The Development of an Integrated Mechanical Skill Instructional Model (IMSIM) in the Secondary Technology School (STM) for the Improvement of Middle Level Skilled Worker

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Abstract: This study was conducted to develop an instructional model of mechanical skill learning for the STM students to improve their cognitive, psychomotoric skills, motivation, and creativity. To develop an adequate instructional model, 15 experts were consulted. Based on the result of consultation, the model was revised. The revised model was then tried-out to 20 students of the STM Bengkulu and 17 students of the STM Curup. The result of try-out showed that the developed test items had moderate validity and reliability. The revised instructional model was applied to 25 students of the STM Bengkulu and 30 students of the STM Curup. The result of the study showed that the integrated instructional model was effective to teach mechanical skill, highly effective to increase students' motivation, and moderate to develop creativity.

Keywords: Integrated Mechanical Skill Instructional Model (IMSIM), Secondary Technology School (STM), Middle Level Skilled Worker.

At present, the development of industry in Indonesia seems to have not yet advanced significantly. This situation leads reflection on the socio-economic conditions that are required for the cultivation of human behavior

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in response to development and modernization, in individual or social context. The solution of the problem is education, in a sense of preparing an educational model that is (1) anticipatory to the future of development, with a stress on industrialization, and (2) responsive to students' development. The model, in essence, needs to produce creative students with high degree of reasoning and initiative (Semiawan and et.al, 1990).

At present, STM graduates are generally low in quality and not prepared to work (Dimyati and Toenlioe, 1992; Slamet, 1989; Vembrianto, 1990). This is reflected, for example, in the fact that more General High School (SMU) graduates are employed than their STM counterparts with an employment ratio of 7.20% to 6.49% (P2TKD, 1987). This, in turn, raises a question whether the existing instructional models have been able to produce high quality graduates as expected.

The quality of an instruction is reflected on the learning outcome. For the purpose of improving instructional quality, a new instructional model that is suitable to the instructional objectives and condition is required. Because the model is typically suitable only for a certain condition, there is a need for the model that is efficient, effective, interesting, and makes learning as an easy and pleasant activity (Reigeluth and Merril, 1978). The instructional model that is considered to be suitable for skill learning, on the ground of its characteristics, is the integrated model. The integrated instructional model involves three stages they are: (1) introductory stage, (2) presentation stage, and (3) application stage. The model, if utilized for the instruction of mechanical skills in STM, is expected to improve learning outcome, skill transfer and learning motivation, and creativity, as the students are involved from the planning and skill transfer of a task.

The strength of the integrated mechanical skill instructional model (IMSIM) is that students are required to design together a task that will produce work pieces based on their interest. The processes in designing a work piece need the use of subskill combination. As a consequence, it is expected that the students will create many work pieces. Students' interest raises work motivation, and motivation can increase their learning outcome. Furthermore, the creation of work pieces by the students and the teacher is also assumed to be able to increase work creativity of students.

In IMSIM, the created work piece, which is in the form of a finished product that can be sold, makes the students understand the benefit of it. By understanding the usefulness of the work piece, the students become interested and motivated to carry out the task. Their interest and work motivation encourage them to do the task diligently and, in turn, produce good work pieces. The model also uses various instructional methods that are suitable to the instructional objectives. This utilization of the methods creates learning situation that facilitates understanding and does not bore the students. This situation can increase students' motivation and learning outcome. In the model, feedback is given immediately, so the students know their weaknesses. If the students do the tasks again correctly it reinforces their understanding on the tasks. This finding is consistent with studies by Cates (1988) and Jonassen (1988) in cognitive domain. The effectiveness of immediate feedback can be explained by the following concept. The information that is provided by the teacher is not immediately disappearing. Heinrich and McKeegan (in Peck and Tucker, 1973) propose that if feedback provision is delayed too long it can cause forgetfulness of several messages from the provider which makes inappropriateness of the feedback receiver in perceiving the messages. Munandar (1987) states that in creative learning students are involved actively in trying to understand subject matter learned. IMSIM provides freedom for students to design themselves work pieces from several subskills. Provision of freedom to students gives opportunity to think and work according to their capabilities.

The IMSIM is expected to increase learning outcome, motivation, and even creativity since it facilitates many important instructional events such as attracting attention, informing the objectives, providing guidance, providing opportunities for the students to show their learning outcomes, providing stimulus, providing feedback, reinforcing retention and transfer, and evaluating learning outcomes.

At present, many STM teachers have not yet utilized methods that are suitable to the learning material. As a consequence, they are unable to improve motivation, creativity, and achievement of the students. In addition, there is also a lack of development in the instruction of mechanical skills. The study was expected to lead to the discovery of an instructional model that is effective, efficient, and able to improve creativity and motivation of the students, as demanded by the STM curriculum (Depdikbud, 1994).

