

Electronic Technology Used in Engineering Thermodynamics

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Abstract

One of the most promising prospects in education is the use of electronic multimedia tools in the classroom and extended to the internet. In the Fall 2005, a thermodynamics class was taught using the UTSA Instructional Theatre classroom. Seventy three students were in the course and it was presented using the latest multimedia resources available at UTSA. Lectures were primarily PowerPoint mixed with the use of a document camera. The document camera was used to keep the course interactive and dynamic. If students asked a question, the camera was used like a chalk board because it was beyond the confines of a slide presentation. Each lecture was video taped and posted as a streaming video file within the WebCT course management system. All handouts, homework and exam solutions were scanned into pdf files and made available within WebCT. An end of the class survey having 58 specific questions was conducted and about 68% of the students participated. Feedback from the survey highlighted what students found to be helpful and has been used to adjust for next semester. The strongest survey results were in the area of being treated fairly by the instructor and the students responding with integrity. Results show that students develop an overall attitude toward the class and instructor and this influences responses in many areas. Lastly, the instructional workload for those who teach in a multimedia classroom are well beyond that of the traditional marker board class. The author concludes that multimedia classrooms are the future and speculates about what the future will look like.

Introduction

Multimedia is a broad term used in educational circles, yet the common point is the use of electronics in presentations. In the early years, multimedia electronics would include record players, cassette tapes, head phones, picture books, and students in cubicles learning at their own pace. It transitioned to overhead projectors, transparencies, slides and today it includes laptops, PowerPoint, audio/video clips, etc. From the beginning,

there has been thrust to augment traditional learning resources with new technologies that have become available largely because of electronics. Today, the trend continues and has intensified. Yet the challenge has not been how to adopt technology to increase coverage of information, but the challenge has been to increase learning. As the mix of audio, static visuals, dynamic visuals, and hands-on has increased, there is a growing consensus that more is often worse than less. It is very easy to create a multimedia class or lecture in which very little learning occurs, yet much material is covered. The problem would be described as information overload with insufficient time allow for assimilation, processing, categorizing, pondering, questioning, etc. which are critical steps a student should take in the cognitive process of learning.¹ As new electronic technology is tried in the classroom, one hears of student feedback that is a repeat of what earlier students said about earlier technology. One hears that PowerPoint “sucks the life out of a class,” yet one could hear similar comments about overheads or audio-visuals.² Whenever there is a lack of spontaneity or interactivity, the live of the class is drained. If the instructor launches into a solo monologue, students drop out. Given the trend that multimedia learning has become more powerful, its wise use as well as common misuse, needs to be understood.³ The greatest misuse is not allowing the audience time to absorb and internalize the new material.

Classroom

In order to try multimedia presentation equipment, the request was made to teach a core mechanical engineering class, Thermodynamics I, in one of the best equipped classrooms at UTSA. Because of class scheduling difficulties, the first 3 weeks of the semester were held in a traditional chalkboard class. The room had two relatively small chalk boards in the front with a raise platform. The seats are arranged in a deep, narrow layout, and are cramped having small pull-up, flip-over writing tops. These rooms have been in use with little modification since originally built.

After three weeks, the class was moved to the electronic theatre classroom, see Figure 1. In contrast, there are two large back projection screen on the left and right side of the instructor. They are well above the minimum of 8 feet, hence the instructor can move without blocking anyone’s view. The instructor’s console is shown in Figure 2, and has a dedicated PC, power/projector/internet hookups for laptops, touch-screen control panel, VHS and other audio/visual projection equipment (for playing films, but was not used in this class), and a document camera. The document camera is becoming widely employed throughout UTSA and is apparently considered an essential component of a modern classroom. All of the equipment was housed in a console behind which the instructor can stand or sit.

