Narrow, and Microsoft Himalaya with vary font sizes range between 10-28 points which were suited to the appropriateness of booklet appearance.

The initial draft of the booklet was named as prototype I. This prototype experienced evaluation by the author to determine the feasibility of the booklet according to the author's understanding. The evaluation was done by fulfilling self-evaluation instrument. As the assessment was completed by the author, the revisions needed were done to the draft. Hence, this version was called prototype II. This prototype will be reviewed and validated by three experts in the expert validation stage.

Developing of Prototype II. The prototype I which was resulted in the previous step was reviewed and validated in expert validation stage through conducting validity test. The purpose of this validity test was to ensure the feasibility of the booklet based on four aspects, namely the feasibility of content, language, presentation, and booklet graphics. The validity test was done by three experts i.e. 1) material expert, 2) media expert, and 3) biology education practitioner. Material experts were lecturers who are competent in the fields of anatomy and physiology at the Department of Biology FMIPA UNP. The qualifications of material expert chosen were earned master degree in Biology and experienced teaching in this subject for at least 3 years. The qualifications of material expert were lecturer who are competent in the field of developing biology teaching materials in the Department of Biology FMIPA UNP. Meanwhile, media expert qualifications were earned master degree in Biology Education and have taught more than 3 years in teaching educational media course. Biology education practitioners in this case were biology teachers of X grade in SMA Negeri 7 Padang who earned bachelor degree in Biology Education and experienced teaching Biology for more than five years.

The validation results (Table 2) showed that the booklet developed was valid based on the four aspects assessed by validators.

Table 2. The validity assessment results of Human Motion System Booklet

| No | Aspect | Nilai Validitas (%) | Kriteria |
|---------|--------------------------|---------------------|--------------|
| 1. | Content eligibility | 95.23 | Highly Valid |
| 2. | Language | 86.90 | Valid |
| 3. | Serving and construction | 97.91 | Highly Valid |
| 4. | Graphics | 96.42 | Highly Valid |
| Average | | 94.11 | Highly Valid |

The validity test on content feasibility aspect aimed to see whether the substance of the product developed is truly able to measure the concept achieved. Assessed the content feasibility aspect, it was proven that the booklet obtained validity value as high as 95.23% (very valid criteria). This means that the booklet developed is in line with the referred curriculum, i.e. Curriculum-2013, following *KI* and *KD*, as well as in accordance with the needs and development of students. This very valid criterion also proved that the description of the booklet material is correct and provides additional insight for students. Moreover, the

content of the booklet does not conflict with moral and social values. Thus, it is important to ensure the rightness of substance and its suitability with the curriculum to avoid students' misunderstanding (Yelviana et al., 2020).

Judging from the linguistic aspect, the booklet was declared valid with the validity value of 86.90%. This indicates that the booklet has met the Indonesia language rules in term of EYD (*Ejaan yang Disempurnakan*/ Enhanced Spelling System), used simple language with clear and short sentences. The linguistic aspect is closely related to the use of clear sentences to eliminate students' confusion. It is very important to pay attention to the use of good and correct language so that the learning material presented can be understood by students (Sukiman, 2012). A teaching material must have clear inter-sentence relationships, use brief sentences, and do not cause double interpretation or ambiguity (Depdiknas, 2008). Furthermore, the presentation of the booklet was declared very valid with the validity value reached 97.91%. This indicates that the booklet has been well presented, and has clarity in stating basic competencies and indicators addressed. The clarity of indicators and learning objectives will help students in learning so that learning becomes more focused (Octiana et al., 2020). The valid category also indicates that the material presented in the booklet is systematic and contains complete subject matter and material details.

In terms of the graphic aspect, the booklet obtained its validity value of 96.42% (very valid). This means that the graphic components such as font type, font size, appearance, color gradations, illustrations, images, and graphics presented in the booklet are overall attractive, clear, and easy to understand. The proper arrangement of content layout, appearance, placement, and the use of good images will be stimulus to attract students to use booklet (Fazlina et al., 2019). The design of teaching materials must consider several components such as color composition, appearance, writing type, size of writing to attract attention and increase student motivation in the learning process. In addition, the use of illustrative images in teaching materials can increase attractiveness (Park et al., 2011) and reduce students' boredom (Prastowo, 2011).

