Design and Fabrication of Mold Base Teaching Tool by using Rapid Prototype Approach

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ABSTRACT

Teaching tool (ABM) are basically developed to provide a clearer picture of teaching and learning activities (PdP). The development of teaching tool (ABM) mold base was produced to assist lecturers in the teaching and learning process (PdP) for the DJC50083 Mold Design course at the Sultan Abdul Halim Mu'adzam Shah Polytechnic. It also aims to help improve students' understanding and knowledge of the mold base, especially in the feed system. Although there is an existing ABM mold base but does not have complete components such as insert cavity, workpiece pocket and feed system. In addition, the existing ABM mold base is heavy, this will make it difficult for lecturers to bring it to the lecture room. Therefore, a mold base teaching aid is produced by using a rapid prototyping process by using a 3 Dimensional (3D) printer. From the results of the analysis of the findings of the study and discussion showed that the average student gave a good evaluation of the results of the production of teaching tool model (ABM) this mold base. The advantage of this design that has been produced is that it has complete components that must be on the mold base such as feed system, insert cavity and workpiece pocket. Thus, with the existence of mold base teaching tool using Rapid Prototyping has helped lecturers and students in the process of teaching and learning.

INTRODUCTION

Outcomes based learning or known as outcomes based education (OBE) is an instructive prepare based on the achievement of certain outcomes within the learning process of a student. It is also a process that involves the restructuring of the curriculum, assessment and reporting in education in ensuring that the level of student achievement reaches a high level. Implementation (OBE) needs to have Program Learning Outcomes (PLO), it must be clearly and explicitly stated about the knowledge, skills and attitudes that need to be achieved by the students as measured through practical tasks. In addition, the implementation (OBE) should have a Course Learning Outcomes (CLO) measured through quizzes and tests to measure student achievement in comprehension in learning. At the Sultan Abdul Halim Mu'adzam Shah Polytechnic (POLIMAS) in the DJC50083 Mold Design course, the Key Performance Index (KPI) set by the lecturer of 80% still did not reach the target because the average student learning outcomes in June 2019 to June 2020 is still 76.1% lower than the target. Therefore, the Continuous Quality Improvement (CQI) process needs to be done to identify problems on unattainable results. The problem faced by Diploma in Mechanical Engineering (Plastics) students in DJC50083 Mold Design course is on CLO1 which involves student or cognitive knowledge. In addition, there are problems with CLO2 that involve students 'psychomotor or skills. To increase the level of understanding of the mold base among students, simulation teaching methods are used. A simulation method is a situation created to resemble a real situation but in a simplified, summarized or reduced form. Among the teaching aids for simulation methods is rapid prototyping [1]. Mold base development using rapid prototyping process can be used as a teaching aid in facilitating the teaching and learning process

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as well as increasing students' level of understanding of the Standard Mold Parts subtopic. Mold base is an empty block that will be filled with a liquid such as plastic that has been melted and then the plastic liquid hardens or settles in the mold (mold) that will produce a shape or product. The objective of this innovation is to design a mold base using a rapid prototyping process to be used as a teaching aid (ABM) for the DJC50083 Mold Design course.

EXPERIMENTAL

The difficulty faced by the students is difficult to understand and memorize each component on the mold base. In addition, students are not able to design the mold base well, especially involving the entire system in the mold such as feed system, gate system and ejection system [2]. Existing base molds do not have complete and heavy component parts. In addition, learning methods that rely on notes and videos alone also cannot further strengthen students' understanding. Figure 1 shows the Project Design Process Flowchart accordingly.