In front of the instructor, in the middle of the first row of student seating, are two large TV-like monitors which the instructor views, see Figure 3. These display what is on the screens that the students see. So the instructor sees what the students see without turning around and looking up at the screens. As the instructor becomes more familiar with the technology, the screens are found to be helpful when switching between equipment like PC and document camera. Without this, the instructor may forget to switch the command

buttons on the console so that the screen continues to show the PC while the instructor is working on the document camera. It may take a few seconds to minutes before a brave student gets the attention and asks it to be fixed. In a previous class, this became a point of agitation for some students whose displeased attitude then infected other students. Having these monitors, the instructor can quickly glance to seek what students see and adjust. Another example of their use is when the distance learning technician who monitors the classroom equipment, decides to place a smaller live camera image of the instructor over a portion of the screen. This can not be seen live in the classroom, but is available through the WebCT course management system to enrolled students who want to review the lecture. The lecture can be replayed using streaming technology over the internet. The camera shot of the instructor often is placed in the lower right corner of the screen. Often the instructor will watch the monitor, see if their image is being presented, and move text on the document camera so that it is not covered by the image. This small thing did become a source of agitation for some students who replay the lecture in order to take better notes, yet find parts of the screen blocked. The distance learning technician may be instructed to add the image of the instructor in order to help keep a live appearance, because it appears to be standard practice to switch the camera image in and out a few times during a 50 minute lecture. The control console for the technician is shown in Figure 4 and typically controls more than one classroom at a time.

The student seating in the theatre classroom is much more comfortable and spacious. Students can enter and exit a row without serious disruption to other students. The room has a higher ceiling and modest theatre slope so students can see over the heads of those in front of them. The room had a less narrow yet deep layout and can hold 99 students. Probably the best feature is the student desktops which were continuous from end to end of the row. They were also relatively deep, allowing students to have multiple things in front of them during lecture. Likewise, there is much more room for taking exams, which require the use of a calculator, equation sheet(s), textbook, and exam sheets. The physical attributes of the new room are so much better than the old room, and this switch is believed to have a good impact on student receptiveness. Just like a building or office creates an inviting ambiance, the classroom had an impact on the feeling of students in the class.

PowerPoint

At the beginning this instructor considered multimedia synonymous with PowerPoint. However faulty this connection may be, it should be recognized that using the multimedia theatre classroom largely means that one uses PowerPoint, or that the semester began with almost the exclusive use of PowerPoint.

Because everything was done in PowerPoint, one quickly found it important to generate lectures. Examples of slides are shown in Figure 5. The textbook comes with excellent electronic support, including a CD that contains a complete solutions manual and textbook in pdf files.⁴ Having the solution manual in pdf files is not uncommon, yet having a complete copy of the textbook was rare for the Fall 2005. This was a huge advantage in making PowerPoint slides. One can view the textbook and use graphics

copy-paste or text copy-paste to create slides. The quality of the pdf images is excellent, especially if one zooms to 150% or 200% in Adobe viewer before copying a graphic so that it looks clear when pasted in PowerPoint. The style of the textbook also lends itself to multimedia presentation. It has a high density of graphics. The outside page margins are about 1/3 of the page width, and it is used to present most figures and tables. If a figure requires more space, it is placed in larger portion of the page and displace text. Yet, most fit comfortably in the outside margins. Because of the large number of illustrations, one can make presentations that has minimal bullet point lists. Gauging student responsiveness during the first few lectures, the instructor sensed that text dominated slides killed student attention. As the semester progressed, the presentations tended to be more graphical.

Because the complete textbook is in pdf files on a CD supplied to the instructor, one may think this is a new trend in textbook publishing. Maybe it is forerunner of the changing landscape of textbooks, such as predicted by Lienhard whose heat transfer textbook is available free in pdf format.⁵ Some predict that the traditional paper hardback textbook dominated by technical publishing firms may be supplanted by individual publishers and internet ebook distribution or groups of authors in wiki internet collaboration. Regardless of the future, today most publishing company representatives have a negative reaction when asked if a copy of their textbooks is available via pdf format to instructors. Having spoken with numerous publishers, they are concerned that their print ready pdft files will be misused. A perusal of ebay shows offerings of complete pdf solutions manuals for many engineering textbooks, emailed directly to anyone for a modest “buy it now” fee of a few dollars. These solution manuals were not generated by the ebay seller, but by the publisher. Likewise, they are for restricted instructor use and not resale especially to students. At this time it appears to be more of an anomaly to have a complete copy of the book in pdf format for instructor use. Maybe the recent handling of music and film copyright may set the precedence for the textbook industry.