The validation results of the booklet developed indicate that the booklet can be used as one of students' learning resources in learning Biology, especially for XI graders to learn human movement systems. However, the validator also provided several suggestions to improve the booklet. Based on the suggestions, the booklet was revised. The revised and reviewed booklet was called as prototype III. Furthermore, the booklet was tested in the next phases i.e. one-to-one evaluation, small group evaluation, and field test. The revisions conducted are served in Figure 1.

| Section | Page Number |
|------------------------|-------------|
| Pendahuluan | i |
| Daftar Isi | ii |
| Daftar Gambar | iii |
| Daftar Tabel | v |
| Kompetensi Belajar | vi |
| Rangka Tubuh | 1 |
| Tulang | 8 |
| Persendian | 11 |
| Otot | 14 |
| Gangguan Sistem Gerak | 18 |
| Teknologi Sistem Gerak | 22 |
| Glosarium | 24 |
| Daftar Pustaka | |
| Biodata Penulis | |

| Section | Page Number |
|------------------------|-------------|
| Pendahuluan | 1 |
| Daftar Isi | ii |
| Daftar Gambar | iii |
| Kompetensi Belajar | vi |
| Rangka Tubuh | 1 |
| Tulang | 7 |
| Persendian | 11 |
| Otot | 13 |
| Gangguan Sistem Gerak | 19 |
| Teknologi Sistem Gerak | 21 |
| Glosarium | 23 |
| Daftar Pustaka | 26 |
| Biodata Penulis | |

Figure 1. Table of contents (a) before revision, (b) after revision

Figure 1 (a) is the appearance of Table of Content page before revised by authors and Figure 1 (b) is the refinement of the previous Table of Content page. Given the suggestions by validator, the display of the Table of Contents must be the same as the appearance of its List of Pictures. Moreover, the validator suggested to ensure the consistency of the use of capital letters in the Table of Content.

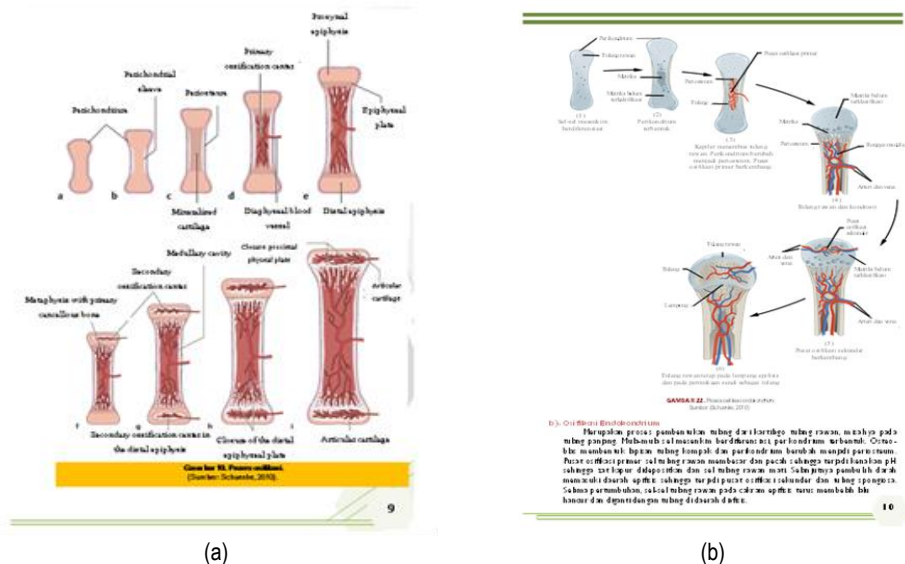


Figure 2. Presentation of images and material (a) before revision, (b) after revision

Figure 2 (a) is the presentation of pictures before revision, meanwhile, Figure 2 (b) is the improvement result of the previous presentation. Based on the suggestions given by validator, the image captions were written in Bahasa Indonesia and the images were taken from textbooks or journals. In more detail, the validator also suggested an improvement in the way images and materials are presented in the booklet. The validator suggested to change the font used in booklet to be more eye-catching font, to remove the background color of the image caption, and to add information about the process described by the image served.

Developing Prototype III. In this stage, one-to-one evaluation was carried out using one-to-one evaluation questionnaire by asking responses to three students from different academic ability levels (high, medium, and low). Based on the positive responses given by students, it was decided by researchers that no improvements need to be made to the booklet content, but to the cover paper used which need to be thickened. After revising the booklet, the development process was continued to the prototype IV development stage.

Developing Prototype IV. In this development stage, the evaluation activity was carried out in small group which consisted of six students. This stage aimed to describe any suggestions, improvements, and affirmations from the previous evaluations done. This evaluation employed small-group evaluation questionnaire. Acknowledged the positive responses obtained from students, no revision was made to the booklet. Hence, the booklet development process was continued to the prototype V development stage.

Developing Prototype V. In this stage, the evaluation activity carried out was field test using field trial questionnaire. The booklet developed was evaluated by 26 students. The results showed that no suggestions given by students so that no improvement needed to the booklet. This means that the booklet can be used for the assessment stage in term of practicality test.