On the ground of the prior description, the study addressed the following questions: (1) Was the IMSIM able to increase mechanical skill learning outcome of the STM students? (2) Was the IMSIM able to increase work motivation of the STM students? (3) Was the IMSIM able to increase creativity on mechanical skill of the STM students?

METHODS

The subjects of this study were the third-semester second-grade students who were machine production major of the STM Bengkulu and machine major of the STM Curup. The students consisted of 26 students from the STM Bengkulu and 32 students from the STM Curup.

The study was a developmental study that was carried out in two years. In the first year, observation on workshop situation, teacher activities, and student activities were conducted. A package of IMSIM (consisted of instructional scenario, instructional materials, and a practice guidance), and a set of evaluation instrument were also developed. Validation and trying-out of the instructional package and the evaluation instrument were conducted in the same first-year. In the second year, the package was applied in the schools. Application of the package consisted of three stages. The first stage was preparation stage in which specific instructional objectives, combination and sequence of several subskills were decided. The second stage was presentation stage. In this stage objectives were presented and materials were explained. The third stage was application stage in which practice with feedback, product feedback of practice, and transfer of training practice were provided. In this study, transfer of training was conducted in the level of practice, but preciseness was not strictly required as in the factory.

The IMSIM package was developed to facilitate the teachers in mechanical skill instruction. The package consisted of presentation scenario, lesson units, overhead transparencies, and feedback guidance for the teachers. The students received learning materials and worksheets. Learning and instructional materials consisted of ten lesson units: (1) cutting taper with compound rest, (2) cutting taper with tailstock, (3) cutting taper with taper attachment, (4) cutting threads with lathe, (5) cutting left-hand threads with lathe, (6) drilling with lathe, (7) cutting slot with milling, (8) cutting work piece with dividing head, (9) cutting face with shaper, and (10) cutting slot with shaper.

The developed model package was validated to several experts including experienced instructor holding doctoral degree in instructional technology, one education expert with the machine engineering background, one machine graduate who is a staff of Barata Corporation factory, and twelve STM teachers. The result of validation showed that generally the package of the model already fulfilled the main criteria of a good instructional package. However, several revisions of the package were needed such as enlarging figure explanations, completing the number of lesson units, and improving figures.

The evaluation instrument that was developed consisted of a forty-item multiple choice test, a ten-item subjective test, a fifteen-item observation guide of motivation, and a set of creativity test. In order to develop an adequate instructional model, 15 experts including 12 STM teachers, one instructional technology expert, one education expert with engineering background, and one worker from an industry enterprise were consulted. Based on the result of consultation, the model was revised. The revised model was then tried-out on 20 students of the STM Bengkulu and 17 students of the STM Curup. The result of try-out showed that the developed test items had moderate validity and reliability (Cr-20 = .70 for multiple choice test and α = .51 for subjective test). The revised instructional model was applied on 25 students of the STM Bengkulu and 30 students of the STM Curup. The motivation instrument was a modification from motivation assessment that was development by the researcher in 1990. From the 22 items of the motivation instrument, there were 18 valid items with the value of r = .139 s.d. r = .77. Machine skill creativity was measured from students' ability to produce work pieces as many as possible by combining several machine subskills.

The procedure of data collection was divided into two stages, preparation stage and application stage. Preparation stage that was conducted in the first year consisted of: (1) observation of STM Bengkulu and STM Curup situations which included the number of teachers and students, condition of machine workshop, and teachers' and administrators' willingness to participate in the study; (2) development of the IMSIM Package; and (3) trying-out the IMSIM package in a small group of students. The application stage was conducted in 25 weeks of the second year. The stage consisted of teaching and learning activities and supporting material post-test of the practice and creativity. Pre-tests were not administered because of its possible influence on the post-test and its requirement of a longer test administration time.

Effectiveness of the IMSIM was measured using percentage descriptive analysis. The level of effectiveness was determined by analogies on achievement criteria such as the grades above 80 were categorized as excellent. If there were many students achieving excellent grade (80%) then the model was considered to be good. The criteria were adopted from STM evaluation guidance book (Depdikbud, 1994).

RESULTS

The result of data tabulation showed that not all students who participated in this study could conduct each stage of the IMSIM such as following all lesson activities and taking the SMP and creativity test. To maintain internal validity, all data from the students who were not involved in each activity stage of the IMSIM were not included in the statistical analysis.

On the basis of the method, the number of students who were included in the analysis was not the same as the number of students who were involved in the study. The data that fulfilled the requirements of analysis were from 25 students of the STM Bengkulu and 30 students of the STM Curup. The data of one student from the STM Bengkulu and two students from the STM Curup were not included because they lacked the data on practice task and the data on SMP test respectively. The data summary is shown in Table 1, Table 2, and Table 3.

Table 1 The number of students who received score of machine practice outcome test.