New scanning technology makes it easy to copy and use color images from textbooks. When textbook files aren't available, the author scans the desired pages. The cost of a good scanner is very reasonable, even for one capable of high quality images. A quality scanner is now as essential as a PC and printer, in the office of faculty who need to make multimedia presentations.

Over the semester, the style of lecture presentations changed from completely PowerPoint to a mixture using the document camera. This was primarily prompted by the restrictive nature of PowerPoint. It is difficult to gauge the number of slides one can cover in a 50 minute lecture. If there are questions, there may be uncovered slides needing to be skipped to get to a wrap-up slide. Skipping slides is not professional and left a bad impression with some students who felt the instructor didn't have control of the clock or class. Likewise, students want to see the solution to a problem developed not just presented. Using PowerPoint, one can “fly-in” pieces of the solution, yet this is very time-consuming to construct and awkward if the instructor forgets what piece flies at what point in the development. This style of presentation is like that of covering a part of a transparency and sliding it down as the discussion progresses. In general, students view

this as too canned. The instructor tried solving the problem on paper and scanning to generate an image that was brought into PowerPoint. Yet the students wanted to see the problem developed, starting from a clean piece of paper or a clean marker board. As the semester progressed, the restrictiveness of PowerPoint for a class like thermodynamics was apparent. Students needed to see problems developed with opportunities to explore changes as motivated by their questions. The document camera was used to do this.

Document Camera

The distance learning center will not allow the use of the marker board in the Instructional theatre classroom or any other multimedia technology dominated room they control. Although equipped with a large board, the middle portion was draped with a UTSA banner as background for the video camera. The next best thing is the document camera which projects an image onto the screen. The image is often of a sheet of paper on which the instructor can write, as shown in Figure 6. This acted as an electronic blackboard. Observed advantages include: sheets can quickly be removed (equivalent to erasing the board), sheets with preprinted problem statements can be the starting point, and pen strokes are similar to chalk strokes. Some observed disadvantages include: the hand blocks the view (like the instructor body in front of the chalk board), the resolution is low, the faculty has to frequently adjust camera focus or size, the faculty can write outside of the projected area (leading to agitated comments from students, “your off the screen”), it is impossible to erase a mistake, and only black markers were effective. Despite drawbacks, using the document camera was a great improvement and was used increasingly during the semester. This was able to break the monologue and allow the students to direct the flow of the class, within reason, to address particular questions or approaches to problems.

Student Feedback

Students input was regularly solicited during the semester and a more details survey was given at the end of the final exam. The survey was given after they had completed the class and had an overall sense of how well they did. A common problem with course surveys is they to get a significant number of responses, you need to catch students before the end of the semester, yet a significant portion of there grade is often determined by a final exam. Promptly after the final exam, emotions about the “fairness” of the exam may bias feedback. Overall, there is a significant degree of variability on the positive or negative feedback one can get depending on when the survey is given and what is the immediate emotional state of the class.

The survey consisted of 58 questions and students were asked to respond by circling either: SD (strongly disagree), D (disagree), N (neutral, or no opinion), A (agree) or SA (strongly agree). Out of 73 students, 48 completed the survey so that about 68% of the class participated. The grade distribution for the class was 13% A, 16% B, 42% C, 10% D, 19% F/W, so that about 30% of the class did not achieve the goal of passing the class and a large fraction of the 42% who earned C grades were disappointed in their

performance. The grade distribution is mentioned because it is the author's opinion that survey results are readily biased by giving a large percentage of A grades.

In Table 1, the questions and responses are summarized. They have been sorted from the most strongly agree to strongly disagree. The right-most column is the average score used to sort questions. If a response was above about +0.8, the class average "agreed" and if it was less than -0.8 the class average "disagreed" with the statement. It is heartening to see the most strongly agreed with question was about how they felt they were treated. From the perspective of technology, they liked homework solutions being made available within WebCT, probably because they can access it anywhere and anytime from the internet. They also liked the classroom which the author believes has a strong overall correlation with student performance. If they dread a class because of uncomfortable seating or cramped table space, the atmosphere of the class can be set in a negative direction. They also liked the textbook and a few items which are summarized in the table.