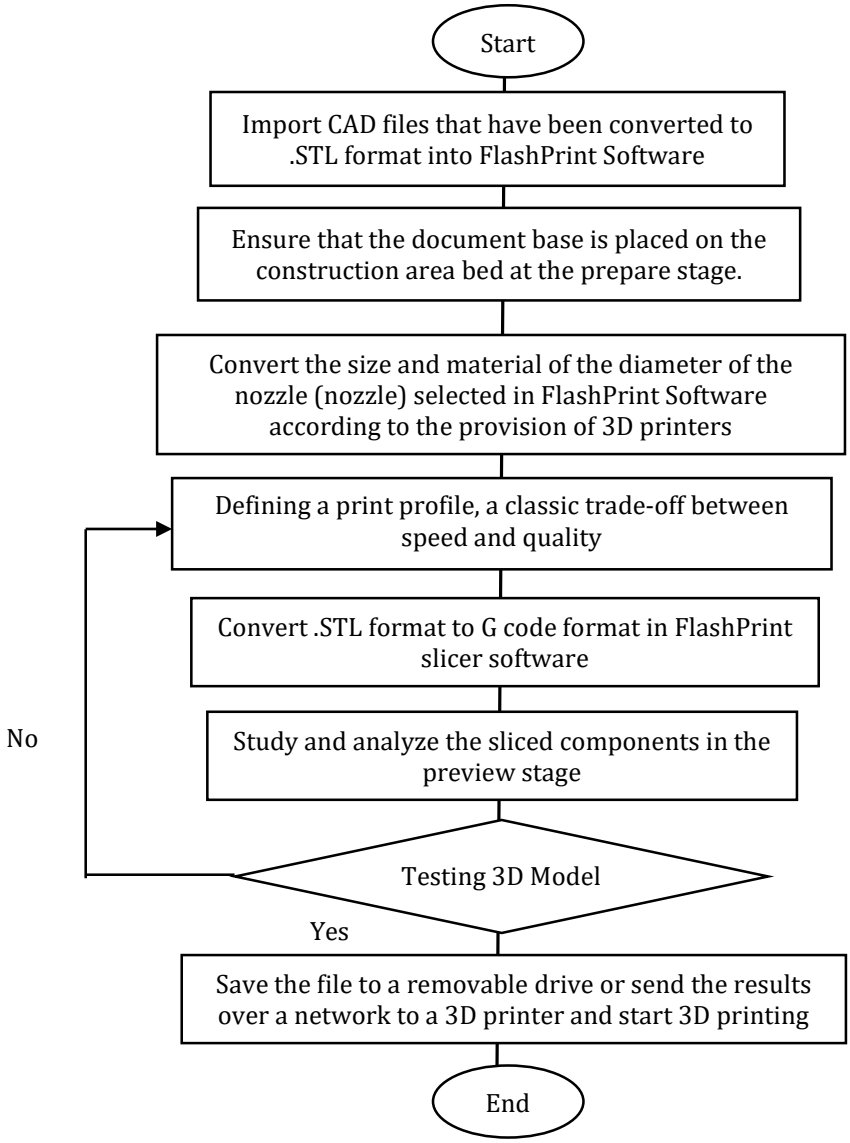

Figure 1. Project Design Process Flowchart.

Mold base (base mold) is an important part of the injection molding machine. The injection of material (plastic liquid) into the mold will shape the geometry of the product according to the shape of the product on the mold. The mold base has two parts consisting of a moveable plate (moving plate) and a stationary plate (stationary plate) [3]. Table 1 shows the function of the mold base section. Rapid Prototyping is an additive manufacturing technology used to produce prototypes, models, patterns and machine parts. Rapid Prototyping uses Computer Aided Design (CAD) 3D models generated using CAD software. Prototypes are used to check for deficiencies in the design before producing and use the parts built by this process as patterns. It is also to develop scale models using Rapid Prototyping [4]. Figure 2 shows the procedures for generating innovation.