School	Score				Total
	50-59	60-69	70-79	80-89	
STM Bengkulu	0	1	9	15	25
STM Curup	0	3	15	12	30

Table 2 The number of students who received grade of work motivation evaluation.

School	Score					Total
	Very low	Low	Moderate	High	Very high	
STM Bengkulu	0	0	0	3	22	25
STM Curup	0	0	0	6	24	30

Table 3 The number of students who received score of machine skill creativity test.

School	Grade					Total
	30-39	40-49	50-59	60-69	70-79	
STM Bengkulu	1	3	5	16	0	25
STM Curup	1	4	6	19	0	30

To test the hypotheses of the study, the data were analyzed by percentage descriptive technique. The analysis result of the first hypotheses was that the IMSIM was effective for machine skill instruction in the STM Bengkulu and the STM Curup. From the participated students of the STM Bengkulu , 60% students had score 80-100, 36% students had score 70-79, and 4% had score 60-69, where as from the STM Curup students 40% students had score 80-100, 50% students had score 70-79, and 10% students had score 60-69. This analysis result showed that more than 90% students received score above 70. Therefore the IMSIM could increase the learning outcome of machine practice which means the first research hypotheses was accepted.

The analysis result of the second hypotheses showed that the IMSIM was very effective to develop work motivation of the STM Bengkulu and the STM Curup students. Of the STM Bengkulu students, 88% students were categorized to have very high motivation and 12% to have high motivation. And of the STM Curup students, 90% had very high motivation and 10% had high motivation. On the overall there were 88% students who had very high motivation. The result means that the second hypothesis of the research was accepted.

On the basis of the analysis of the third hypothesis, the IMSIM was also effective to develop creativity of the STM Bengkulu and the STM Curup students. Of the STM Bengkulu students, 64% had score 60-69, 20% students had score 50-59, 14% had score 40-49, and 3% had score 30-39. Whereas 63% students of the STM Curup had score 60-69, 20% had score 50-59, 14% students had score 40-49, and 3% had score 30-39. This analysis showed that only 63% students were categorized as having moderate creativity. As a conclusion, the IMSIM could develop moderate creativity. Therefore the third hypotheses was rejected.

An additional finding of the study showed that 20% students of the STM Bengkulu and 80% students of the STM Curup experienced anxiety on the first practice. However, the number of students who experienced the feeling decreased in the following practices. Only 4% (one student) of the STM Bengkulu and 6% of the STM Curup students experienced the feeling on the third-week practice.

From the analysis, the IMSIM was able to increase students' mechanical skill and motivation. However, the model did not give an optimal result on students' creativity. Application of the IMSIM on the schools could arouse anxiety on students even though the feeling decreased as the students got used to the model.

DISCUSSION

Based on the result of the hypothesis testing, the IMSIM was able to improve students learning outcome, motivation, and creativity. Therefore, the model could help the students in their learning process. The findings can be used as starting points to conduct more studies on the strengths of the IMSIM in improving students learning outcome, motivation, and creativity.

The first and the second findings, the improvement of learning outcome and motivation, were inseparable. In the IMSIM the students designed together the tasks that were interesting to them. The students knew that the product of the tasks would be useful and had economic value. By knowing the usefulness and the economic value of the product, the students were more interested and enthusiastic in conducting the task. These interest and enthusiasm made them enjoy their work and produce good work products. The utilization of instructional methods that were suitable with instructional objectives in the IMSIM created learning situation that facilitated understanding and did not bore the students. For example, demonstration method was used by the teachers to demonstrate skills immediately after the teachers explained the supporting materials. The involvement of various students' senses in the IMSIM created a strong and intense the impression or perception perceived by students on the lesson. This strong impression or perception increased students' learning outcome.

In the IMSIM, the feedback that was given immediately after the practice increased students' learning outcome. This finding is consistent with the result of the study that was conducted by Cates (1988) and Jonassen (1988) in cognitive domain. The effectiveness of the immediate feedback can be explained in the following concept. The information from the teachers was not immediately disappearing. The same notion was proposed by Heinrich and McKeegan (in Tucker, 1973), that too long feedback delaying results in the lost and forgotten information. Moreover, delaying feedback results in a lack of accuracy of the students to perceive the feedback. In turn feedback causes ineffectiveness on improving students' behavior. According to Heward and et.al, (1984), delayed feedback can be harmful because it can create opportunities for students to make mistakes again. A study that was conducted by Riyanto (1994) shows that students' learning outcome of mechanical skill is better if immediate feedback is given than the delayed one.

The provision of immediate feedback helped the students to monitor and arrange the subsequent activities immediately. If the students made mistakes they could correct the mistakes immediately. The feedback can function as reinforcement (reward and punishment). The students who were given immediate feedback would reinforce their performance quicker. In addition, they would not want to take risks for making mistakes again because they were afraid of punishment.