Question 39 concerned PowerPoint and it was heartening to see that providing the slides via WebCT was considered helpful, and question 37 confirmed that students reviewed the posted slides. There are concerns about material being too easily accessible to the students, whereby they may skip class and assignments and rely more on supplemental material. Question 38 addresses that point where students "strongly disagree" with the assertion that having PowerPoint slides available encouraged them to miss class. Likewise, Question 31 was the opposite of 39, where students confirmed that PowerPoint lectures were not "terrible". In summary, the student responses confirm that having WebCT access, video lectures, copies of homework, and copies of PowerPoint lecture slides did not encourage them to miss class which is implicitly correlated with diminished desire to learn the material.

Questions 36 and 34, reveal that the video lectures were much less effective than the instructor believed they would be. The students typically reviewed a lecture or two, for the novelty of doing it. But, only a very few students routinely reviewed the lectures. In one case, a student had emergency knee surgery which forced them to miss about 4 lectures. Upon return, the student cheerfully reported they were able to keep up to date by viewing lectures from home over their high speed DSL internet connection. The student, however, was quick to follow up with a complaint that the audio was not able to hear a student's question but only the instructor's voice. The instructor used a lapel mic and the classroom was equipped with talk buttons on the table tops in front of each pair of students, see Figure 1. Likewise there were drop down mics hanging from the ceiling. In theory, if a student wanted to speak, they would hold down the button which would do two things. It would move a camera to the student and send the student's image to the video streamed file or to a second distance learning site. It would also activate the mic which would pick up the student's voice. None of this, however, was evident to the student asking the questions. Their image was not displayed and they could not tell if their voice was being recorded. At the beginning, the instructor asked students to hold down the button when they wanted to ask or answer a question. Yet without feedback, it was quickly forgotten. Worse even, many students were reluctant to push the button and

were less apt to participate. After a few weeks, the instructor stopped asking students to use the button, and concentrated on those who were present in the lecture. As the semester progressed, there was less concern about generating a quality video for after-hours viewing. The focus was to create and maintain a normal classroom environment where the electronic technology was not intrusive, but only in the background.

Overall, the student feedback was encouraging, yet it prompted some changes. Informal feedback was also collected from students who suggested the Instructor try more dynamic media and also move away from the stiff PowerPoint to a more flowing lecture using a TabletPC. Both are being used today, and are discussed because they may represent more of the vision of the future multimedia classroom.

Internet Video Clips

Within the past few years, there has been an explosion of video clips available over the internet and many are suitable for use in the classroom. A good example is related to the 4-stroke otto cycle common in spark-ignition internal combustion engines. Within the PowerPoint presentation, one slide showed links to sites that have dynamic illustrations and two sites were visited.^{6,7} The transition was virtually seamless and the instructor was able to use things that would have been expensive if not impossible to create myself. Video clips of physics experiments also are interesting, but only still clips of a few experiments and a demonstration are available at no cost.⁸ Another example is that of university produced video clips such as from the University of Colorado.⁹ In the future, one would like to see more available via the internet so that the instructor doesn't have to spend time managing files and making sure the latest videos are being used. The preferred way would be for the department, college or library to secure site license to educational resources that can be accessed over the internet, if costs are an issue. Or, the instructor can hunt for appropriate clips for their class. Because short video clips are effective, the instructor has purchased a digital camera and is asking student to generate their own educational resources by becoming the teacher. This is a topic in itself, yet having students teach students holds promise because of the advances in electronic technology.

TabletPC

Near the end of the semester, a few students suggested that the faculty explore using the TabletPC in the classroom. After making some inquiries, it was found TabletPCs were being used in a few classes at UTSA. From Question 7 of the survey, one found students had been exposed to them and typically liked them in the classroom. The instructor had no experience with a TabletPC but decided to move in that direction and try one in the Spring 2006. After some research, it was found that the TabletPC has been used and discussed in a number of educational articles,^{2,10,11} and has some distinct advantages. First, a pen stylus is used to write on the screen of the TabletPC which can be displayed onto the screen. Using digital-ink, the color can be switched readily, it can be made into a highlighter, and it can be turned over like a pencil and used to erase mistakes. It brings the dynamic board experience back into the class. Using Microsoft

Journal software, one can transform existing files or parts of files into Journal files. One can add or erase annotation without disturbing the original imported text or image. A typical example of a screen image is shown in Figures 7, where the semester syllabus is shown. Using the highlighter, one discusses the goals of today as well as plans for the week and possibly alert students to the next quiz, homework, or exam. This has become the favorite way to begin all lectures. With a quick click, the next Journal file is opened and one proceeds with the lecture.