Project Development Procedure

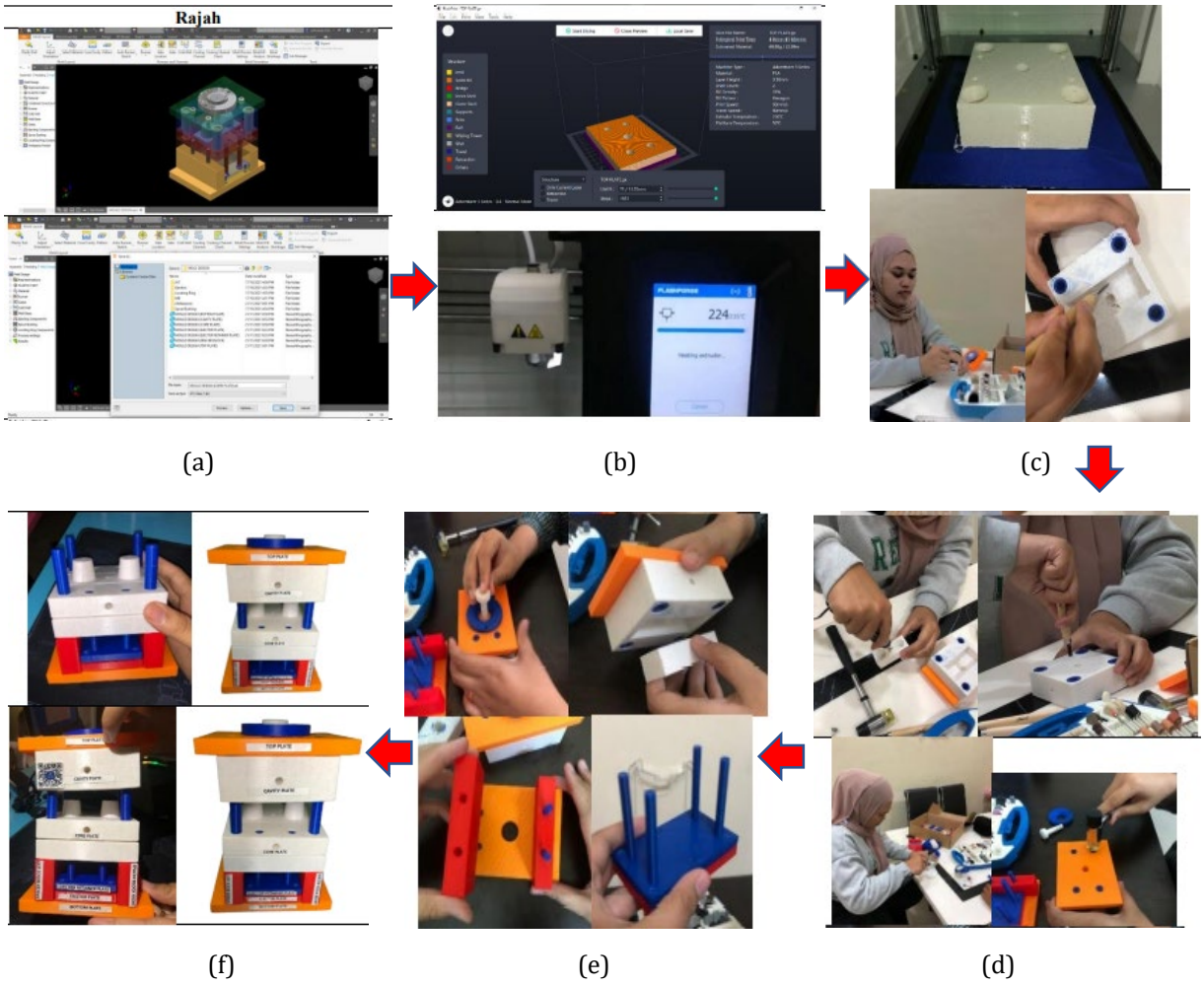

Figure 2. Procedures for generating innovation.

Figure 2 shows design prototype mold base in Computer Aided Design Software (Autodesk Inventor 2019). Save and export files into STL file format for each plate for the mold base. Open and slice (slicing) the STL file into the slicer software (FlashPrint 5). Click filament and then click load on the LCD display of the FlashForge 3D printer (Advanturer 3). Make sure the filaments are inserted in the correct direction. Wait until the temperature of the injector (extruder) rises to the maximum level. Click build on the LCD display of the FlashForge 3D printer (Advanturer 3) and select product design and print. The printing process begins. When the printing process is complete the printer beeps, then remove the base by pressing down and pulling out. Product date of the liner (base plate). Support material should be removed by scraping the support material

from the required part. Finish and clean every part of the prototype model. Connect the top plate and cavity plate by inserting the prototype socket head cap screw in the top plate hole. Install the locating ring in the middle of the top plate and insert the sprue bushing in the middle hole of the top plate. Insert the guide bush into the hole of the cavity plate. Insert the cavity insert into the workpiece pocket in the cavity plate. Insert the prototype socket head cap screw in the bottom plate hole. Insert the right and left block spacers in the correct position. Insert the return pin into the hole of the ejector retainer plate and then connect to the ejector plate using a prototype socket head cap screw. Insert the guide pin into the hole of the core plate. Connect all the plates in the core section. Place the core insert on the surface of the core plate. The process of labeling each plate on the prototype mold base model [5, 6].