Immediate feedback was also used to evaluate and modify lesson plan continuously based on students' response. The continuity of evaluation and lesson plan modification is the key component for successful instruction (Carlton, 1981). The accuracy of feedback also helped the students to understand their performance improvement gradually. Accumulation of gradual improvement will lead to bigger improvement (Heward, Heron, and Poster, 1984).

This IMSIM was successful in improving students' learning outcome and motivation because the model stressed many important instructional events such as attracting attention, informing objectives, providing counseling, providing opportunities for the students to show their learning outcome, providing stimuli, providing feedback, reinforcing retention and transfer, and evaluating students' learning outcome.

The third finding showed that the IMSIM has not showed its effectiveness to develop creativity. This finding can be understood because creativity is not developed suddenly in a quite short period of time (during the research). Even though the model did not improve creativity significantly, theoretically the model is able to develop creativity. One of the reasons that the model has not improved students' creativity is that the model was not applied optimally. Several activities that were not optimal are design activity and discussion. In design activity and discussion, the students were expected to be active. However, this situation was difficult for the students. As a consequence, the teachers had to be more active to encourage the students to do the practice. With teachers' intervention, the students' initiative was not fully developed. The teachers' intervention was conducted because of time constraint. After all, the IMSIM is more advanced than the instructional model that was usually applied by the teachers in which the students only wrote the tasks on the worksheets. Other factors that influenced the ineffectiveness of the model to develop creativity were the overall instructional system in the schools, educational system of parents, and educational system in society. Therefore, the IMSIM is suitable for machine skill instruction for schools that have enough machines. For schools that have few machines, the practice can be conducted in group.

CONCLUSION

On the basis of the research result and discussion, it can be concluded that: (1) the IMSIM was effective to improve students' learning outcome of machine skill instruction, (2) the IMSIM was very effective to increase students' motivation, and (3) the IMSIM was moderately effective to increase students' creativity. From the result, the IMSIM was more effective to improve students' learning outcome and motivation. However, the model has not shown optimal result on students' creativity. An additional finding of this study was that in the beginning of its application many students of the STM Curup experienced anxiety, whereas only few students of the STM Bengkulu experience the same feeling.

REFERENCES

Carlton, L.G. 1981. Processing Visual Feedback Information for Movement Control. *Journal of Experimental psychology: Human Perception and Performance, 7*(5), 1019-1030.

Cates, J.S. 1988. *Delay of Feedback and Cognitive Task Level in Practice Exercises.* New York: Macmillan.

Depdikbud, 1994. Pedoman Penilaian Praktek. Jakarta: Depdikbud.

Dimyati, M. and Toenlioe, A.J.E. 1992, 10 Maret. Pendidikan yang Berorientasi Pasar. *Kompas, 27*(249), 4, 3-5.

Heward, W.L., Heron, T.E., Hill, D.S., & Poster, J.T. 1984. *Focus on Behavior Analysis in Education.* Columbus, OH: Bell and Howell.

Jonassen, D.H. (Ed.). 1988. *Instructional Design for Micro Computer Courseware.* Englewood Cliffs, NJ: Lawrence Erlbaum Associates.

Munandar, S.C.U. 1987. *Mengembangkan Bakat dan Kreativitas Anak Sekolah.* Jakarta: Gramedia.

P2TKD. 1987. *Dunia Pendidikan dan Dunia Usaha dalam Menyongsong Era Industrialisasi: Rumusan Hasil Seminar, Analisis dan Beberapa Alternatif Pemecahan.* Surabaya: Proyek Penataran Tenaga Kependidikan Dikmenjur.

Peck, R.F. & Tucker, J.A. 1973. In Robert M.W.T. (Ed.). *Research on Teacher Education: Second Handbook of Research on Teaching.* Chicago: Rand McNalley.

Reigeluth, C.M. & Merrill, M.D. 1978. A Knowledge Base for Improving Our Methods of Instruction. *Educational Psychologist*, 13, 57-70.

Riyanto. 1994. *Pengaruh Metode Pengajaran dan Waktu Pemberian Balikan terhadap Hasil Belajar Keterampilan Psikomotor.* Unpublished Disertasion. Bandung: PPS IKIP Malang.

Semiawan, C.R., Munandar, A.S., and Munandar, S.C.U. 1990. *Memupuk Bakat dan Kreativitas Siswa Sekolah Menengah, Petunjuk bagi Guru dan Orangtua.* Jakarta: Gramedia.

Slamet P.H. 1989, December 11. Kolaborasi Sekolah Kejuruan dengan Dunia Kerja. *Kedaulatan Rakyat, 40*(75), 4, 7.

Vembrianto, St. 1990, April 3. Sekolah Kejuruan Suatu Pemborosan? *Kedaulatan Rakyat, 45*(184), 4, 1-3.