Figure 8 shows another example of a screen image after solving a problem. The original problem statement with illustration is electronically cut-and-paste from the text. The markings can be added with quick changes to the color or thickness of the pen. The students then can see the solution to the problem developed in a flowing error-prone yet real environment instead of a debugged and canned PowerPoint presentation. The instructor can often change solution strategies or address questions, just like on a chalk board. It takes some learning, but the TabletPC is intuitive and readily mastered.

In addition, the screen images and audio are captured using Camtasia software¹². This software is loaded onto the TabletPC and is activated at the beginning of the lecture. The instructor proceeds as normal and the audio and video are saved, without sluggishness on the TabletPC. The only way to determine if the software is working is to see a small icon flash in the lower right portion of the taskbar. At the end of the lecture, the software is deactivated. The files can then be edited to produce production quality screen casts. This software has gained widespread use and is targeted to an audience much beyond the typical University classroom, hence only a small portion of the capabilities are used. For our purpose, the files are not edited or cleaned, but are produced as recorded. The production is streamlined and begins with a few clicks before the TabletPC is loaded into the briefcase. Because it is battery operated, the processing occurs in the briefcase while the Instructor answers questions and walks back to class. It is often completed in ~5 minutes before getting back to the office. It can now be loaded onto WebCT with a surprisingly little effort using WebDev, or any course management system. The most annoying part of the process is creating the link within WebCT to the uploaded files.

The author settled on the Macromedia flash format, although the software offers avi, wmv, mov, etc. Files are automatically stored in a newly created folder per lecture for organization purposes. All of this can be automated within the Camtasia software. The video screen dimensions used are 800x600 with no JPEG encoding/compression. The files use “high color” so they look sharp. To save on the file sizes only two video screen frames per second is used. In this way, the entire 50 minute lecture takes about 15 Mb. Having 2 frames per second makes the pen strokes a little jumpy, but no information is lost. The quality of the audio is considered much more important.

Conclusions

In conclusion, a number of technologies have been used to create a more engaging learning environment for students. This is being done in a traditionally difficult mechanical engineering class of thermodynamics. It was observed that a well equipped

classroom is essential for the instructor (PC, laptop hookups, large/clear screens, document camera). Likewise a comfortable room for the students is needed if you want them to focus on learning. In a lecture dominated class, electronic technology is not to be viewed as simply PowerPoint but should include the use of dynamic video clip (readily available via the Internet) and electronic marker board. The document camera and TabletPC have been used to keep a dynamic, interactive atmosphere in the class. Using course management software, additional education resources can be made available to students. Students especially like having ready access to material outside of lecture and office-hour times.

The level of effort to investigate new technology and secure the hardware/software with the University structure often inhibits faculty exploration and innovation. It takes faculty time to explore options. Often one learns what doesn't work as well as what does, so one must be flexible and responsive to students. In this work, canned PowerPoint lectures were deemed a failure. Students can quickly become frustrated if the lectures are not run smoothly or if they inhibit their participation. Overall, faculty should continue to evaluate new technologies because so much is changing in the digital, audio/visual arena and much of it can be use to facilitate learning. The use of screen casting using a TabletPC is especially promising and is currently being pursued with early student feedback being overwhelming positive.

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Figure 1. Instructional theatre classroom from back of room.



Figure 2. Instructor console with PC, touch-screen control panel, and document camera.



Figure 3. Instructional theatre classroom from front of room showing TV monitors.



Figure 4. Audio-visual console used by IT technicians.

Joule-Thomson Process

A thermodynamic process (also called a throttling process) in which enthalpy is conserved.


$$h_2 = h_1$$

Magnitude of the temperature change (often drop) during a throttling process is governed by a fluid property called the Joule-Thomson coefficient.

$$\mu = \left(\frac{\partial T}{\partial p} \right)_h$$

7

Joule-Thomson Effect



James Prescott Joule
English, 1818-1889

William Thomson (Lord Kelvin)
English, 1824-1907

8

Joule-Thomson Effect

Liquids and non-ideal gases exhibit intermolecular interactions (cohesion).