RESULTS AND DISCUSSION

The results of data collection and analysis include evaluations related to projects that have been developed including advantages, disadvantages or problems in the process of development of teaching aids (ABM) mold base. Testing carried out on the product that has been produced along with testing methods and equipment. Design testing criteria is an evaluation conducted on the product produced to obtain feedback on the product produced whether it meets the criteria that have been set or unsatisfactory. Table 1 shows the application Testing Criteria for Mold Design Teaching Tool using Rapid Prototyping.

Table 1 Application Testing Criteria for Mold Design Teaching Tool using Rapid Prototyping

No.	Design Testing Criteria	Evualution Scale				
		1	2	3	4	5
1	Safety				√	
2	Understanding				√	
3	Function				√	
4	Final Product				√	
5	Eco-friendly			√		
6	Material suitability				√	
7	Ergonomic				√	
8	Types of testing					

Criterion	Discription
User	The product to be produced is for the use of students and lecturers of the Department of Mechanical Engineering (Plastics) at POLIMAS
Function	Mold base teaching aids are to assist students and lecturers in teaching and learning sessions. In addition, it serves to increase comprehension to students
Materials	The materials used to develop this project are 3 dimensional printer (3D Printer), PLA filament (filament) and mold base (CAD)

Source: Mohd et al., 2017

(a) (b)

Figure 3. Comparison between current and previous innovation

Figure 3 (a) shows the DJC50083 course a lecturer is conducting a teaching and learning process (PdP) using a prototype teaching aid (ABM) mold base. Meanwhile, Figure 3 (b) shows that the students from DMK5A and DMK5B classes are testing the mold base teaching aids and Argumented Reality application. Questionnaires were given after the teaching and learning session accordingly [9, 10).

Innovation Functionality Feedback from Users

Table 2 shows a comparison of the design of existing teaching aid (ABM) mold base and prototype model of teaching aid (ABM) mold base using rapid prototyping.

Table 2 Comparison of Teaching Aids Design (ABM) Mold Base

Specification	Design of Teaching Aids (ABM) Existing Mold Base	Prototype Model of Teaching Aid (ABM) Mold Base
Design of product		
Dimension	250 mm x 200 mm	150 mm x 150 mm x 220 mm (skala 60%)
Weight	6.9 kg	430 g
Material	Perspek	PLA Filament
Advantage	• Assist the instructor explain the mold base more easily • Assist students understand the mold base clearly	• Complete components including feed system, insert cavity and workpiece pocket • This prototype model is lightweight and easy to carry.

From the analysis of Table 2, the findings of this study shows that the production of teaching aids (ABM) helps the lecturers in teaching and learning sessions (PdP) for the course DJC50083 Mold Design. The result of the analysis shows that the students able to know more about base and each part of it including feed system. Therefore, the objective of this project is to design a mold base using rapid prototyping process to be used as a teaching aid (ABM) for the course DJC50083 Mold Design has been successfully achieved. Table 2 are shown a Comparison of Teaching Aids Design (ABM) Mold Base.

CONCLUSION

The design of teaching aids (ABM) mold base using this rapid prototyping process has been successfully produced and achieved. The objectives stated before about the process of producing a prototype model of teaching aids mold base has been carried out. This project has focused on six main processes, namely designing a mold base prototype in Computer Aided Design software (Autodesk Inventor 2019), save (save) and export (export) files into STL format for each mold base plate, convert STL format to G-code format in the slicer software (FlashPrint 5), click filament and then click load on the LCD display of the FlashForge 3D printer (Advanturer 3). Make sure the filaments are inserted in the correct direction. Wait until the temperature of the injector (extruder) rises to the maximum level, click build on the LCD display of the FlashForge 3D printer (Advanturer 3) and select the product design and print. Finally, the process of finishing and assembling the prototype. This process is to improve the design and function of the existing teaching aids (ABM) mold base. This innovation is to help instructors in the teaching and learning process (PdP) and also help students in improving their understanding of the mold base, especially in the feed system so that students can see more clearly with the prototype of this mold base. The advantage of this design that has been produced is that it has complete components that must be on the mold base such as feed system, insert cavity and workpiece pocket. In addition, the advantage of this product it is light and easy to carry to the lecture's room.

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