Assessment phase

After generating several improvements based on one-to-one evaluation, small-group evaluation, and field test, the booklet practicality test was conducted. The practicality test of the booklet was carried out on students and teachers, by asking them to fill out a practicality questionnaire. The results obtained from the practicality test depicted that the booklet developed is practical to implement.

Booklet practicality for students

The results of the practicality test gained from students are briefly served in Table 3.

Table 3. The results of booklet practicality test by students

| No. | Assessment component | Practicality value (%) | Criteria |
|---------|------------------------------------|------------------------|------------------|
| 1. | Ease of use | 95.44 | Highly Practical |
| 2. | The effectiveness of learning time | 93.57 | Highly Practical |
| 3. | Benefits | 94.85 | Highly Practical |
| 4. | Attractiveness | 94.52 | Highly Practical |
| Average | | 94.59 | Highly Practical |

Based on [Table 3](#), it can be seen that the practicality value of the booklet by students of SMA Negeri 7 Padang reached 94.59%. This means that the booklet is very practical in all aspects measured i.e. the ease of use, the effectiveness of learning time, benefits, and attractiveness. This also shows that the booklet developed is very practical for students to use in learning.

Booklet practicality for teachers

The results of the booklet practicality test done by the teachers are summarized in [Table 4](#).

Tabel 4. Results of booklet practicality test by teachers

| No. | Assessment component | Practicality value (%) | Criteria |
|-----|------------------------------------|------------------------|------------------|
| 1. | Ease of use | 90.62 | Highly Practical |
| 2. | The effectiveness of learning time | 87.50 | Practical |
| 3. | Benefits | 95.00 | Highly Practical |
| 4. | Attractiveness | 91.66 | Highly Practical |
| | Average | 92.19 | Highly Practical |

Practicality tests are carried out to obtain practical information and ease of use of booklets ([Octiana et al., 2020](#)). The practicality test in this research involved 35 science students of XII grade and a Biology teacher of SMA Negeri 7 Padang. The data analysis of the booklet practicality test was based on four aspects, namely the ease of use, effectiveness of learning time, attractiveness, and benefits. The results of the practicality test showed that the booklet developed is categorized as very practical. This can be seen from the practicality test by the both students ([Table 3](#)) and teachers ([Table 4](#)) that the booklet developed is highly practical in which the average practicality values reached were 94.59% (by students) and 92.19% (by teachers).

Judging from the aspect of ease of use, the booklet was considered as very practical by the both students (95.44%) and teachers (90.62%). This means that the material presented in the booklet is clear, the language used is easy to understand, the writing and size of letters are easy to read, and the booklet size is practical and easy to carry. This is following the criteria of a printed teaching material, which must be easy to read ([Puspita et al., 2017](#)). In terms of the effectiveness of the learning time, it is known that the booklet obtained very practical category from students (93.57%) and teachers (87.50%). This shows that students can learn by using the booklet at their own pace, and their learning time can be more effective by using booklet. In the other words, this learning media, in general, can overcome the limitations of space, time, sensory power, and shorten the learning time. Teaching materials should be able to open opportunities for students to be able to learn at their own pace ([Nasution, 2012](#)).

Similarly, the booklet obtained very practical category from students (94.85%) and teachers (95.00) for its benefits aspect. This proves that the booklet is useful for students and teachers in learning. The booklet enables the students to understand concepts, adds insights, knowledge, as well as increases their interest and motivation to learn. Moreover, the booklet also helps teachers deliver material and reduce their work to explain repetitive material. This is in line with the previous research finding which stated that good learning media provides benefits for educators, including facilitating material delivery, and be motivation generator for students, and makes material easier to understand ([Sanaky & Faizah, 2013](#)).

In terms of attractiveness, the booklet obtained a practicality value of 94.52% with a very practical category by students, and the practicality value of 91.66% with a very practical category by teachers. This category shows that the booklet can attract students' attention to read as it has attractive appearance, good color composition, and communicative pictures and illustrations. The selection of good color compositions and communicative illustrations need to be considered so that the media developed can increase students' interest in learning ([Fazlina, 2018](#); [Teng et al., 2017](#)).

The booklet as a whole from the results of the validity and practicality tests is stated to be very valid and very practical. Hence, this booklet can be used as biology supplement materials for human motion systems by students and teachers.

CONCLUSION

Based on the results of the research done, it can be concluded that the human motion system booklet developed is categorized as very valid as the average of validity value gained was 94.11% which means that the booklet meets the aspects required for a good learning material i.e. content feasibility, language, presentation, and graphics. In addition, it is suggested that teachers and students use the human motion system booklet as a supplement for biology learning materials for XI graders.

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