When fluid expands, the cohesion ends which require energy. This energy comes from the fluid causing it to cool down.

Internal energy + Flow energy = Constant

$$u_1 + P_1 v_1 = u_2 + P_2 v_2$$

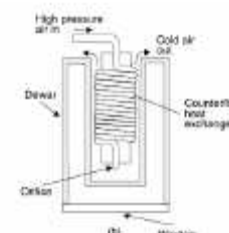
↓
↑
 down up

9

Joule-Thomson Cooling

The effect is observed in refrigerators and air-conditioners.

Gas at very high pressure is allowed to escape through a very small nozzle into a larger volume, which contains the element to be cooled.

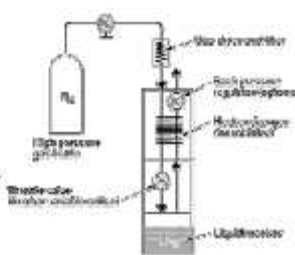


10

Joule-Thomson Cooling

Store high pressure Nitrogen.

JT Cooler used to generate cryogenic (77 K) liquid Nitrogen.



11

CO2 fire extinguisher freezes water in a test tube.



Video Encyclopedia of Physics Demonstrations

12

Figure 5: Example of PowerPoint slides with high density of visual graphics.

6-113 Consider a Carnot heat-engine cycle executed in a steady-flow system using steam as the working fluid. The cycle has a thermal efficiency of 30 percent, and steam changes from saturated liquid to saturated vapor at 275°C during the heat addition process. If the mass flow rate of the steam is 3 kg/s, determine the net power output of this engine, in kW.

$$\dot{w} = \eta \cdot \dot{Q}_H$$

$$\dot{Q}_H = \dot{m} (h_{fg@275^\circ\text{C}})$$

$$= \frac{3 \text{ kg}}{\text{s}} \cdot 1574.5 \frac{\text{kJ}}{\text{kg}}$$

$$= 4723.5 \text{ kW}$$

$$\dot{w} = 1417 \text{ kW}$$

Figure 6: Example of document camera slide with original problem statement from textbook and worked solution developed in class.

| ME 4293: Thermodynamics II MWF 10:00 – 10:50, Spring 2006 | | | | |
|--|-------------------------|---|----------|---|
| Monday | Tuesday | Wednesday | Thursday | Friday |
| Jan 16 Holiday | Jan 17 Classes Begin | Jan 18 Review | Jan 19 | Jan 20 HW #1: 7-46, 7-72, 7-88, 7-114, 7-134 |
| Jan 23 Quiz #1 Review | Jan 24 | Jan 25 Review | Jan 26 | Jan 27 HW #2: 7-163, 7-170, 7-194, 7-204, 7-210 |
| Jan 30 Ch 8 – Exergy | Jan 31 | Feb 1 Ch 8 – Exergy | Feb 2 | Feb 3 HW #3: 8-16, 8-20, 8-30, 8-36, 8-51 |
| Feb 6 Quiz #2 Ch 8 – Exergy | Feb 7 | Feb 8 HW #4: 8-54, 8-57, 8-63, 8-76, 8-92 | Feb 9 | Feb 10 Exam #1, Ch 7-8 |
| Feb 13 Ch 9 – Gas Power Cycles | Feb 14 | Feb 15 Ch 9 – Gas Power Cycles | Feb 16 | Feb 17 HW #5: 9-20, 9-34, 9-52, 9-84, 9-91 |
| Feb 20 Quiz #3 Ch 9 – Gas Power Cycles | Feb 21 | Feb 22 Ch 9 – Gas Power Cycles | Feb 23 | Feb 24 HW #6: 9-93, 9-108, 9-123, 9-129, 9-157 |
| Feb 27 Ch 10 – Vapor Power Cycles | Feb 28 | Mar 1 Ch 10 – Vapor Power Cycles | Mar 2 | Mar 3 HW #7: 10-22, 10-25, 10-32, 10-38, 10-51 |

Figure 7: Example of how typical lecture begins using TabletPC image projected to the screen while audio/visual are being captured using Camtasia software.

8-92 Steam enters a turbine at 12 MPa, 550°C, and 60 m/s and leaves at 20 kPa and 130 m/s with a moisture content of 5 percent. The turbine is not adequately insulated and it is estimated that heat is lost from the turbine at a rate of 150 kW. The power output of the turbine is 2.5 MW. Assuming the surroundings to be at 25°C, determine (a) the reversible power output of the turbine, (b) the exergy destroyed within the turbine, and (c) the second-law efficiency of the turbine. (d) Also, estimate the possible increase in the power output of the turbine if the turbine were perfectly insulated.

$\dot{w}_{rev} = 3365 \text{ kW} = \underline{\underline{3.37 \text{ MW}}}$
 $\rightarrow \text{find } \dot{w}$
 $\rightarrow = \dot{w}_i (\psi_1 - \psi_2)$
 $\dot{X}_{dest} = \dot{w}_{rev} - \dot{w}_{act}$
 $T_0 \dot{S}_{gen} = 865 \text{ kW}$
 719 kW
 $\eta_{II} = \frac{\dot{w}_{act}}{\dot{w}_{rev}} = 74\%$

Steam
 12 MPa
 550°C, 60 m/s
 TURBINE
 $\dot{w} = 2.5 \text{ MW}$
 $\dot{Q} = 150 \text{ kW}$
 20 kPa
 130 m/s
 $x = 0.95$

Figure 8: Examples of Microsoft Journal screen cast images from a lecture.

Table 1. Thermodynamics Course Survey Summary, Fall 2005.

| | Questions | SD | D | N | A | SA | Avg Score |
|----|---|-----------|----------|----------|----------|-----------|------------------|
| 54 | You like the way you were treated in this class. | 0 | 0 | 1 | 17 | 31 | 1.6 |
| 16 | Worked homework solutions should be made available using WebCT | 0 | 1 | 4 | 9 | 35 | 1.6 |
| 1 | You like the classroom BB 3.04.18 | 1 | 0 | 3 | 14 | 31 | 1.5 |
| 58 | You like the way exams were handled in this class. | 0 | 2 | 2 | 24 | 21 | 1.3 |
| 46 | The textbook has good examples | 0 | 1 | 2 | 29 | 17 | 1.3 |
| 20 | You passed the homework “integrity check” | 4 | 1 | 6 | 10 | 28 | 1.2 |
| 28 | Answering “conceptual” problems was helpful | 1 | 4 | 2 | 23 | 19 | 1.1 |
| 39 | Instructor provided PowerPoint slides helped you learn | 2 | 2 | 6 | 18 | 21 | 1.1 |
| 18 | It is helpful to go over homework solutions in class using “red pens” | 1 | 4 | 4 | 24 | 16 | 1.0 |
| 56 | You like the way homework was handled in this class. | 1 | 4 | 6 | 23 | 15 | 1.0 |
| 55 | You like the way lectures was handled in this class. | 0 | 6 | 6 | 23 | 14 | 0.9 |
| 37 | You have reviewed the PowerPoint slides available on WebCT | 5 | 5 | 1 | 18 | 20 | 0.9 |
| 14 | Numeric answers to homework should be available | 2 | 5 | 6 | 21 | 15 | 0.9 |
| 45 | The textbook is easy to read | 1 | 6 | 7 | 25 | 10 | 0.8 |
| 48 | Recitations were helpful | 0 | 0 | 25 | 11 | 13 | 0.8 |
| 57 | You like the way recitations were handled in this class. | 0 | 2 | 22 | 12 | 13 | 0.7 |
| 5 | You like classes that use the chalk/marker board | 2 | 4 | 13 | 17 | 13 | 0.7 |
| 7 | You like classes that use TabletPC | 3 | 1 | 15 | 18 | 12 | 0.7 |
| 15 | Worked homework solutions should be made available using UTSA Library | 5 | 4 | 9 | 15 | 16 | 0.7 |
| 21 | Students at UTSA cheat in other classes | 2 | 5 | 17 | 18 | 7 | 0.5 |
| 49 | Recitations in other classes are helpful | 2 | 6 | 13 | 23 | 5 | 0.5 |
| 32 | The instructor should use the document camera more | 1 | 3 | 21 | 22 | 2 | 0.4 |
| 42 | Students should get more partial credit on exams | 2 | 9 | 13 | 16 | 9 | 0.4 |
| 27 | Lectures need to have more example problems | 0 | 10 | 16 | 16 | 7 | 0.4 |
| 6 | You like classes that use PowerPoint | 4 | 3 | 16 | 22 | 4 | 0.4 |
| 30 | In general, you like PowerPoint lectures | 3 | 9 | 11 | 18 | 8 | 0.4 |
| 22 | Some students cheated in this class | 2 | 11 | 18 | 12 | 6 | 0.2 |
| 53 | In engineering courses, your grades are: A, A/B, B, B/C, C | 3 | 16 | 8 | 17 | 5 | 0.1 |
| 36 | Video lectures have helped you learn | 9 | 7 | 14 | 11 | 8 | 0.0 |
| 4 | You like classes that are primarily lecture | 2 | 15 | 16 | 13 | 3 | 0.0 |
| 47 | You read the textbook before most lectures | 4 | 17 | 11 | 10 | 7 | 0.0 |
| 26 | Lectures need to cover more theory | 5 | 14 | 14 | 15 | 1 | -0.1 |
| 29 | The pace of the lectures was: too fast, fast, just right, slow, too slow. | 2 | 9 | 35 | 3 | 0 | -0.2 |

| | | | | | | | |
|----|--|----|----|----|---|---|------|
| 19 | Homework should be collected and graded by the instructor (abandon the “red pens”) | 5 | 11 | 25 | 6 | 2 | -0.2 |
| 24 | The instructor needs to do more to prevent cheating | 3 | 14 | 26 | 5 | 1 | -0.3 |
| 25 | The instructor is doing too much to prevent cheating | 3 | 17 | 25 | 3 | 1 | -0.4 |
| 34 | You viewed many lecture video lectures on WebCT | 15 | 11 | 7 | 9 | 7 | -0.4 |
| 3 | The classroom has little impact on your learning | 7 | 26 | 3 | 7 | 6 | -0.4 |
| 13 | Homework should be voluntary and not graded | 11 | 17 | 10 | 5 | 6 | -0.4 |
| 8 | There was too much homework assigned in this class | 3 | 29 | 13 | 4 | 0 | -0.6 |
| 9 | Homework needs to be more challenging | 7 | 25 | 12 | 5 | 0 | -0.7 |
| 41 | There should be fewer exams during the semester | 10 | 21 | 12 | 5 | 1 | -0.7 |
| 43 | Low scores on the first 2 exams should not be replaceable | 15 | 15 | 11 | 5 | 3 | -0.7 |
| 12 | Homework needs more open-ended design (longer) problems | 12 | 18 | 12 | 7 | 0 | -0.7 |
| 52 | What is the grade you expect in this class: A, B, C, D, F | 10 | 24 | 10 | 4 | 1 | -0.8 |
| 10 | Homework should require more problems | 9 | 27 | 10 | 3 | 0 | -0.9 |
| 11 | Homework needs computer problems | 16 | 17 | 11 | 4 | 1 | -0.9 |
| 17 | Too much time was spent in class going over homework solutions | 13 | 25 | 6 | 4 | 1 | -0.9 |
| 31 | In this class, the PowerPoint lectures were terrible | 15 | 21 | 10 | 2 | 1 | -1.0 |
| 33 | The instructor spends too much time answering questions in class | 10 | 29 | 10 | 0 | 0 | -1.0 |
| 44 | Exams are too long and can not be finished in time | 16 | 23 | 4 | 6 | 0 | -1.0 |
| 35 | Having WebCT and video lectures encouraged you to miss class | 20 | 19 | 3 | 5 | 2 | -1.0 |
| 40 | There should be more exams during the semester | 12 | 29 | 6 | 1 | 1 | -1.0 |
| 50 | You rarely read the textbook | 15 | 25 | 5 | 3 | 1 | -1.0 |
| 2 | You liked the first classroom SB 2.02.06 better | 29 | 9 | 3 | 4 | 4 | -1.1 |
| 38 | Having the PowerPoint slides available encouraged you to miss class | 23 | 17 | 3 | 4 | 2 | -1.1 |
| 51 | A new textbook needs to be used for the class | 27 | 18 | 1 | 2 | 1 | -1.4 |
| 23 | You cheated in this class | 37 | 7 | 2 | 2 | 1 | -1.6 |

SD = Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree.